Forest / Forêt   **Association CNVC00272**

Populus tremuloides – Picea mariana / Alnus incana
Trembling Aspen – Black Spruce / Speckled Alder
Peuplier faux-tremble – Épinette noire / Aulne rugueux

Subassociations: *272a typic, 272b Populus balsamifera*
CNVC Alliance: CA00017 *Populus tremuloides / Alnus incana / Eurybia macrophylla*
**CNVC Group:** CG0008 Ontario-Quebec Boreal Moist Black Spruce – Trembling Aspen – Balsam Fir – Paper Birch Forest

Type Description

Concept: CNVC00272 is a boreal mixedwood forest Association that ranges from Manitoba to Quebec. It has a moderately closed to closed canopy dominated by trembling aspen (*Populus tremuloides*) and black spruce (*Picea mariana*). The shrub layer is tall and moderately developed to dense, often with abundant speckled alder (*Alnus incana*). Regenerating balsam fir (*Abies balsamea*) and black spruce are usually present, and various shrub species occur with lower constancy and abundance. The herb layer is well developed and commonly includes bunchberry (*Cornus canadensis*), dwarf raspberry (*Rubus pubescens*), wild lily-of-the-valley (*Maianthemum canadense*), arctic sweet coltsfoot (*Petasites frigidus*), twinflower (*Linnaea borealis*), northern starflower (*Lysimachia borealis*), naked mitrewort (*Mitella nuda*) and yellow clintonia (*Clintonia borealis*). The moss layer varies from poorly to well developed and is better developed in stands with less broad-leaf litter. Red-stemmed feathermoss (*Pleurozium schreberi*) and knight's-plume moss (*Ptilium crista-castrensis*) are usually present. CNVC00272 occurs in a region with a continental boreal climate that grades from subhumid in the western portion of its range to humid in the east. It is primarily found on moist, nutrient-rich sites; these are some of the most productive sites in the region. It can establish as the first cohort after fire or harvesting, or succeed an earlier seral hardwood condition. Two subassociations are distinguished, *typic* and *Populus balsamifera*.

Vegetation: CNVC00272 is a mixedwood forest Association with a moderately closed to closed canopy that is dominated by *Populus tremuloides* and *Picea mariana*. The shrub layer is moderately developed to dense, typically dominated by the tall shrub *Alnus incana* (see Comments). Regenerating *Abies balsamea* and *P. mariana* are also common, and there are usually other shrub species present with lower abundance. The well-developed herb layer commonly includes *Cornus canadensis*, *Rubus pubescens*, *Maianthemum canadense*, *Petasites frigidus*, *Linnaea borealis*, *Lysimachia borealis*, *Mitella nuda* and *Clintonia borealis*. *Eurybia macrophylla* is less common but can be abundant. The moss layer is poorly to well developed and is usually better developed in stands with less broad-leaf litter (i.e., greater conifer cover). *Pleurozium schreberi* and *Ptilium crista-castrensis* are the most common species.

The *Populus balsamifera* subassociation has *P. balsamifera* as a component of its overstory, lower overall tree, shrub and herb cover, and a well-developed moss layer. It has less *A. incana* in the shrub layer than in the *typic* subassociation, but *Rosa acicularis* and *Vaccinium myrtilloides* are more common. There is also greater cover of *Hylocomium splendens* in the moss layer.

Soil Nutrient Regime
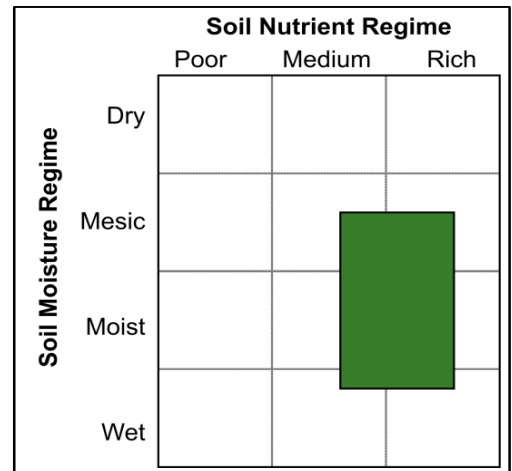
Populus tremuloides – Picea mariana / Alnus incana CNVC00272

Type Description (cont'd)

Environment: CNVC00272 occurs in a continental boreal climate that is subhumid in the western part of its range, becoming increasingly humid farther east. It is found primarily on moist to mesic, nutrient-rich sites; these are some of the most productive sites in this region of the boreal. Stands are commonly on level sites or gentle slopes. Soils are deep to moderately deep and usually fine-textured clays, fine loams or silts of glaciolacustrine or lacustrine origin. Even in the subhumid climate of the western part of its range, the fine-textured soils retain enough moisture to support *Alnus incana*, a shrub that fixes nitrogen, thereby further enriching the soil nutrient status. Mor humus forms are common, but compared to other boreal Associations, moders are relatively frequent. Peatymors can develop on wetter sites. Compared to the *typic,* the *Populus balsamifera* subassociation more often occurs on deep lacustrine soils.

Within the range of CNVC00272, regional fire cycles are intermediate (100-270 years), long (270-500 years) or even very long (>500 years). However, these stands often exist where there are natural fire breaks (e.g., water bodies) and are less prone to fire because of their moisture status. Where the regional fire cycle is intermediate, stands are less likely to burn than the surrounding landscape.

Dynamics: CNVC00272 can establish after fire or harvesting, or succeed an earlier seral Association in which *Populus tremuloides* is dominant (e.g., CNVC00241 [*Populus tremuloides (P. balsamifera) / Alnus incana / Eurybia macrophylla*]). *P. tremuloides* and *Picea mariana* are adapted to disturbance. Following any disturbance that does not kill its roots, *P. tremuloides* can reproduce vegetatively from root suckers. It also produces abundant, light, wind-dispersed seeds that can readily colonize mineral soil seedbeds exposed by disturbance. *P. mariana* has cones that open when heated to release seeds. Although its seeds can germinate on a variety of substrates, seedbeds are usually improved by a fire that reduces organic matter and exposes mineral soil. Unlike *P. tremuloides, P. mariana* is self-replacing because of its shade tolerance and can persist in the stand. If seed sources are available, other shade tolerant conifers, especially *Abies balsamea,* can become established in these stands and may grow into the canopy as the *P. tremuloides* declines.

Alnus incana can form dense thickets in canopy openings, particularly after harvesting when tree removal can contribute to a rise in the water table. These thickets can significantly delay the growth of regenerating trees. The deep roots of *A. incana* can survive even high-severity fires and it can respond quickly after disturbance by sprouting. Being semi-shade tolerant, *A. incana* persists even as the canopy closes, limiting available light for plants beneath it.

Forest tent caterpillar (*Malacosoma disstria*) and *Armillaria* root disease (*Armillaria* spp.) can have significant impacts on *Populus* spp. Defoliation by the caterpillar can reduce growth, cause dieback and sometimes lead to mortality. *Armillaria* spp. can weaken or kill individual or small groups of trees. Canopy openings that result from insect or pathogen disturbance can promote forest succession by enhancing the growth of understory trees such as *A. balsamea* and *Picea* spp.

Range: CNVC00272 occurs in the boreal region of Quebec and Ontario and likely extends into southeastern Manitoba as far west as Lake Winnipeg. In Quebec, it is most common on the Clay Belt but extends east to the Upper North Shore of the Saint Lawrence River near Baie-Comeau and also occurs in the Gaspé region. CNVC00272 occurs sporadically in the northern temperate region, usually on sites that are cooler than normal for that region. The *typic* subassociation is described from Ontario and Quebec. The *Populus balsamifera* subassociation is described only from Ontario.

Conservation Status (NatureServe)

Global Conservation Rank: no applicable rank
National Conservation Rank: not yet determined
Subnational Conservation Rank: not yet determined

Canadian National Vegetation Classification (CNVC)
Classification nationale de la végétation du Canada (CNVC)

Forest / Forêt   **Association CNVC00272**

Populus tremuloides – Picea mariana / Alnus incana
Trembling Aspen – Black Spruce / Speckled Alder
Peuplier faux-tremble – Épinette noire / Aulne rugueux

Distribution

Countries: Canada

Provinces / Territories / States: Manitoba, Ontario, Quebec

Terrestrial Ecozones and Ecoregions of Canada: Atlantic Highlands: Appalachians; Boreal Shield: Abitibi Plains, Big Trout Lake, Central Laurentians, Lac Seul Upland, Lake Nipigon, Lake of the Woods, Lake Timiskaming Lowland, Rainy River, Rivière Rupert Plateau, Southern Laurentians, Thunder Bay-Quetico; Hudson Plains: James Bay Lowland

Rowe's Forest Regions and Sections of Canada: Boreal: Central Plateau, Chibougamau-Natashquan, East James Bay, Gaspé, Gouin, Hudson Bay Lowlands, Missinaibi-Cabonga, Laurentide-Onatchiway, Lower English River, Northern Clay, Northern Coniferous, Superior, Upper English River; Great Lakes-St. Lawrence: Haileybury Clay, Laurentian, Quetico, Rainy River, Timagami

NAAEC CEC Ecoregions of North America (Levels I & II): Hudson Plains; Northern Forests: Atlantic Highlands, Mixed Wood Shield, Softwood Shield

Nature Conservancy of Canada Ecoregions: Boreal Shield, Great Lakes, Hudson Plains, Northern Appalachians-Acadia, Superior-Lake of the Woods

Ecozones and Ecoregions of Manitoba: Boreal Shield

Manitoba Protected Areas Initiative Natural Regions: Manitoba Lowlands: Lake of the Woods; Precambrian Boreal Forest: Lac Seul Upland

Ecological Land Classification of Ontario (ecoregions and ecodistricts): 2W-1, 2W-2, 2W-3, 3E-1, 3E-2, 3E-4, 3E-5, 3E-6, 3E-7, 3S-1, 3S-2, 3S-3, 3S-4, 3S-5, 3W-1, 3W-2, 3W-3, 3W-4, 3W-5, 4E-3, 4S-1, 4S-2, 4S-5, 4S-6, 4W-1, 4W-2, 5S-2

Bioclimatic Domains and Subdomains of Québec: 4 Ouest, 5 Est, 5 Ouest, 6 Est, 6 Ouest

Plot locations
Extent of plot sampling
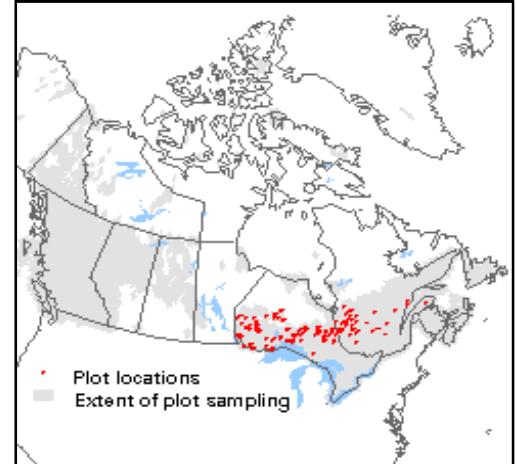
Corresponding Types and Associations

272a typic	Ontario	BTr8-7	Populus tremuloides - Picea mariana / Alnus incana / Rubus pubescens
	Quebec	QC088A	Populus tremuloides - Picea mariana / Alnus incana [Typique]
		QC088B	Populus tremuloides - Picea mariana / Alnus incana [Pleurozium schreberi]
		QC089	Populus tremuloides - Picea mariana - Abies balsamea / Alnus incana
272b Populus balsamifera	Ontario	BTr8-6	Picea mariana - Populus balsamifera / Rubus pubescens / Hylocomium splendens

Canadian National Vegetation Classification (CNVC)
Classification nationale de la végétation du Canada (CNVC)

http://cnvc-cnvc.ca

Forest / Forêt   **Association CNVC00272**

Populus tremuloides – Picea mariana / Alnus incana
Trembling Aspen – Black Spruce / Speckled Alder
Peuplier faux-tremble – Épinette noire / Aulne rugueux

Vegetation Summary*

Species Name[T]	Association CNVC00272		Subassociation 272a *typic*		Subassociation 272b *Populus balsamifera*	
	171 plots		133 plots		38 plots	
	% Cover[±]	% Presence[^]	% Cover[±]	% Presence[^]	% Cover[±]	% Presence[^]
Overstory Trees						
Populus tremuloides	**31**	**76**	**33**	**91**	**13**	**24**
Picea mariana	**25**	**75**	**23**	**70**	**32**	**92**
Abies balsamea	12	35	13	39	8	21
Pinus banksiana	19	30	20	31	14	29
Betula papyrifera	18	29	19	33	13	16
Populus balsamifera	**13**	**26**	**11**	**5**	**14**	**100**
Picea glauca	15	23	15	26	11	16
Tree Stratum Cover (P_{10} P_{25} Mean P_{75} P_{90})[‡]	(27 42 61 85 100)		(26 45 63 86 100)		(28 35 53 68 86)	
Understory Woody Shrubs and Regenerating Trees						
Alnus incana	**29**	**80**	**31**	**89**	**12**	**47**
Abies balsamea	8	73	8	74	7	66
Picea mariana	9	70	9	70	9	68
Rosa acicularis	3	58	3	54	2	74
Vaccinium myrtilloides	3	57	3	55	2	63
Populus tremuloides	2	53	2	59	2	34
Rubus idaeus	4	47	5	54	4	24
Viburnum edule	4	46	5	46	2	45
Ribes triste	2	44	2	42	1	50
Rhododendron groenlandicum	8	43	8	44	8	39
Sorbus decora	2	41	2	38	2	50
Vaccinium angustifolium	3	37	3	41	1	24
Diervilla lonicera	6	35	6	36	6	29
Cornus stolonifera	4	35	5	35	3	34
Ribes glandulosum	3	35	3	43	1	8
Betula papyrifera	4	32	4	34	4	26
Ribes lacustre	2	27	2	24	2	37
Acer spicatum	8	25	8	29	2	11
Amelanchier sp.	3	25	3	31	0	3
Populus balsamifera	2	25	2	11	2	71
Picea glauca	5	21	4	22	7	18
Salix sp.	4	20	4	26	-	-
Corylus cornuta	6	18	6	21	2	8
Lonicera involucrata	1	10	1	7	1	21
Shrub Stratum Cover (P_{10} P_{25} Mean P_{75} P_{90})[‡]	(20 32 56 83 99)		(28 37 62 86 99)		(11 19 35 54 68)	

Populus tremuloides – Picea mariana / Alnus incana CNVC00272

Vegetation Summary (cont'd)*

Species Name[T]	Association CNVC00272		Subassociation 272a *typic*		Subassociation 272b *Populus balsamifera*	
	% Cover[±]	% Presence^	% Cover[±]	% Presence^	% Cover[±]	% Presence^
Understory Herbs and Dwarf Shrubs						
Cornus canadensis	7	89	8	89	6	92
Rubus pubescens	6	84	6	83	6	87
Maianthemum canadense	3	82	3	84	2	76
Petasites frigidus	2	74	3	70	2	87
Linnaea borealis	3	69	3	64	2	87
Lysimachia borealis	1	67	1	71	1	53
Mitella nuda	4	63	4	58	2	82
Clintonia borealis	4	62	4	65	2	50
Aralia nudicaulis	5	59	6	62	3	50
Coptis trifolia	2	59	2	59	2	61
Eurybia macrophylla	13	50	12	54	16	37
Equisetum sylvaticum	1	49	1	50	1	47
Lycopodium annotinum	8	46	9	50	2	29
Galium triflorum	1	44	1	44	1	42
Viola renifolia	2	43	2	37	1	66
Gaultheria hispidula	2	40	2	35	3	55
Fragaria virginiana	2	39	2	38	1	42
Chamerion angustifolium	2	36	2	36	2	34
Streptopus lanceolatus	1	36	1	39	1	24
Gymnocarpium dryopteris	1	32	2	32	1	34
Mertensia paniculata	2	29	2	26	2	39
Goodyera repens	1	28	1	25	1	39
Actaea rubra	1	27	1	26	1	32
Anemone quinquefolia	1	26	1	26	1	24
Poaceae	4	25	4	32	1	3
Symphyotrichum ciliolatum	1	24	1	22	1	32
Carex sp.	3	23	3	29	1	3
Pyrola asarifolia	2	21	2	24	< 1	11
Viola sp.	3	20	3	26	-	-
Calamagrostis canadensis	2	20	2	21	1	16
Dryopteris spinulosa complex	5	18	5	23	-	-
Athyrium filix-femina	3	18	3	21	1	8
Pyrola chlorantha	1	11	1	7	1	26
Geocaulon lividum	1	11	1	6	1	29
Herb Stratum Cover (P$_{10}$ P$_{25}$ Mean P$_{75}$ P$_{90}$)[±]	**(16 28 48 70 90)**		**(16 31 51 72 90)**		**(6 20 39 54 74)**	
Bryophytes and Lichens						
Pleurozium schreberi	16	93	11	92	30	97
Ptilium crista-castrensis	7	73	8	68	6	89
Hylocomium splendens	9	53	5	45	17	82
Rhytidiadelphus triquetrus	6	42	6	39	7	53
Dicranum polysetum	2	38	1	26	2	79
Cladonia sp.	2	32	2	37	1	13
Dicranum fuscescens	1	25	1	17	1	50

Populus tremuloides – Picea mariana / Alnus incana CNVC00272

Vegetation Summary (cont'd)*

Species Name[T]	Association CNVC00272		Subassociation 272a *typic*		Subassociation 272b *Populus balsamifera*	
	% Cover[±]	% Presence[^]	% Cover[±]	% Presence[^]	% Cover[±]	% Presence[^]
Sanionia uncinata	1	23	1	23	1	21
Dicranum sp.	3	21	3	27	-	-
Cladina rangiferina	2	21	2	21	1	21
Plagiomnium cuspidatum	1	20	1	20	1	18
Polytrichum sp.	3	18	3	23	-	-
Peltigera aphthosa	1	11	< 1	4	1	37
Bryo-Lichen Stratum Cover **(P$_{10}$ P$_{25}$ Mean P$_{75}$ P$_{90}$)[‡]**	**(3 8 33 53 87)**		**(3 7 26 35 80)**		**(12 32 58 86 93)**	

* species present in > 20% of sample plots are listed

[†] see **Botanical Nomenclature** link at http://cnvc-cnvc.ca for botanical sources, synonyms and common names

[±] average percent cover of a species within the plots in which it occurs (i.e., characteristic cover)

[^] percent frequency occurrence for a species within the total plots

[‡] P$_x$ = Xth percentile (e.g., P$_{10}$ = 10th percentile)

Forest / Forêt   **Association CNVC00272**

Populus tremuloides – Picea mariana / Alnus incana
Trembling Aspen – Black Spruce / Speckled Alder
Peuplier faux-tremble – Épinette noire / Aulne rugueux

Site / Soil Characteristics

	Association CNVC00272 **171 plots**	Subassociation 272a *typic* **133 plots**	Subassociation 272b *Populus balsamifera* **38 plots**
Elevation Range (min–mean–max meters)			
	50–309–520	50–310–520	175–306–405
	missing data (13)	missing data (15)	missing data (5)
Slope Gradient (% frequency)			
	very steep (1)	very steep (1)	very steep (0)
	moderately steep (3)	moderately steep (2)	moderately steep (5)
	moderate (7)	moderate (9)	moderate (0)
	gentle (20)	gentle (21)	gentle (16)
	level (64)	**level (63)**	**level (68)**
	missing data (5)	missing data (4)	missing data (11)
Aspect (% frequency)			
	north (13)	north (15)	north (8)
	east (9)	east (11)	east (5)
	south (11)	south (8)	south (21)
	west (19)	west (22)	west (8)
	level (46)	**level (42)**	**level (58)**
	missing data (2)	missing data (2)	missing data (0)
Meso Topoposition (% frequency)			
	crest / upper (19)	crest / upper (21)	crest / upper (13)
	mid (16)	mid (18)	mid (8)
	lower / toe (16)	lower / toe (16)	lower / toe (18)
	depression (2)	depression (1)	depression (8)
	level (46)	**level (44)**	**level (53)**
	missing data (1)	missing data (1)	missing data (0)
Moisture Regime (% frequency)			
	very dry (1)	very dry (1)	very dry (0)
	dry (5)	dry (5)	dry (5)
	mesic (42)	mesic (41)	mesic (45)
	moist (48)	**moist (47)**	**moist (50)**
	wet (4)	wet (5)	wet (0)
Nutrient Regime (% frequency)			
	missing data (100)	missing data (100)	missing data (100)

Populus tremuloides – Picea mariana / Alnus incana CNVC00272

Site / Soil Characteristics (cont'd)

	Association CNVC00272	Subassociation 272a *typic*	Subassociation 272b *Populus balsamifera*
Soil Parent Material (% frequency)			
	bedrock (1)	bedrock (1)	bedrock (0)
	colluvium (5)	colluvium (4)	colluvium (8)
	moraine / till (16)	moraine / till (18)	moraine / till (8)
	fluvial (4)	fluvial (5)	fluvial (3)
	glaciofluvial (9)	glaciofluvial (8)	glaciofluvial (16)
	lacustrine (40)	**lacustrine (32)**	**lacustrine (66)**
	glaciolacustrine (18)	glaciolacustrine (23)	glaciolacustrine (0)
	marine (1)	marine (1)	marine (0)
	organic (1)	organic (2)	organic (0)
	missing data (6)	missing data (8)	missing data (0)
Soil Rooting Zone Substrate (% frequency)			
	non-soil (5)	non-soil (5)	non-soil (8)
	sandy (5)	sandy (5)	sandy (5)
	coarse loamy (8)	coarse loamy (7)	coarse loamy (11)
	fine loamy (12)	fine loamy (11)	fine loamy (16)
	silty (11)	silty (11)	silty (11)
	clayey (20)	clayey (21)	clayey (16)
	organic (1)	organic (2)	organic (0)
	missing data (38)	missing data (39)	missing data (34)
Root Restricting Depth (% frequency)			
	0 – 20 cm (6)	0 – 20 cm (7)	0 – 20 cm (3)
	21 – 99 cm (34)	**21 – 99 cm (39)**	21 – 99 cm (16)
	≥ 100 cm (30)	≥ 100 cm (23)	**≥ 100 cm (55)**
	missing data (30)	missing data (32)	missing data (26)
Humus Form (% frequency)			
	mor (57)	**mor (56)**	**mor (63)**
	moder (27)	moder (27)	moder (26)
	mull (2)	mull (2)	mull (3)
	peatymor (9)	peatymor (10)	peatymor (8)
	missing data (4)	missing data (5)	missing data (0)

Forest / Forêt   **Association CNVC00272**

Populus tremuloides – Picea mariana / Alnus incana
Trembling Aspen – Black Spruce / Speckled Alder
Peuplier faux-tremble – Épinette noire / Aulne rugueux

Additional Characteristics
Species of High Conservation Concern:

Non-native Species:

Management Issues:

Type Statistics
Internal Similarity: **Confidence:**
Strength:

Related Concepts
Similar CNVC Associations:

CNVC00213 [*Populus tremuloides – Betula papyrifera – Picea mariana – Pinus banksiana / Diervilla lonicera / Pleurozium schreberi*] occurs on drier, poorer sites in the same range and lacks *Alnus incana* in the shrub layer.

CNVC00215 [*Betula papyrifera – Populus tremuloides – Pinus banksiana / Acer spicatum / Clintonia borealis*] occurs on mesic, often slightly warmer sites in the same range and has *Acer spicatum*, rather than *Alnus incana*, dominant in the shrub layer.

CNVC00241 [*Populus tremuloides (P. balsamifera) / Alnus incana / Eurybia macrophylla*] is a similar hardwood condition that occurs on comparable sites in the same range (see Dynamics).

CNVC00273 [*Populus tremuloides – Betula papyrifera – Abies balsamea / Alnus incana*] occurs on comparable boreal sites in Quebec. It has less *Picea mariana* and greater proportions of *Betula papyrifera* and *Abies balsamea* in the canopy.

CNVC00347 [*Populus tremuloides – Picea mariana – Pinus banksiana / Acer spicatum (Rosa acicularis)*] occurs in northwestern Ontario and eastern Manitoba on sites that are not quite as moist or rich. It has *Acer spicatum* rather than *Alnus incana* dominant in the shrub layer.

Related United States National Vegetation Classification Associations:

Relationships with Other Classifications:

Comments
Alnus incana here refers to ssp. *rugosa* (speckled alder).

Source Information
Number of source plots for CNVC00272: 171
Number of source plots for 272a typic: 133
Number of source plots for 272b Populus balsamifera: 38
Information Sources:

McMurray, S.C., Johnson, J.A., Zhou, K., Uhlig, P.W.C. 2015. Ontario ecological land classification program - Ecological Data Repository (EDR). Ont. Min. Nat. Resour. & For., Sci.& Info. Branch, Sault Ste. Marie, ON.

Ministère des Ressources naturelles, de la Faune et des Parcs, Forêt Québec. 2003. Base de données des points d'observation écologique (version 2003). Gouv. du Qué., Min. des Res. nat., de la Faune et des Parcs, Forêt Qué., Dir. des inv. for., QC.

Concept Authors: K. Baldwin, K. Chapman, M. Major, C. Morneau, P. Uhlig, M. Wester
Description Authors: K. Chapman and K. Baldwin
Date of Concept: January, 2014
Date of Description: March, 2016

Populus tremuloides – Picea mariana / Alnus incana CNVC00272

Classification References:

Bergeron, J-F.; Grondin, P.; Blouin, J. 1999. Rapport de classification écologique du sous-domaine bioclimatique de la pessière à mousses de l'ouest. Min. des Res. nat. du Qué, Dir. des inv. for., Sainte-Foy, QC.

Grondin, P.; Blouin, J.; Racine, P. 1998. Rapport de classification écologique du sous-domaine bioclimatique de la sapinière à bouleau blanc de l'ouest. Min. des Res. nat. du Qué., Dir. des inv. for., QC.

Uhlig, P.W.C., Chapman, K., Baldwin, K., Wester, M., Yanni, S. 2016. Draft boreal treed vegetation type factsheets. Ecol. Land Class. Prog., Ont. Min. Nat. Resour. & For., Sci. & Info Branch, Sault Ste. Marie, ON.

Characterization References:

Bell, F.W. 1991. Critical silvics of conifer crop species and selected competitive vegetation in northwestern Ontario. For. Can., Ontario Region, Sault Ste. Marie, Ont. and NW Ont. Tech. Dev. Unit, Min. Nat. Resour., Thunder Bay, ON. COFRDA Rep. 3310.

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