

UNECE/FAO
FORESTRY AND TIMBER SECTION

Team of Specialists on Boreal Forests

**Inaugural online meeting
21 October, 15:00-18:00**

Background paper

Boreal forests - introduction

As there is no commonly applied definition and delineation of a boreal biome, different approaches to classify and measure them are used at international and national levels. According to the Global Forest Resources Assessment (FRA) 2020, boreal forests grow in high-latitude environments of Canada, Finland, Norway, the Russian Federation, Sweden, and the United States of America. The European Environment Agency, on the other hand, states that the hemi-boreal zone, which is a transitional zone between the boreal and temperate forest, also covers Estonia, Latvia, Lithuania, northern Belarus and north-eastern Poland¹. Overall, boreal forests cover 27 per cent of the global forest area² and possess some unique characteristics. The boreal biome contains more surface freshwater than any other biome in the world, and about one-third of the biome is underlain by permafrost. Boreal trees, soils and peatlands constitute the largest terrestrial carbon pool with 559 Gt C, and thus play a key role in regulating the global climate. Temperature increases in the boreal zone are predicted to be much higher than global averages, and while there will be regions with increased carbon accumulation, in other regions more frequent fires, thawing of permafrost and other climate-related changes will result in considerable losses of carbon and profound changes to ecosystems.

Cooperation on boreal forests – background

Since 2012, six countries of the boreal region have been in dialogue to strengthen cooperation, which culminated in the establishment of the Circumboreal working group (CWG) in 2013. The CWG has been active through joint scientific missions, country reports, thematic studies and a bioeconomy working group. A high-level science/policy dialogue was held in Haparanda, Sweden, in order to plan for formalizing the cooperation. The Haparanda Ministerial Declaration³ on Circumboreal Cooperation on Forests, adopted on 26 June 2018, recognizes that countries across the circumboreal region face similar challenges and opportunities, with significant benefits to be gained from increased research cooperation and knowledge sharing to address complex boreal forest issues. To this end, the IBFRA insight process was launched. It is an IPCC like assessment of scientific consensus on selected science-based and policy relevant topics focused on the boreal

¹ EEA 2007. European forest types. EEA Technical Report No 9/2006. Copenhagen.
https://www.eea.europa.eu/publications/technical_report_2006_9

² FAO. 2020. Global Forest Resources Assessment 2020 : Main report. Rome.
<http://www.fao.org/documents/card/en/c/ca9825en>

³ https://www.regjeringen.no/contentassets/88033c539e834a65aaaffc130bc8c025/final_boreal-ministerial-declaration-20180607.pdf

region. The first assessment will look at challenges and opportunities for climate change mitigation in boreal forests and will be published soon. It will address climate change impacts, role of forests in mitigating climate change and the ways in which the forest sector can contribute to net negative emissions.

The Haparanda Ministerial Declaration paved the way for the establishment of a UNECE/FAO Team of Specialists (ToS) on Boreal Forests, which was formally approved by the UNECE Executive Committee in December 2019. Member States can nominate experts to participate in the ToS on Boreal Forests. The Secretariat lies with the Joint UNECE/FAO Forestry and Timber Section.

Objectives of the UNECE/FAO Team of Specialists on Boreal Forests

The UNECE/FAO ToS on Boreal Forests aims to: 1) contribute to science and policy cooperation on boreal forests, while reducing duplication of efforts and encouraging the pursuit of cost-effective approaches for circumboreal cooperation; 2) increase collaboration with the International Boreal Forest Research Association (IBFRA) and other boreal-related research organizations, in order to strengthen science and policy cooperation with regards to the boreal biome; 3) improve awareness and understanding of the role boreal forests play in global issues such as climate change and the bioeconomy, as well as in addressing the challenges reflected in the 2030 Agenda for Sustainable Development and 4) advise the UNECE/FAO Forestry and Timber Section on any matters related to boreal forests within the integrated programme of work.

It will achieve these objectives by facilitating a science-policy dialogue on boreal forest issues, providing a platform for the exchange of information, experiences and best practices, and working with other international bodies including IBFRA in order to coordinate initiatives.

Some of the expected outputs of this ToS will include the following⁴:

- Identify priority issues for the sustainable management of boreal forests, taking into account regional realities and differences;
- Increase knowledge and understanding of issues related to boreal forests;
- Produce information products that reflect collaborative efforts on boreal forest issues;
- Produce assessment and scoping documents based on existing information, describing conditions in boreal forests and identifying important issues and opportunities in their management;
- Provide consultation and advice on boreal related issues as needed.

All information regarding the work of the ToS can be found here: www.unece.org/forests/boreal-tos

The process so far

During a preparatory informal meeting of the ToS that was held virtually on 23 April 2020⁵, newly elected members were asked to identify key challenges facing boreal forests, to assess the needs in

⁴ For a comprehensive list of objectives, activities and expected outputs, visit: http://www.unece.org/fileadmin/DAM/timber/images/1_mandat.pdf

⁵ Find the agenda, presentations and minutes of the meeting here : <http://www.unece.org/index.php?id=54331>

terms of data, policy recommendations, and other tools that could help address some of those challenges, and discuss what activities the ToS could focus on in this context.

The following themes were identified as central concerns:

- Lack of awareness and understanding of the role boreal forests play in global issues such as climate change and the bioeconomy,
- The boreal forest ecosystem's vulnerability to climate change.
- The development of a forest-based bioeconomy (incl. indigenous and rural communities)

The following tools and policies were identified as important in helping to address these challenges:

- Increased collaboration on interdisciplinary research;
- Communication to counter misinformation;
- Development of coherent strategies for climate mitigation and adaptation.

The following activities that could be undertaken by the ToS were proposed:

- Develop first steps to encourage collaboration with research organizations (including IBFRA).
- Establish a science-policy hub and platform for exchange of experience;
- Compile data and identify research priorities which are aligned with policy concerns;
- Translate the latest science into digestible policy briefs and bring them to the attention of policymakers.
- Develop at least one synthesis paper/study on boreal forests in the context of global change;
- Build on the IBFRA Insight Process to explore further topics to be assessed and engage potential donors;
- Support communication around the IBFRA Insight Process.

Country fact sheets

All participating boreal countries submitted fact sheets in order to highlight some common concerns, policy responses, ecosystem characteristics etc. (full list of fact sheets can be found in the Annex II). A short summary of some key challenges related to boreal forests, including forest disturbances, can be found below (ranked in order of prevalence).

Main challenges related to boreal forests

- Climate change, including mitigation and adaptation
- Natural disturbance changes and their interrelated impacts
- Development of the bioeconomy
- Public perception and awareness about the ecosystem services provided by boreal biome
- Biodiversity conservation
- Market acceptance and dynamics
- Species at Risk
- Finance for research

Forest related disturbances with the highest impact

- Storms
- Fires
- Pests and diseases (dominantly bark beetle)
- Drought
- Permafrost degradation
- Snow

- Illegal logging
- Floods
- Wildlife browsing

First meeting of the UNECE/FAO Team of Specialists on Boreal Forests

The first meeting will take place online on 21 October 2020 from 15:00 to 18:00 CET. Participants will benefit from interpretation in Russian and English. The meeting will be initially chaired by the Secretariat, and once the election of the team leader has taken place, the elected person will take over the chairing for the remainder of the meeting. The full agenda can be found in Annex I.

The goal of the meeting is to:

- (a) Elect the leadership of the team - for more information about roles and responsibilities of the team leader, deputy leader(s) and team members, please refer to the [guidelines](#) as contained in ECE/TIM/2017/2-FO:EFC/2017/2;
- (b) Discuss the future plan of activities – this will be an interactive session which will allow participants to set priorities for activities they would like the team to pursue in the short- and medium-term. It will also be an opportunity for participants to explore upcoming conferences and other relevant events which might be of interest to the ToS to participate in.

Annex I

Provisional Agenda of the first meeting of the UNECE/FAO ToS on Boreal Forests, 21 October 2020, online

- 5 min.* **Welcome by Chief of the UNECE/FAO Forestry and Timber Section,
Mr. Gianluca Sambucini**
- 20 min.* **Round of introductions of participants**
- 5 min.* **Item 1. Adoption of the agenda**
- 10 min.* **Item 2. Election of the Team Leader and Deputy Leader(s)**
- 10 min.* **Item 3. Update by the Secretary, Ms. Leonie Meier**
- 5 min.* **Coffee break**
- 120 min.* **Item 4. Discussion about the future plan of activities**
- Feasible and expected goals, deliverables and outcomes for the coming year;
 - Activities that could be implemented in the short- to medium term, and important meetings that the ToS could contribute to.
- 5 min.* **Item 5. Date and place of the meeting**
- 2 min.* **Item 6. Wrap-up and closure**

Annex II

Country fact sheets

Canada

Main challenges related to boreal forests	<p>Climate change (natural disturbance changes and its effects on everything else)</p> <p>Health of the sector</p> <p>Understanding the role and ecology of the boreal</p> <p>Market acceptance</p> <p>Species at Risk</p>												
Policy responses to these challenges	<p>Provincial laws and regulations regarding forest management</p> <p>Federal, Provincial and territorial SAR and environmental protections laws and regulations</p> <p>Federal programs for forest sector innovation & transformation, and market development</p> <p>Evidenced-based decision-making and policy development</p>												
Boreal Forest Area	<p>In Canada, there is 307 M ha forest and other wooded land. About 72% of the forest land is in the boreal zone and about 91% of the other wooded land and other land with tree cover is in the boreal zone.</p> <p>The remainder of Canada's forest and other wooded land lies in the temperate zone, principally in southern and western British Columbia and from Ontario east to the Atlantic Ocean. The temperate continental interior is covered principally by grasslands.</p>												
Forest jurisdiction/ownership/levels of authority, legislative/regulatory framework for forest management	<p>Ownership of Canadian forests is as follows:</p> <table> <tr> <td>Provincial</td> <td>89.5%</td> </tr> <tr> <td>Private</td> <td>6.2%</td> </tr> <tr> <td>Aboriginal</td> <td>2.0%</td> </tr> <tr> <td>Federal</td> <td>1.6%</td> </tr> <tr> <td>Municipal</td> <td>0.3%</td> </tr> <tr> <td>Other</td> <td>0.4%</td> </tr> </table> <p>Forest management on public land is the responsibility of provincial and territorial governments and is closely governed by a variety of laws and regulations. Forest management on private land is encouraged by provincial tax incentives and a variety of other policies. Forest research is conducted by the federal government, academia (partially supported by federal funding), the private sector, and several other institutions (supported by private and public sectors, and NGOs).</p>	Provincial	89.5%	Private	6.2%	Aboriginal	2.0%	Federal	1.6%	Municipal	0.3%	Other	0.4%
Provincial	89.5%												
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Main commodities/forest products	<p>Much of Canada's wood-fabricated materials (dimensional lumber, laminated lumber, plywood, etc), pulp and paper products, and primary wood products (logs, pulpwood, wood chips) for domestic and export markets come from forestry operations in the southern portion of the boreal zone and the northern portion of the temperate zone, commonly referred to as Canada's commercial forest. The boreal portion of the commercial forest covers about 144 M ha.</p>												
Key export markets	<p>Canada exported \$35 B of forest products in 2017. These exports go to a variety of countries. Our largest export market is the USA, which accounts for 68%, followed by China at 15%, Japan at 4%, and the EU at 3%. The largest proportion of exports by value, 49%, is as pulp and paper products, followed by 47% as wood-fabricated materials, and the remainder as primary wood products.</p>												
Species at Risk	<p>In Canada's boreal zone, there are 65 species or populations on the SAR list:</p> <p>4 amphibians, 3 arthropods, 15 birds, 8 fish, 3 lichens, 10 mammals, 1 mollusc, 1 moss and 20 plants.</p>												

	In terms of level of concern in the Canadian boreal, there are no extirpated species, 10 endangered, 14 threatened, and 41 of special concern. Some of the boreal species on the list are restricted to very specialized and localized habitats such as active sand dunes or hot springs. The highest profile SAR for Canada is the boreal population of woodland caribou.
Phytosanitary issues (movement of goods and restrictions associated with pests)	Invasive species are a major concern for Canada. Most invasive species that have become established in Canada are found almost exclusively in temperate forested ecosystems and many recent introduced species originated from similar ecosystems in Far East Asia.
Forest-related disturbances with highest impact	Stand-replacing crown fires are a major disturbance type in boreal Canada, generally affecting a few million hectares annually. Naturally occurring pests that commonly reach extensive outbreaks in the boreal include spruce budworm (<i>Choristoneura fumiferana</i>), forest tent caterpillar (<i>Malacosoma disstria</i>), and large aspen tortrix (<i>Choristoneura conflictana</i>). Large outbreaks of these pests can reach a few million hectares in size. More recently, mountain pine beetle (<i>Dendroctonus ponderosae</i>), which is primarily an endemic pest of western North American temperate pine forests, has moved into Canada's western boreal zone and is a novel pest in these ecosystems. Climate change is having a major impact on the frequency, intensity, and duration of natural disturbances. Another major climate-mediated change that is occurring in Canada's northern boreal forests is the melting of permafrost, which is affecting stability of soils and changing local drainage patterns leading to deterioration of forest health over extensive areas. For more information on climate change consequences, see the paper by Price et al. (2013) .
Development resulting from other natural resource sectors (Cumulative impacts)	In Canada's boreal zone, human development is related to forestry, extraction and exploration of mineral and energy resources, hydroelectric development, and some limited agricultural development and peat mining. Associated with each of these industrial sectors is the development of infrastructure such as roads, railways, pipelines, seismic lines, utility corridors, impoundments, and urban centres of various sizes. There are concerns about the cumulative effects of development in Canada on terrestrial and aquatic boreal ecosystem, including effects on biodiversity. More information on the level and types of development in Canada's boreal can be found in Brandt et al. (2013) , Venier et al. (2014) , and Kreutzweiser et al. (2013) .
Market Access issues (misinformation, market-based campaigns)	Canada's boreal has been the subject of several market-based campaigns. Common themes have included climate change, species at risk, and forest practices. Often, these claims are not based on credible science, or outdated forest management practices. Such distortions have contributed to public misunderstandings about forest management in Canada, and boreal dynamics in particular.
Bioeconomy/circular economy – national strategies in place	In 2017, the federal, provincial and territorial forest ministries through the Canadian Council of Forest Ministers (CCFM) developed and endorsed <i>A Forest Bioeconomy Framework for Canada</i> . The framework aims to make Canada a global leader in the production and use of forest biomass for advanced bioproducts and innovative solutions, based on the sustainable management of Canadian forests. The framework includes a comprehensive set of policies that are designed to advance Canada's forest bioeconomy and addresses four core pillars of building strong communities; establishing the certainty and standards of biomass supply; improving public perception and demand for bioproducts; and supporting innovation to fulfil that demand cost-effectively and environmentally. Federal, provincial, and territorial governments continue to work together through the CCFM and individually to implement the framework. The Government of Canada is working towards a more circular economy, through the development of policy initiatives like the Canada-Wide Action Plan on Zero Plastics Waste. For the forest sector, Natural Resources Canada through the Innovative Solutions Canada program introduced the Bioplastics and Biofoam Challenges, which incentivizes small Canadian businesses and innovators to develop novel solutions utilizing forest-based residues into sustainable domestic compostable plastic material. Winning small businesses may receive up to \$150,000 to refine their research and development and, if accepted into Phase 2, receive up to \$1 million to

	develop a working prototype. The Bioplastics and Biofoam challenges improve forest resource efficiency, seek to improve the biodegradability of bio-based plastics as replacements for single use plastics and packaging, and develop fully recyclable and lower carbon intensive biofoam for insulation.
Certification standards used in your country	Three certification systems are common in Canada: the Canadian Standards Association's Sustainable Forest Management Standards (CSA); the Forest Stewardship Council Standards (FSC); and the Sustainable Forestry Initiative (SFI). The CSA and SFI standards are recognized internationally by the Programme for the Endorsement of Forest Certification (PEFC). As of December 2017, Canada had 170 million hectares (most of which is in the boreal) certified to at least one of the three internationally recognized forest certification programs. Although each of these certification programs have their own distinct elements, they all promote principles and practices that form the basis of sustainable forest management.
What is the primary source of science/data for informing decision-making? (academia, government science, conservation organizations, peer-review literature)	Canada has its National Forest Inventory, which tracks status and trends in its forests (available here). As well, there is the National Forest Information System, which has other important forestry statistics (available here). Most Canadian forest research is conducted by the federal government, provinces, academia (partially supported by federal funding), the private sector, and several other institutions (supported by private and public sectors, and NGOs).
Primary forests – definitional challenges	<p>The FAO defines “primary forest” as “naturally regenerated forest of native species where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed,” with additional notes related to the occurrence of natural forest dynamics, the sufficient size to maintain natural characteristics, and the full recovery from potential past human interventions (FAO 2012).</p> <p>However, it is Canada’s position that this is not an operational definition and therefore has to be translated into a measurable property or set of properties that can be evaluated by individual reporting countries.</p> <p>The resulting inconsistency in reporting among countries is compounded by the use of other terms by other groups, often used interchangeably with, or treated as synonymous to, “primary forest,” such as “old-growth forest,” “virgin forest,” “untouched forest,” “primeval forest,” “pristine forest,” “ancient forest,” and “intact forest” (Wirth et al. 2009). Whereas the term “primary forest” ultimately refers to a land use (i.e., a lack of use by humans), many of these alternate terms refer to land covers whose properties do not necessarily correspond to those that characterize primary forests.</p> <p>Natural stand-replacing disturbances in some forest ecosystems complicate the picture further by imparting to forests regionally specific variability in their structural properties. Most countries do not directly distinguish primary forests from other forests in their national forest inventories but instead use a variety of proxies based on land use or land cover or a combination of both.</p> <p>As a result, there are substantial inconsistencies in the way that individual countries define their primary forest areas. A full characterization of the challenges associated with the term “primary forests” can be found here.</p>

Finland

Main challenges related to boreal forests	Climate change mitigation Climate change adaptation and forest damages Maintenance of Biodiversity Development of forest-based bioeconomy Forest and water management
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	Securing long-term finance and resources for research Acceptability of forestry and forest management
Policy responses to these challenges	Review and update legislation. Development of forest programmes – national and regional – balancing various demands for forests, participatory approaches. Improving the quality and accessibility of forest information data Shift in forest management practices Research Intensified communication.
Boreal Forest Area	21 million hectares
Forest jurisdiction/ownership/levels of authority, legislative/regulatory framework for forest management	Private ownership 61%, State 25%, companies 8%, other 4%. The Forest Act (1093/1996; amended 567/2014) https://www.finlex.fi/fi/laki/kaannokset/1996/en19961093_20140567.pdf Voluntary guidelines for forest management
Main commodities/forest products	Pulp and paper, sawnwood, energy, non-wood products
Key export markets	Europe 62%, Germany 11% UK 7%, Asia 21%, including China 10%, Africa 6%, North America 6%
Species at Risk	Norway spruce (forest damages)
Phytosanitary issues (movement of goods and restrictions associated with pests)	The Forest Damages Prevention Act (1087/2013) containing provisions e.g. on prevention of roof rot and pests. https://www.finlex.fi/en/laki/kaannokset/2013/en20131087.pdf
Forest-related disturbances with highest impact	Root rot, storm, snow damages, drought, bark beetle
Development resulting from other natural resource sectors (Cumulative impacts)	Restricted use of forests in Lapland due to reindeer herding (Sami people), connection to HCV?? Other land use forms, tourism, reindeer herding
Market Access issues (misinformation, market-based campaigns)	
Bioeconomy/circular economy – national strategies in place?	Finnish Bioeconomy Strategy 2014 https://www.bioeconomy.fi/facts-and-contacts/finnish-bioeconomy-strategy/
Certification standards used in your country	PEFC (85% of forest area) and FSC (10 %)
What is the primary source of science/data for informing decision-making? (academia, government science, conservation organizations, peer-review literature)	Government research institutions Natural Research Institute Finland (Luke) and Finnish Environment Institute (SYKE), as well as Universities and their reports, policy briefs and other peer-reviewed literature.
Primary forests – definitional challenges	Limited amount of primary forests, about 230 000 ha.

Lithuania

Main challenges related to boreal forests	Climate change and globalization (forest health and sustainability); Species distribution changes and invasive species; Rising demand for forest resources and forest products;
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	<p>Increase CO₂ sequestration potential in soil and biomass and storage in wood products;</p> <p>Public perception (conservation vs use);</p> <p>Sustainable forest management to ensure social, environmental and economic needs.</p>
Policy responses to these challenges	<p>Climate change adapted forest management systems;</p> <p>Funding for afforestation of abandonment, not suitable for agriculture lands;</p> <p>Cascading of woody biomass resources.</p>
Boreal Forest Area	<p>The answer depends on the boreal forest distribution. The total forest land area was 2,195,600 ha, covering 33.6% of the country's territory.</p> <p>According to different references it seems that there no clear consensus on the area of boreal forest. According to European Environmental Agency (EEA technical report No/9 2006) the boreal forest distribution cover 8 countries (Norway, Sweden, Finland, Russia, Estonia, Latvia, Lithuania and Belarus). According to this classification, Lithuania belongs to the southern part of boreal forests.</p> <p>FRA 2000 references (http://www.fao.org/3/y1997e/y1997e0w.htm) provide other distribution, where boreal forest includes only Norway, Sweden, Finland and Russia.</p> <p>Lithuanian Researchers agree that Lithuania belong to a temperate and hemiboreal forests, because there is a natural convergence zone between boreal and temperate forests. Southern part of Lithuania are defined as temperate, while Northern as hemiboreal. The watershed between two zones are drawn by the distribution of European hornbeam (<i>Carpinus Betulus</i>) (Ahti et al., 1968).</p> <p>Generally, the area of boreal forest are mostly defined by climate and vegetation.</p>
Forest jurisdiction/ownership/levels of authority, legislative/regulatory framework for forest management	<p>Lithuania's forested area is 2.2 million hectares, State forests – 1.3 million ha, 59 % of the forest land (State Enterprise "State Forests" manages 1.1 million ha of them), private owners and companies own 0.9 million. ha (41 %), average private parcel – 3 ha.</p> <p>The requirements for managing forests are stipulated in the Forest Act.</p> <p>The State Forest Agency is the national authority, tasked to control law enforcement and monitoring.</p>
Main commodities/forest products	<p>In 2017 (<i>Lithuanian Statistical Yearbook of Forestry 2017</i>)</p> <p>Roundwood – about 7 million m³ (5.6 m³ million for domestic use)</p> <p>5.6 million m³ used for:</p> <p>sawnwood - 1.33 million m³</p> <p>wood based panels</p> <p>veneered panels – 48,500 m³</p> <p>veneer sheets 72,000 m³</p> <p>particle board 748,000 m³</p> <p>fibre board – 22.2 million m²</p> <p>Paper and paper board – 159,500 t</p> <p>Other –</p>
Key export markets	EU countries 58%, other (42%) (Russia, Belarus, Norway, USA, China)
Species at Risk	European Ash dieback
Phytosanitary issues (movement of goods and restrictions associated with pests)	<p>No restrictions for movement of wood.</p> <p>There are some obligations related to spruce bark beetles:</p> <p>Urgent removal of spruce windbreaks from the forest until bark beetles have settled there;</p> <p>Finding and felling the freshly infested spruce trees in the forest as soon as possible, as well as removal of the timber together with the new generation of bark beetles developing under the bark;</p> <p>Prompt removal of raw spruce timber from the forest in summer at a distance of no closer than 3 km or insecticide treatment of the surface of the bark of raw wood stored in the forest to prevent bark beetle infestation (peeling of the bark of timber).</p>

Forest-related disturbances with highest impact	<p>Pests and diseases Norway spruce – <i>Ips typographus</i>, <i>H. annosum</i>. Scots pine – <i>H. annosum</i>. Common Ash – <i>Hymenoscyphus fraxineus</i> Increase risk of <i>Phytophthora</i></p> <p>Wind damages Most vulnerable species – Norway spruce</p> <p>Forest droughts (direct effects) and its related effects (pests and diseases). Most vulnerable species – Norway spruce.</p> <p>Forest fires Low risk</p>
Development resulting from other natural resource sectors (Cumulative impacts)	<p>With agriculture sector. Moderate cumulative impacts. Both sectors related with bioeconomy and bio-energy sectors. Not fertile and abandoned agricultural lands conversion to forest land (LULUCF sector).</p> <p>Mining sector. Low cumulative impact. Lithuania don't have any very valuable resources. For domestic use – sand, clay, limestone, peat (currently not heavily exploited), dolomite, oil (very low annual rate – about 60.000 – 70.000 m³).</p>
Market Access issues (misinformation, market-based campaigns)	
Bioeconomy/circular economy – national strategies in place?	<p>EU regulation on bioeconomy and circular economy. Lithuania has not developed the National Bioeconomy Strategy. Involvement of stakeholders representing forest-based sector, construction sector, society and scientists is essential in the preparation of the Lithuanian Bioeconomy Strategy.</p> <p>Forest sector importance in bioeconomy is evident. The forest-based sector as a whole (including wood and furniture industry) contributes about 4% to the gross domestic product (GDP) of Lithuania, and this contribution has been increasing over the last decade; forestry alone contributes about 0.6% to the GDP. On average, the forest-based sector provides around 59,000 jobs (2010–2015) mainly in the manufacture of furniture and the manufacture of wood products; forestry alone contributes about 10,000 jobs.</p>
Certification standards used in your country	State and private forest certified according to FSC (Forest Stewardship Council) certification principles. All state forests are certified. A higher proportion of private forests are not certified.
What is the primary source of science/data for informing decision-making? (academia, government science, conservation organizations, peer-review literature)	Agriculture Academy of Vytautas Magnus University (VDU); Lithuanian Research Centre for Agriculture and Forestry (LAMMC)
Primary forests – definitional challenges	<p>Definition presented in “Forest Resources Assessment Working Paper - 188 FRA 2018 Terms and Definitions FRA 2020” is appropriate. However, it is important to highlight the differences from other definitions as old-growth forest and virgin forest.</p> <p>According to “FRA 2015 – Country Report, Lithuania” there is 0 ha primary forests in Lithuania.</p>

Norway

Main challenges related to boreal forests	Negative impacts of climate change on forests; Extreme weather events and inadequate forest adaptation causing large bark beetle damages.
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	Low recognition of the opportunities in forestry and the bioeconomy to adapt forests and mitigate climate change; lack of knowledge in the public, reputation of SFM as a balancing tool, disproportionate attention in international processes.
Policy responses to these challenges	Strategies for forest adaption and improved plans of preparedness for forest hazards. Actively contribute to international processes to improve the concept of SFM. Integration of climate change actions in forestry policies (measures in silviculture, seed breeding). Development of strategies to increase science, innovations and use of green wood-based products (wood in buildings, bioenergy, biofuel, animal fodder etc.).
Boreal Forest Area	Norway's forested area is 121 million hectares of which about 8,3 million hectares is considered productive (growth > 1m ³ /ha/year). About 6,5 million hectares is estimated to be available for wood supply, and thereof considered our managed forest area. Boreal forests can be estimated to the 7,5 million hectares of which 5,5 is coniferous and 2 is mixed with broadleaves. Dependent on definitions of boreal forests, coniferous forests on the west coast and northern Norway is included in this estimation. The 4,5 million hectares of broadleaves mainly constitute the slow growing birch forest bordering the alpine zone.
Forest jurisdiction/ownership/levels of authority, legislative/regulatory framework for forest management	Forest Act based on the principal of forest owner's freedom of responsibility and environmental accountability. Investments in silviculture, roadbuilding and forest plans, are co-financed by economic schemes and a Forest Trust Fund based on equity from forest owner's timber sale. Lower legal authority mainly at municipal level. National authority at ministerial level, through directorate and state county level. 78 % of forest area is family owned private forests with average property size of 50 hectares. 12% of forest area is publicly owned.
Main commodities/forest products	Round wood, lumber, chipboard, CLT. Pulp and paper, chemical products, special cellulose
Key export markets	Sweden, Germany.
Species at Risk (limited to tree species)	Ash Dieback by the fungus <i>Hymenoscyphus fraxineus</i> Beech, Alnus and other broadleaves by the alga <i>Phytophthora</i> ssp. (Out of approx. 35 species, 23 species with conservation measures.)
Phytosanitary issues (movement of goods and restrictions associated with pests)	Trend of increased frequency of invasive species Governmental action plan against destructive invasive species under development. Strengthening phytosanitary health restrictions on moving wood and plant material.
Forest-related disturbances with highest impact	Wind damages or droughts followed by bark beetle attacks
Development resulting from other natural resource sectors (Cumulative impacts)	Browsing challenges in regions with high population of corvid's (Birch, Pine, Spruce)
Market Access issues (misinformation, market-based campaigns)	Long lasting effort to improve and expand building in wood, including through governmental programs, but mostly by cooperation among stakeholders.
Bioeconomy/circular economy – national strategies in place?	Yes, a national bioeconomy strategy adopted 2016. Governmental circular strategy under development. Skog 22 (Forest 22) Strategy for forest sector competitiveness and contribution to the transition to green economy
Certification standards used in your country	PEFC, FSC. Basically, all traded timber in Norway is certified.
What is the primary source of science/data for informing decision-making? (academia, government science, conservation organizations, peer-review literature)	National Forest Inventory (inaugurated 1919), Norwegian Institute of Bioeconomy Research. Norwegian University of Life Sciences. European Forest Institute (EFI) and other international organisations and networks

Primary forests – definitional challenges	Old growth or primary forests are currently defined to be forests without human activity for not less than 160 years.
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Russian Federation

Main challenges related to boreal forests	<ol style="list-style-type: none"> 1. Climate change. 2. Influence of negative factors (forest fires, extreme weather conditions, pests and diseases); 3. Underestimated evaluation of forest ecosystem services. 4. Increasing demand in the production of forest sector for the present-day and forecasted future makes it necessary to ensure stable provision of resources for forest industry, including by increased increment.
Policy responses to these challenges	<p>1. The above-mentioned forestry-related challenges are quite interconnected. This is why policy responses tend to address them comprehensively and avoid silos effect.</p> <p>Framework for the State policy on the use, protection and restoration of forests till 2030 (Framework for State policy) defines the principles, key goals and targets with regard to the sustainable forest management, as well as the tools for their implementation. The Framework has the priorities set in three dimensions – economic, environmental and social. The goals and targets of the Framework have strong climate component, and other forest-ecosystem services.</p> <p>The Framework for State policy is one of the major strategic decisions, with more targeted and time-bound strategies built on its principles. One of them is the Strategy for Russian Forest Sector development to 2030, which is aimed at increasing the input of forest sector into social and economic development. The key measures stipulated in the Strategy are focused on forest protection against fires, pests and diseases, as well as on maintaining ecological functions of forests. Besides, to ensure the necessary forest resources for the industry, the Strategy provides for zoning-based intensive forest management.</p> <p>In the Russian State Forestry programme for the period till 2025, we have goals & targets, as well as the key directions of the forestry development, use, protection, reforestation and the issues of research and training. Specifically, the state programme covers the issues of forest health monitoring, forest-fire danger, forest engineering, strategic issues of governance and funding.</p> <p>‘Conservation of forests’ federal project was launched in 2018, It is one of the key components of the ‘Ecology’ national project which addresses the issues of biodiversity, eco-tourism, air quality, water resources, waste management, etc. In case of forestry, the national project focuses on forest restoration and protection. These both issues are supervised under ‘Conservation of forests’ federal project.</p> <p>2. Climate change Regarding the climate-related challenges, several important decisions have been taken by the Russian Federation:</p> <ul style="list-style-type: none"> • Ratification of the Paris Agreement by the Russian Federation (RF Government Resolution 1228 dated 21st of September 2019). Russia proceeds from the importance of maintenance and increasing the absorbing capacity of forests and other ecosystems, from the necessity to take maximum account of that.

	<ul style="list-style-type: none"> • Климатическая доктрина РФ; The Climate Doctrine of the Russian Federation approved in 2011 reflects the basics of the state policy related to climate change. This policy is aimed at safe and sustainable development of the Russian Federation in the context of climate change and emerging threats it may cause. • The National Action Plan for adaptation to climate change for the period till 2025. The AP provides for certain legislative, regulatory and organizational measures to be taken at both federal and regional levels. Inter alia, the measures are aimed at development of science-based approaches for adaptation to climate change. The AP also stipulates development of regional and sectoral plans. • Presently, a Strategy on reducing GHG emissions through 2050 is under development. It is expected that the Strategy will include measures aimed at ensuring full balance between forest restoration and removed/dead, enhancing forest protection against fires and pests, decrease of clear cutting, bringing the forests located on agricultural lands into the forest cadastre, etc.
Boreal Forest Area	<p>There is no unique response to the question about the boreal forest area. Much depends on the definition of the ‘boreal forest’ (and ‘a forest’ as a whole). These definitions vary among countries and international organisations. However, most international processes and projects accepted the definition of forest as approved for the FAO Forest Resources Assessment (FRA). All the countries who take part in the international process tend to convert into FAO-standards.</p> <p>There is no unified understanding of the definition for boreal forests in the international scientific society.</p> <p>The Forest Code of the Russian Federation proceeds from the concept of forest as an ecological system as well as of natural resources.</p> <p>In Russia, boreal forests are represented mainly by coniferous forests growing in the subarctic and temperate climate in three forest vegetation zones: sub tundra, open taiga; taiga (subzones of northern, mid-, southern taiga) and the mountainous area of South Siberia. This definition is fixed in the List of forest vegetation zones of the Russian Federation as well as in the List of forest regions and is documented by Ministry of Natural Resources and Environment of the Russian Federation (order 367 from 18.08.2014).</p> <p>In Russia, forest lands of boreal zone cover over 810 million ha (as of 2017). Wooded boreal forest lands extend across around 717 million ha (88%) of that. Boreal forest lands cover about 94 % of forest land of Russia. (and more than 62% of the forest fund of Russia). The share of commercial forest lands is 55% of boreal forests (about 443 million ha, with 402 million ha wooded).</p>
Forest jurisdiction/ownership/levels of authority, legislative/regulatory framework for forest management	<p><u>Ownership</u></p> <p>All forests of the Russian Federation are owned by the State. Forests located in the territories of the Forest Fund are federally owned. The Federal Fund is a subcategory of Land Fund, which means that the territories have forest-related main purpose and the relevant legal regime of land use and protection. Forests located on the Forest Fund lands are nationally (Federally) owned.</p> <p>The same type of ownership (Federal) is true for forests growing on the defence and security lands as well as on the lands of federal protected natural areas (e.g. on the lands of nature reserves, national parks, etc.). Forest plots may belong to constituent members of Russia and to municipalities.</p> <p>Besides, the Forest Code stipulates the lease of forest plots on forest fund lands. (As of the end of 2019, there were 230 million ha on lease.)</p> <p>Private ownership can be the case when forests grow on private lands, e.g. agricultural lands.</p> <p><u>System of Governance</u></p> <p>System of forest management at the federal level:</p>

	<p>The Federal Forestry Agency of Russia (FFA/ Rosleskhoz) is state executive authority in the system of Ministry of Natural Resources and Environment of the Russian Federation. The FFA performs monitoring and supervision in forestry (with the exception of forests growing within the territories of special protection). The FFA also provides public services and manages the federal forest property. The FFA has its branches in the federal districts of Russia.</p> <p>At the regional level, forest management is performed by regional forest-related executive authorities which include forestry districts and units.</p> <p><u>Legislation</u></p> <p>Russian forest legislation includes the Forest Code (2006), other federal laws as well as regional legislation. Regional legislation is developed in accordance with the federal.</p>
Main commodities/forest products	<p>Forests can produce</p> <ul style="list-style-type: none"> • Wood and non-wood forest resources • Edible forest resources and medicinal plants. <p>Forest is used for agriculture, e.g. beekeeping, reindeer breeding.</p> <ul style="list-style-type: none"> • Key products include roundwood, lumber, plywood, wood particle board, high-density fibreboard, pulp and paper, cardboard, etc. • Innovative products include: <ul style="list-style-type: none"> • Biofuels (pellets), • Trial production of biocoal, liquid biofuels, nanocellulose, • Laminated wood constructions (glulam), CLT.
Key export markets	<p>Key directions for roundwood export are China and Finland.</p> <p>Since 2006, export of raw wood from Russia has been decreasing mainly due to higher export duties.</p> <p>Export of timber (logs, board) is more oriented at China, Japan, Egypt, as well as Uzbekistan and Azerbaijan.</p> <p>Key importers of softwood are China, Finland whereas other markets are less-significant (Sweden, Japan, UK, Germany).</p> <p>Export of pulp-and-paper industry goes to more than 80 countries of the world. The largest importers are Italy, China, Uzbekistan, Germany and Bulgaria.</p>
Species at Risk	<p>All the species which are under the risk of extinction are listed in the Red Book of the Russian Federation and red books of the constituent members of Russia. These lists are of legal status and provide regulations for protection of rare flora and fauna.</p> <p>Key tree species of boreal forest are not under risk of extinction. But there are specific regulations, regards <i>Pinus Sibirica</i> which prohibit wood harvesting and fellings.</p> <p>Regional regulations are focused on certain species like <i>Larix Sibirica</i> in the Arkhangelsk region, or <i>Juniperus</i>.</p> <p>Another problem of regional level is dieback of spruce in the North-West Federal District of Russia. The phenomenon is caused by the age of trees, severe weather conditions, pest outbreaks and phreatic decline.</p> <p>There are about 50 tree and 6 shrub species which can't be harvested for timber. This list is documented by the order 513 of Federal Forestry Agency of Russia dated 2011. It is important to highlight that species on that list not necessarily include plants from the boreal zone.</p>
Phytosanitary issues (movement of goods and restrictions associated with pests)	<p>Phytosanitary control and quarantine are organized by State Service for Plant Quarantine functioning in the system of Ministry of Agriculture of the Russian Federation.</p> <p>This Service includes the State Inspection for plant quarantine, state border inspections with laboratories, etc.</p>

	<p>The Ministry of Agriculture of the RF documented the list of quarantine objects. It includes, inter alia, <i>Choristoneura fumiferana</i>, <i>Choristoneura conflictana</i>, etc. Guidance on certification of timber and phytosanitary safety have been endorsed.</p> <p><u>Key pests and disease</u> <i>Ips typographus</i>, <i>Dendrolimus superans</i>, <i>Polygraphus proximus</i> Blandford</p>
Forest-related disturbances with highest impact	<ol style="list-style-type: none"> 1. Forest fires; 2. Biogenic-based disturbances; 3. Illegal logging; 4. Severe weather conditions (windfall, floods, lack of snowfall).
Development resulting from other natural resource sectors (Cumulative impacts)	<p>Boreal forests are influenced by other natural resource sectors. Those include surface mining, gas and oil development. Other factors of influence include urbanization and development linear structure.</p> <p>Russia traditionally has enough fossil fuels. The use of wood as energy source for industrial and social use has always been low. The situation is changing nowadays towards higher production of wood energy. But this is still low on a national scale.</p>
Market Access issues (misinformation, market-based campaigns)	<p>Market access of these or those forest-sector products usually depends on regional approach (regional initiatives that promote bioenergy, wood construction, etc.)</p>
Bioeconomy/circular economy – national strategies in place?	<p>At the global level, there is no common understanding of ‘a bioeconomy’ nor of ‘a circular economy’.</p> <p>In Russia, we don’t presently have a nation-wide strategy for bioeconomy. Still, the experience of Bio-2020 programme is reflected in present-day plans.</p> <p>Concepts usually associated with a circular economy are reflected in RF strategic documents. For instance, the goals on energy efficiency, sustainable and comprehensive use of resources are set in the State policy for environment till 2030, Energy strategy of Russia for the period to 2030, Strategy of development of mineral resources base of the Russian Federation till 2035, Strategy for ecological security till 2025, Key work areas of the Government of the Russian Federation till 2024.</p> <p>Strategy for economic security of the Russian Federation for the period until 2030, Strategy for scientific and technological development for the period until 2030, and Forecast of the Russian Federation scientific development until 2030 set long-term vectors for technological and innovative development with appropriate consideration of increasing environmental risks.</p> <p>Addressing social and economic goals that provide for environmental economic growth is a strategic goal of the state environmental policy.</p> <p>Issues of innovative environment and green-technologies, efficient waste management are also addressed in the Strategy for spatial development of Russia for the period till 2025.</p>
Certification standards used in your country	<p>The FSC scheme is more wide-spread in Russia, with more than 52 million ha of certified forests and 500 CoC certificates, 200 forest management certificates.</p> <p>To put that in context, over 16 million hectares of forest are certified according to the PEFC scheme, 38 CoC certificates.</p> <p>PEFC is more often used as the second certification for tenants (double FSC/PEFC system of certification). Just few businesses have PEFC certificates only.</p> <p>At least two national systems of forest certification got registration with Rosstandart (Federal service for technical regulation and metrology) and harmonized with</p>

	<p>international standards. They are grouped under Centre for Development of Forest Certification – PEFC Russia. PEFC Russia got accreditation with PEFC.</p> <p>Technical certification in Russia is applied to wood and wood-based products.</p>
<p>What is the primary source of science/data for informing decision-making? (academia, government science, conservation organizations, peer-review literature)</p>	<p>Researchers, lecturers and high-level officers at forests services tend to use all sources of science and data.</p> <p>Executive authorities are guided mainly by the decisions and orders from state authorities, recommendations of government science and conclusions made by groups of experts.</p> <p>The system of the Federal Forestry Agency of Russia includes headquarters in Moscow and branches in federal districts of Russia, as well as by specialized research institutions (VNIILM, SPbNIILKh, DalNIILKh, SevNIILKh, VNIILGISbiotekh) and centres for capacity-building and training.</p> <p>FFA subordinate bodies are carrying out State forest inventory, forest engineering as well as perform forest-health and forest-fire monitoring. These data are used for state policymaking on SFM.</p>
<p>Primary forests – definitional challenges</p>	<p>International science features many definitions for the forests that have not undergone any changes caused by humans or underwent them to a low extent. Among those definitions one can come across ‘primary, pristine, intact, old-growth, virgin’, etc. These definitions are applied by various national and international bodies and processes. The ideas of those phenomena may not coincide and vary among them, so the lack of coherence (especially with regard to terms used in official national documents).</p> <p>There is not any official definition for primary forests in Russia.</p> <p>To a great extent, ‘primary forest’ definition matches the definition of ‘natural forest’, which is the forest that did not undergo obvious human impact and has been changing naturally over generations of key forest tree species (Encyclopaedia for forestry, 2006). Following this definition, in case of Russia, primary forests relate to ‘reserve forests’ and to some categories of ‘protective forests.</p> <p>Reserve forests are the forests which stay outside any commercial management, located far from transport lines, and preserved for possible use in the future.</p> <p>Protective forests are the ones with special value, so there are specific regulations for them.</p> <p>According to the Forest Code (as stipulated by Federal Law № 538 dated 27 December 2018), there are five categories of protective forests – forests growing on the lands of protected natural areas (reserves, etc.), forests growing in the water protection zones, forests that protect other objects of nature, forests of special value, and urban forests. The four first categories can be associated with the given definition of primary forests.</p>

Sweden

<p>Main challenges related to boreal forests</p>	<p>Sweden and hence the Swedish forest industry are dominated by boreal forest. Management of these forests have challenges e.g. relying on few species and slow growth (long rotation period) which could imply a high risk in disturbances, climate change and changes in markets. Regarding biodiversity there are challenges in fragmentation of the landscape.</p>
<p>Policy responses to these challenges</p>	<p>The national Swedish Forest Policy is founded on two equal objectives: Production and environment. Both of these objectives are ambitious. The policy presumes a willingness of forest owners and users to make larger investments in forest management (both concerning conservations efforts and measures to improve</p>

	<p>production) than what is stipulated in the law. The forest sector is seen as a commercial sector which should be economically self-sustained.</p> <p>In 2014 the government decided to establish a national Forest Programme in order to meet the increasing demands for public participation in forest policy development and to meet the need to move the entire economy towards a bioeconomy.</p>
Boreal Forest Area	The Boreal Forest Area in Sweden is 19,9 M ha which is 71 % of total forest area.
Forest jurisdiction/ownership/levels of authority, legislative/regulatory framework for forest management	The Swedish forests are dominated by private ownership, half of the forest land are owned by > 300 000 individuals and private companies own another quarter. The requirements for managing forests are stipulated mainly in the Forest Act and the environmental code. The Swedish Forest Agency is the national authority, tasked to promote this policy through e.g. information, law enforcement and monitoring.
Main commodities/forest products	Most important forest products are sawn timber, pulp and paper. 80 % of the production is exported. Export value 2018 amounted to SEK 145 billion. Sweden is also one of the leading countries in bioenergy. The use of biomass from forest in the Swedish energy system has increased over the years, currently 25 percent of the total supply.
Key export markets	Sweden is a very export orientated country and currently ranks third in export of forest products globally. On regional basis EU is the key export market with half of the export value for wood, wood products, pulp and paper (2019). Country wise however the highest export value is to Germany, United Kingdom, Netherlands and China. The EU market is more important for pulp and paper than for wood and wood products.
Species at Risk	The habitats for over half of Sweden's 58.000 plant and species are found in the forest landscape. The effects of modern forestry on species population vary. The species whose number decline are often specifically adapted to a certain type of habitat or substrate that are being reduced in terms of area and quality. There are about 2250 forest dwelling species on the Swedish Red list (SLU Swedish Species Information Centre's listing of species at risk in 2015) which make up for about half of the species at risk in Sweden.
Phytosanitary issues (movement of goods and restrictions associated with pests)	<p>In recent years Sweden has experienced large outbreaks of Spruce bark beetle. In 2019 the damage exceeded 11 million m³ which is about 12% of the annual harvest. In the north of Sweden there is an increasing impact of multiple diseases/damages affecting young pine stands.</p> <p>Other invasive pathogens include Diplodia, Dutch elm disease and Ash dieback. These are to a varying extent established in southern Sweden.</p> <p>The Pine Wood Nematode has not yet spread to Sweden. There is however a risk that it could be introduced by contaminated wood and wood packaging.</p>
Forest-related disturbances with highest impact	<p>Browsing from moose on young pine stands are a big problem, more or less in the whole of Sweden. Besides the direct effects there are also indirect effects e.g. regeneration with spruce on less suitable sites.</p> <p>Locally/regionally there are also disturbances from wind and fires.</p>
Development resulting from other natural resource sectors (Cumulative impacts)	The forest area in Sweden in total are very stable. Locally there are some land-use change e.g. from forest area to urban area and from pasture to forest land.
Market Access issues (misinformation, market-based campaigns)	<p>Sweden has traditionally been an export-oriented nation and typically maintains a trade surplus. A key feature of the Swedish economy is its openness and liberal approach to trade.</p> <p>Several campaigns for market stimulus have been launched in recent years:</p> <p><i>The Swedish Wood Building Strategy</i> and the <i>Construction Sector's Roadmap for 2025</i> are two Government initiatives to increase the industrial wood construction.</p> <p><i>The Fossil Free Sweden initiative</i> has encouraged business sectors to draw up their own roadmaps as to how they will be fossil free while also increasing their competitiveness.</p>

Bioeconomy/circular economy – national strategies in place?	<p>There is no overall national bioeconomy strategy for Sweden, but the Swedish Government have announced that such a strategy should be developed. There are however several strategies and initiatives in place that are in line with bioeconomy/circular economy e.g.</p> <ul style="list-style-type: none"> • The Swedish Government have adopted a strategy for Sweden’s National Forest Programme and an action plan with specific measures. The action plan will be updated in dialogue with interested parties. One of the five focus areas of the strategy is world-class innovations and refined forest raw materials where an increased industrial wood construction is included. • The Swedish Government has presented a wood building strategy. The Government believes that increasing the industrial wood construction of sustainably produced forest raw materials should be promoted to increase the climate benefit, housing construction, exports and employment in the whole country. • Based on the decision by the parliament to make Sweden climate neutral by 2045, the Fossil Free Sweden initiative has encouraged business sectors to draw up their own roadmaps as to how they will be fossil free while also increasing their competitiveness. • The Swedish Forest-based Sector Research Agenda compiles the research and development priorities of the forest-based sector. Experts, from the industry as well as the research community, have contributed to an agenda that will guide the Swedish sector’s endeavours for years to come.
Certification standards used in your country	Both PEFC and FSC. In total 16,9 M ha (60 %) are under forest management certification schemes. Many forest owners (77 % of the certified area) have a double certification FSC and PEFC.
What is the primary source of science/data for informing decision-making? (academia, government science, conservation organizations, peer-review literature)	Sweden have a continuous NFI and other monitoring programs which provides good information on the state of the Swedish forest. Based on that information the Swedish Forest Agency recurrently do Forest Impact Assessment/Scenario analysis for future management. Sweden also have an international highly ranked forest research institution. The policy development is facilitated by well-organized forest owners, forest industry and ENGO: s.
Primary forests – definitional challenges	Sweden do not see any major challenges with the definition used in FRA 2020. The criteria are implemented in the Swedish NFI for an assessment on every plot. We have noticed an initiative from FAO to improve the reporting on primary forest and will actively contribute to that discussion.

United States of America

Main challenges related to boreal forests	<p>Vast majority of boreal forests are located in Alaska which lacks sufficient infrastructure for forest management activities coupled with hurdles to monitoring. Topics of interest include:</p> <ul style="list-style-type: none"> • Global change including climate • Carbon dynamics • Biodiversity conservation • Local human populations (especially indigenous) • Wildfire • Distant markets and generally poor economic prospects coupled with lack of infrastructure
Policy responses to these challenges	Partnerships between state, local, and federal officials have led to the first inventory of Alaskan boreal forests
Boreal Forest Area	Alaskan boreal forest is estimated at 113 million acres (46 million ha.), while sub-boreal forest in northern Minnesota and Maine total 5+ million acres (2+ million ha.)
Forest jurisdiction/ownership/levels of	Given the lack of commercial forest management activities in Alaskan boreal forests, Alaskan boreal forests are owned by public entities (predominantly federal, but also state, local, and tribal). To the extent that these boreal forests are managed, they are

authority, legislative/regulatory framework for forest management	managed in accordance with general federal and state forest laws and agency guidelines. Most of this activity is simply monitoring while indigenous corporations conduct some forest management for production of firewood.
Main commodities/forest products	Subsistence extraction including firewood, berry collection, and fur trapping. Mineral and fossil fuel development where it occurs.
Key export markets	N/A
Species at Risk	There are a very limited number of federally recognized endangered species but lists of sensitive species for conservation purposes have been compiled (https://aknhp.uaa.alaska.edu/apps/rareplants/#map?lg=011bfaa2-cff0-11e3-92d1-00219bfe5678). There are concerns over the sustainability of berry producing species due to fulfilling subsistence needs. Spruce bark beetle is also a major threat to boreal AK forests.
Phytosanitary issues (movement of goods and restrictions associated with pests)	Few invasive plant species make their way into the forests, but <i>Elodea</i> (a common aquarium species that forms dense floating mats) has been transported to lakes/ponds around Alaska (often on the pontoons of float planes) after aquarium contents were discarded in natural ponds/lakes. <i>Elodea</i> threatens some species that are likely to be affected by changes in water chemistry/sunlight penetration, etc. and efforts are underway to prevent float planes from landing on invaded lakes/ponds and to prevent spread via watercraft.
Forest-related disturbances with highest impact	Climate change including wildfires and permafrost degradation. Specifically, changes in wildfire frequency and severity. The boreal is a fire-adapted ecosystem, but fires are becoming both more frequent and more severe with changing climatic conditions.
Development resulting from other natural resource sectors (Cumulative impacts)	Concerns regarding fossil fuel and mineral development (extraction and transshipment).
Market Access issues (misinformation, market-based campaigns)	N/A
Bioeconomy/circular economy – national strategies in place?	Boreal forests: Some villages are interested but due to slow growth of AK boreal forests compared to the temperate forests of the US this might not ever come to fruition beyond subsistence firewood extraction. Sub-boreal forest partnerships are exploring the utilization of low-grade timber and emerging markets/technologies to ensure robust markets to enable forest management in northern forests. The relative return on investment management and technologies on industrial temperate timberlands in the US dissuades investment in far northern US forests where returns are small or negative.
Certification standards used in your country	No federal standard, although there are a host of private certification standards such as SFI or FSC (note that this does not generally apply to Alaska boreal, since production forestry is extremely limited)
What is the primary source of science/data for informing decision-making? (academia, government science, conservation organizations, peer-review literature)	Federal and state surveys of forest land and associated attributes provide foundational data. Federal, state, local and academic institutions provide management expertise and research.
Primary forests – definitional challenges	Given the lack of management coupled with sparse population (infrastructure) a large swath of AK's boreal forest can be assumed to be primary with some impact from other resource industries such as oil and mining