

Supplementary Information: This Supplementary Information has not been peer reviewed.

Title: From guidelines to practice: Operational criteria for identifying old-growth forests in northern Europe

Table S1. Volume proportions (%) of native tree species across Fennoscandia and the Baltic states (FAO 2020). * <0.1 %

Tree species	Total region	Norway	Sweden	Finland	Estonia	Latvia	Lithuania
Scots pine, <i>Pinus sylvestris</i>	39.7	29.4	37.8	50.1	30.6	33.0	36.2
Norway spruce, <i>Picea abies</i>	36.0	42.6	39.9	29.9	22.7	19.8	22.2
Birch, <i>Betula</i> spp.	16.3	17.4	15.1	16.6	25.8	23.3	15.5
Aspen, <i>Populus tremula</i>	2.6	1.8	1.5	1.7	6.7	10.1	5.8
Black alder, <i>Alnus glutinosa</i>	2.6	*	1.1	0.3	4.5	6.5	9.4
Grey alder, <i>Alnus incana</i>	2.0	1.9	1.1	0.7	6.7	5.3	3.7
Oak, <i>Quercus robur</i>	0.8	0.8	1.1	*	*	0.4	1.0
Willows, <i>Salix</i> spp.	0.5	1.1	0.4	0.3	0.6	*	*
Ash, <i>Fraxinus excelsior</i>	0.4	0.3	*	*	0.8	0.7	*
Rowan, <i>Sorbus aucuparia</i>	0.3	1.0	0.2	0.3	*	*	*
Other native species	0.8	3.4	1.4	0.3	1.4	0.6	0.7
Total native species	100	100	100	100	100	100	100

FAO. 2020. *Global Forest Resources Assessment 2020: Country reports*. Food and Agriculture Organization of the United Nations, Rome.

Table S2. Volumes (m³/ha) of coarse woody debris (at least 10 cm in diameter, except Siitonen et al. 2026 >5 cm) in different boreal forest vegetation zones of primary old growth forests;. Mean values, standard deviation and 10th percentile (decile) in primary old growth spruce- and pine-dominated (and deciduous dominated hemiboreal) forests in three large compilations of OGFs (n = number of stands; * recalculated from original data).

Boreal vegetation subzones	n	mean	std	1 st decile	Source
Deciduous dominated					
Hemiboreal	35	119	64	48	Rosenvald et al. 2026*
Southern and middle boreal	22	33	26	5	Siitonen et al. 2026
Spruce dominated					
Hemiboreal	50	154	73	66	Rosenvald et al. 2026*
Hemi- and southern boreal	26	138	67	58	Syrjänen et al. 2024
Middle boreal	38	97	44	44	
Northern boreal	43	44	25	18	
Southern and middle boreal	121	73	54	12	Siitonen et al. 2026
Pine dominated					
Hemiboreal	37	78	51	13	Rosenvald et al. 2026*
Hemi- and southern boreal	10	43	25	5	Syrjänen et al 2024
Middle boreal	18	88	27	49	
Northern boreal	22	21	15	7	
Southern and middle boreal	90	37	29	7	Siitonen et al. 2026

Rosenvald, R., A. Lõhmus, R. Kont, A. Kraut, A., P. Lõhmus, L. Remm, T. Tekko, M. Vaikre, and K. Runnel. 2026. Dataset on stand structure in hemiboreal forests across management histories and stand ages. *Data in Brief* 66: 112688. <https://doi.org/10.1016/j.dib.2026.112688>

Siitonen, J., A. Immonen, J. Suominen & R. Mäkipää. 2026. Amount and quality of dead wood in boreal old-growth forests on different site types in southern Finland. Manuscript in preparation.

Syrjänen, K., K.T. Korhonen, P. Punttila, and J. Siitonen. 2024. Primary forests and old-growth forests in Finland. Suomen ympäristökeskuksen raportteja 2, 2024. (In Finnish with English summary) <http://hdl.handle.net/10138/571053>

Table S3. Example of a regional evidence-based list of indicator species of old-growth forests: Estonia.

Species	Group	Red-list status	Evidence of old-growth specificity	References
<i>Amylocystis lapponica</i>	Wood-inhabiting basidiomycetes	CR	Distributed only in, and spreading along, old-growth reserve networks	[1,2,3]
<i>Antrodia piceata</i>		EN	Only recorded in old natural forests where occurs regularly	[1,3]
<i>Fomitopsis rosea</i>		NT	Substrate- and connectivity-dependent species on coarse spruce wood	[4]
<i>Phellinus nigrolimitatus</i>		LC	Substrate-, stand-age and connectivity-dependent species on coarse spruce wood	[4]
<i>Rigidoporus crocatus</i>		LC	Confined to fallen trunks in permanently wet conditions, mostly in natural swamp forests	[1,3]
<i>Phellinus chrysoloma</i>	Tree-parasitic basidiomycetes	LC	Microhabitat-creating species on slowly grown old live spruce	[3,4]
<i>Phellinus pini</i>		LC	Hollow-creating keystone species in old live pine trees	[3,4,5,7]
<i>Junghuhnia pseudozilingiana</i>	Saprotrophic basidiomycete	VU	On old aspens hollowed by <i>Phellinus tremulae</i> , only in closed-canopy forests	[6,7]
<i>Hydnellum aurantiacum</i>	Ectomycorrhizal basidiomycete	VU	Disturbance-sensitive soil fungus in old conifer forests	[7]
<i>Multiclavula mucida</i> (basidiocarps)	Wood-inhabiting basidiolichen	VU	On large moist decayed fallen trunks in naturally developed forests	[7,9]
<i>Alectoria sarmentosa</i>	Pendulous canopy-dwelling macrolichen	VU	Confined to natural mixed and conifer forests with high temporal connectivity	[1]
<i>Lobaria pulmonaria</i>	Epiphytic macrolichens on live deciduous trees	VU	Connectivity-dependent species on nemoral broad-leaved trees and aspen; typically in forests >100 years old	[7,8,9]
<i>Menegazzia terebrata</i>		VU	Confined to hydrologically intact natural wet forests (apparently connectivity-dependent)	[7,9]
<i>Nephroma laevigatum</i> ; <i>N. bellum</i>		EN	Confined to old deciduous trees in natural closed-canopy forests	[1,10]
<i>Mycoblastus sanguinarius</i>	Bark- and wood-inhabiting lichens	LC	Confined to old moist forests	[9]
<i>Xylopsora friesii</i>		NT	In conifer forests with continuity of small-scale (fire) disturbances and slow-grown old trees	[9,11]
<i>Chaenotheca gracilentia</i>	Microhabitat-dependent microlichen	EN	Confined to shady moist microhabitats on dying and uprooted old trees in natural forests	[7,9,12]
<i>Buxbaumia viridis</i> (sporophyte)	Wood-inhabiting bryophyte	VU	Confined to >80 years-old conifer forests with high temporal connectivity	[7,13]
<i>Sphagnum wulfianum</i>	Ground-dwelling bryophytes	LC	In old spruce forests near mires; competition-sensitive	[1,14]
<i>Bazzabia trilobata</i>		NT	In old mixed forests	[1]

<i>Cucujus cinnaberinus</i>	Wood-inhabiting beetle	EN	In Estonia recorded exclusively in old-growth stands on dying and dead aspens	[15]
<i>Vertigo alpestris</i>	Snail	LC	Confined to old stands with abundant coarse woody debris	[16]
<i>Pteromys volans</i> (occupied cavity)	Cavity-nesting mammal	CR	In Estonia, confined to cavity-rich vertically diverse forests of ca. 120 years optimal age	[17,18]

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