SUPPLEMENTARY MATERIAL

Table S1: Description of 127 selected NFI attributes as response variables Y to be predicted and mapped. Two types of aggregation were applied to rasterized PP polygons at 25 m resolution aggregated to the 250 m resolution of MODIS: simple areal averaging (*) and areal averaging with biomass weighting (*†)* for some attributes to take into account vegetation abundance across aggregated PP polygons, particularly for species composition.

CATEGORY	NFI MAP ATTRIBUTE & *description in relation toNFI PP polygons*	ATTRIBUTE LABEL	UNITS	ATTRIBUTE LINKS
LANDCOVER	Non-vegetated proportion *% of non-vegetated polygons **	NON-VEG	%	Sums to 100%
	Vegetated proportion *% vegetated polygons **	VEG	%	
	Treed proportion *% of vegetated treed polygons **	TREED	%	Sums to VEG
	Non-treed proportion *% of vegetated non-treed polygons **	NON-TREED	%	
STRUCTURE	Site age *Mean age of the leading species of polygons †*	AGE	years	None
	Site height *Mean height of the leading species in the polygons †*	HEIGHT	m	
	Crown closure *Mean crown closure of polygons **	CLOSURE	%	
	Merchantable volume *Mean merchantable volume of polygons **	VOL_M	m3/ha	
	Total Volume *Mean total volume of polygons **	VOL_T	m3/ha	
	Total live aboveground biomass *Mean total live above-ground biomass of polygons **	AGB	t/ha	Used as a weight in aggregation †
	Branch biomass *Mean branch biomass component of polygons **	AGB_BR	t/ha	Sums to 100 % of AGB
	Foliage biomass *Mean foliage biomass component of polygons **	AGB_FO	t/ha	
	Stem bark biomass *Mean stem bark biomass component of polygons **	AGB_SB	t/ha	
	Stem wood biomass *Mean stem wood biomass component of polygons **	AGB_SW	t/ha	
	Total dead biomass *Mean total dead standing biomass of polygons **	AGB_DE	t/ha	None

(Table S1 continued)

CATEGORY	**NFI MAP ATTRIBUTE &** ***description in relation to NFI PP polygons***	**ATTRIBUTE LABEL**	**UNITS**	**ATTRIBUTE LINKS**
SPECIES COMPOSITION *(See Table S2 for details on species) †*	Species composition for each 109 NFI species *% weighted by AGB †*	GEN_SP_VAR	%	Sum to 100% of AGB
	Unknown species composition *% of unidentified species †*	UNKNOWN	%	
	No species composition *Dummy variable used to account for the presence of non-vegetated areas in the MODIS pixel with no species and nul biomass †* *(=100% when AGB = 0 t/ha)*	NO_SPP	%	
	Needle-leaf species composition *% weighted by AGB of all identified and non-identified needle-leaf species †*	NLS	%	NLS: Sum of all % needle-leaf species above BLS: Sum of all % broad-leaf species above
	Broad-leaf species composition *% weighted by AGB of all identified and non-identified broad-leaf species †*	BLS	%	NLS+BLS+ UNKNOWN+ NO_SPP=100 %

Aggregation type:
* Areal averaging
† Areal averaging with AGB weighting to take into account relative vegetation abundance across polygons

Table S2: Overall accuracy measurements for all 127 selected NFI attributes using validation pixels (N_{val}=8721) within six well-inventoried ecozones and two partly-inventoried ecozones (Mixedwood Plains and Taiga Cordillera) of interest to increase the number of available species. Empty cells at the end of the table are due to lack of a given species in the validation set. MD and RMSD are reported in addition to MD% and RMSD%, these two being scale dependent. Grey cells indicate attributes for which $R^2 > 0.3$ or RMSD% < 100 % or absolute MD% < 10%. All attribute layers are available at https://nfi.nfis.org/

CATEGORY	ATTRIBUTE LABEL	ATTRIBUTE DESCRIPTION	UNITS	R^2	RMSD%	MD%	RMSD	MD
LAND COVER	NON-VEG	Non-vegetated proportion	%	0.74	109.80	-4.18	16.32	-0.62
	VEG	Vegetated proportion	%	0.74	19.17	0.73	16.32	0.62
	TREED	Vegetated treed proportion	%	0.62	38.44	0.65	24.92	0.42
	NON-TREED	Vegetated non-treed proportion	%	0.37	129.48	0.97	26.29	0.20
STRUCTURE	AGE	Age of leading species	years	0.57	60.26	2.10	44.29	1.54
	CLOSURE	Crown closure	%	0.64	46.52	-0.07	16.71	-0.02
	HEIGHT	Height of leading species	m	0.58	48.16	0.61	5.66	0.07
	VOL_M	Merchantable volume	m3/ha	0.59	75.79	0.00	77.97	0.00
	VOL_T	Total volume	m3/ha	0.52	94.31	0.00	66.08	0.00
	AGB	Total live aboveground biomass	t/ha	0.62	68.46	0.04	44.90	0.03
	AGB_br	Branch biomass	t/ha	0.66	66.32	-0.22	5.98	-0.02
	AGB_de	Dead biomass	t/ha	0.62	86.94	0.89	7.63	0.08
	AGB_fo	Foliage biomass	t/ha	0.65	60.38	0.53	3.34	0.03
	AGB_sb	Stem bark biomass	t/ha	0.59	68.68	0.09	4.68	0.01
	AGB_sw	Stem wood biomass	t/ha	0.60	72.93	0.03	32.26	0.01
SPECIES	NLS	Needle-leaf species	%	0.59	44.78	1.45	25.50	0.82
	BLS	Broad-leaf species	%	0.61	90.01	-0.77	18.75	-0.16
	ABIE_AMA	Amabilis fir (pacific silver fir)	%	0.20	1169.72	2.26	3.00	0.01
	ABIE_BAL	Balsam Fir	%	0.51	176.01	-5.58	7.66	-0.24
	ABIE_LAS	Alpine fir (subalpine fir)	%	0.36	375.12	5.88	11.09	0.17
	ABIE_SPP	Fir	%	0.20	579.06	13.48	9.12	0.21
	ACER_MAC	Bigleaf maple	%	0.30	2786.76	-19.25	0.80	-0.01
	ACER_NEG	Manitoba maple (box-elder, ash-leaved maple)	%	-0.01	5924.13	-70.54	1.27	-0.02
	ACER_PEN	Striped maple	%	-0.61	3795.87	30.03	0.07	0.00
	ACER_RUB	Red maple	%	0.47	341.53	-1.31	3.16	-0.01
	ACER_SAC	Silver maple	%	0.05	1482.95	-29.54	1.45	-0.03
	ACER_SAH	Sugar maple (hard maple)	%	0.57	338.92	-6.20	4.40	-0.08
	ACER_SPI	Mountain maple	%	-0.08	2528.13	-26.66	0.25	0.00

	ACER_SPP	Maple	%	0.25	717.39	-15.14	2.09	-0.04
SPECIES	ALNU_INC	Gray alder	%	0.00	9338.63	-100.00	0.00	0.00
	ALNU_INC_RUG	Speckled alder	%	0.07	1985.90	-25.28	2.05	-0.03
	ALNU_INC_TEN	Mountain alder	%	-0.02	4106.37	-55.63	1.13	-0.02
	ALNU_RUB	Red alder (Oregon, western alder)	%	0.22	2022.77	5.47	1.50	0.00
	ALNU_SPP	Alder sp.	%	0.05	3463.08	-44.29	1.43	-0.02
	ARBU_MEN	Arbutus (madrona, madrone)	%	0.11	6284.53	-81.70	0.04	0.00
	ASIM_TRI	Pawpaw	%	0.00	9338.63	-100.00	0.01	0.00
	BETU_ALL	Yellow birch	%	0.34	384.91	7.94	2.96	0.06
	BETU_PAP	White birch	%	0.33	210.29	-4.03	7.53	-0.14
	BETU_POP	Gray birch (wire birch)	%	-0.18	2771.80	16.11	0.20	0.00
	BETU_SPP	Birch	%	0.06	1211.75	11.54	2.66	0.03
	CARP_CAR	Blue-beech (ironwood, hornbeam)	%	0.01	2717.26	-50.85	0.65	-0.01
	CARP_COR	Blue-beech (ironwood, hornbeam)	%	-0.09	5935.73	110.91	0.09	0.00
	CAST_DEN	American chestnut	%	-0.01	9366.17	-82.81	0.02	0.00
	CHAM_NOO	Yellow cypress (Alaska cedar)	%	0.25	1014.58	10.03	2.47	0.02
	FAGU_GRA	American beech	%	0.37	602.22	-7.38	1.00	-0.01
	FRAX_AME	White ash	%	-0.01	1691.16	-29.96	0.78	-0.01
	FRAX_NIG	Black ash (swamp ash)	%	0.02	1687.79	6.80	1.12	0.00
	FRAX_PEN	Red ash	%	-0.73	5171.33	41.27	0.18	0.00
	FRAX_SPP	Ash	%	-0.72	12245.71	136.15	0.09	0.00
	GEN_BLS	Generic broad-leaf species	%	0.21	475.02	-5.70	6.00	-0.07
	GEN_NLS	Generic needle-leaf species	%	0.27	424.13	-8.06	8.62	-0.16
	JUGL_CIN	Butternut (white walnut)	%	-0.05	4130.41	-56.76	0.07	0.00
	LARI_LAR	Tamarack	%	0.15	441.88	10.40	7.97	0.19
	LARI_LYA	Alpine larch (subalpine larch)	%	-0.57	6045.45	108.08	0.71	0.01

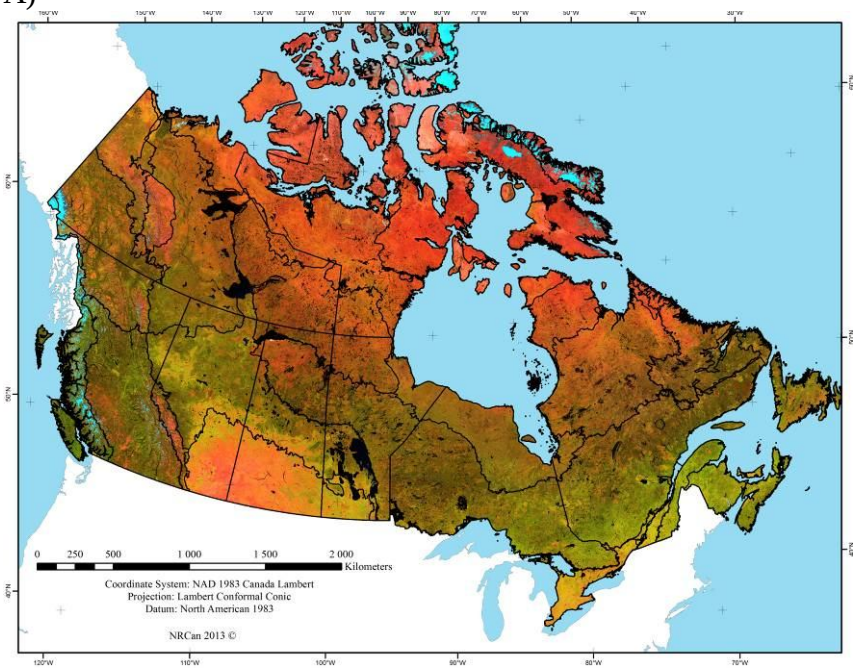
	LARI_OCC	Western larch (western tamarack)	%	-0.07	1903.44	-1.53	1.92	0.00
	LARI_SPP	Larch	%	0.07	2283.43	4.99	1.33	0.00
	OSTR_VIR	Ironwood (hop-hornbeam)	%	-0.03	2859.16	-14.34	0.31	0.00
SPECIES	PICE_ABI	Norway spruce	%	-0.07	2574.89	6.81	1.43	0.00
	PICE_ENG	Engelmann spruce (mountain spruce)	%	0.30	714.96	9.87	5.09	0.07
	PICE_ENG_GLA	Englemann x white	%	-0.03	2803.18	25.55	1.95	0.02
	PICE_GLA	White spruce	%	0.21	250.74	2.47	11.91	0.12
	PICE_MAR	Black spruce	%	0.58	103.86	7.01	18.81	1.27
	PICE_RUB	Red spruce (yellow spruce)	%	0.37	600.96	-8.16	3.72	-0.05
	PICE_SIT	Sitka spruce (tideland spruce)	%	-0.33	3253.53	89.39	1.04	0.03
	PICE_SPP	Spruce	%	0.26	392.23	-5.03	9.82	-0.13
	PINU_ALB	Whitebark pine (scrub pine)	%	-0.07	2250.00	18.57	2.01	0.02
	PINU_BAN	Jack pine	%	0.39	250.22	-9.53	11.01	-0.42
	PINU_CON	Lodgepole pine	%	0.59	229.84	-3.80	11.26	-0.19
	PINU_CON_LAT	Shore pine	%	0.35	626.39	3.80	6.20	0.04
	PINU_MON	Western white pine (silver pine)	%	0.11	2358.87	-19.05	0.53	0.00
	PINU_PON	Ponderosa pine (yellow pine, bull pine)	%	0.31	1952.72	-5.69	1.71	0.00
	PINU_RES	Red pine (Norway pine)	%	0.07	1478.37	1.45	1.99	0.00
	PINU_SPP	Pine	%	0.07	1932.16	-1.42	2.69	0.00
	PINU_STR	Eastern white pine (weymouth pine)	%	0.38	518.13	-8.39	3.30	-0.05
	PINU_SYL	Scots pine	%	-1.84	11125.42	134.83	0.06	0.00
	POPU_BAL	Balsam poplar (tacamahac)	%	0.12	595.22	1.32	4.75	0.01
	POPU_DEL	Eastern cottonwood	%	-0.04	9519.59	-72.02	0.37	0.00
	POPU_GRA	Largetooth aspen	%	0.13	997.60	-6.29	1.03	-0.01
	POPU_SPP	Poplar (cottonwood, aspen)	%	0.40	328.70	-1.19	6.93	-0.02
	POPU_TRE	Trembling aspen	%	0.55	169.72	3.78	14.22	0.32
	POPU_TRI	Black cottonwood (western balsam poplar)	%	-0.13	4570.22	-22.31	0.92	0.00
	PRUN_PEN	Pin cherry (red, bird, fire cherry)	%	-0.09	919.25	19.73	0.31	0.01

	PRUN_SER	Black cherry	%	-0.18	2302.81	26.92	0.17	0.00
	PSEU_MEN	Douglas-fir	%	0.52	422.04	-3.58	6.92	-0.06
	PSEU_MEN_GLA	Interior Douglas-fir	%	-0.02	2206.76	-32.54	2.49	-0.04
	PSEU_MEN_MEN	Coastal Douglas-fir	%	-0.07	3749.74	-42.73	1.27	-0.01
SPECIES	QUER_ALB	White oak	%	-0.15	4328.06	-0.01	0.15	0.00
	QUER_BIC	Swamp white oak	%	0.00	9323.73	-87.01	0.03	0.00
	QUER_GAR	Garry oak (Oregon white oak)	%	0.00	9338.63	-100.00	0.10	0.00
	QUER_MAC	Bur oak	%	-0.01	5480.79	-46.87	0.59	-0.01
	QUER_RUB	Red oak	%	0.05	1101.72	-18.80	2.32	-0.04
	SALI_BEB	Peachleaf willow	%	-0.13	1304.40	20.93	0.15	0.00
	SALI_SPP	Willow	%	-0.15	3867.00	-24.80	0.95	-0.01
	SORB_AME	American mountain ash	%	0.06	1143.04	4.38	0.12	0.00
	THUJ_OCC	Eastern white-cedar	%	0.05	608.81	10.43	3.06	0.05
	THUJ_PLI	Western red cedar	%	0.56	475.65	-8.03	3.85	-0.06
	THUJ_SPP	Cedar (arbor-vitae)	%	-0.05	1542.53	27.85	2.12	0.04
	TILI_AME	Basswood (American linden)	%	0.02	1252.54	-6.74	0.47	0.00
	TSUG_CAN	Eastern hemlock	%	0.14	974.62	1.44	1.72	0.00
	TSUG_HET	Western hemlock	%	0.35	606.55	-2.46	5.22	-0.02
	TSUG_MER	Mountain hemlock	%	0.20	1511.93	20.53	3.12	0.04
	TSUG_MER_HET	Mountain x western hemlock hybrid	%	0.00	9338.63	-100.00	0.84	-0.01
	TSUG_SPP	Hemlock	%	0.26	691.19	-4.11	5.76	-0.03
	ULMU_AME	White elm (American elm)	%	-0.13	5469.41	25.93	0.41	0.00
	ULMU_THO	Rock elm (cork elm)	%	0.00	6701.60	-100.00	0.01	0.00
	UNKNOWN	Unknown species	%	0.59	112.19	-2.80	24.88	-0.62
	ABIE_GRA	Grand fir (lowland fir)	%					
	ACER_CIR	Vine maple	%					

	CRAT_SPP	Hawthorn	%					
	FRAX_PEN_SUB	Green ash	%					
	GLED_TRI	Honey-locust	%					
	JUGL_NIG	Black walnut	%					
	JUNI_VIR	Eastern red cedar (juniper)	%					
	LARI_KAE	Japanese larch	%					
	MALU_FUS	Pacific crab apple	%					
	MALU_SPP	Apple	%					
SPECIES	PINU_FLE	Limber pine (Rocky Mountain white pine)	%					
	PINU_RIG	Pitch pine	%					
	PLAT_OCC	Sycamore (plane-tree, buttonball)	%					
	PRUN_VIR	Choke cherry	%					
	ROBI_PSE	Black-locust	%					
	SALI_NIG	Black willow	%					
	SASS_ALB	Sassafras	%					
	SORB_DEC	Showy mountain ash	%					
	SORB_SPP	Mountain-ash	%					
	ULMU_RUB	Slippery elm (red elm)	%					
	ULMU_SPP	Elm	%					

FIGURES

A)



B)

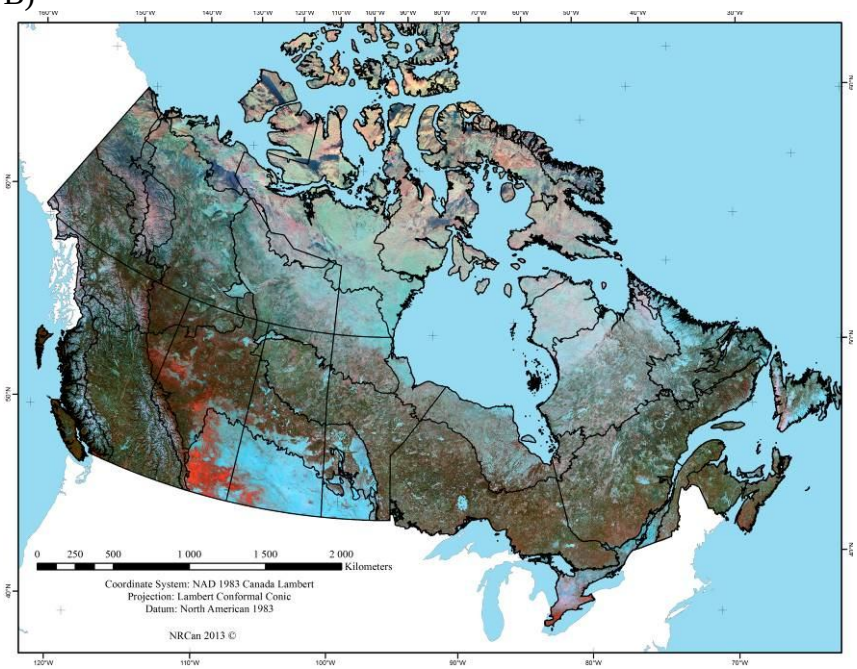


Figure S1: A) Summer (July-August) and B) winter (January-February) colour composites of 2001 MODIS 250 m composite mosaics (Red: Band 2, Green: Band 6, Blue: Band 1) as key geospatial layers across Canada used to impute NFI attributes.

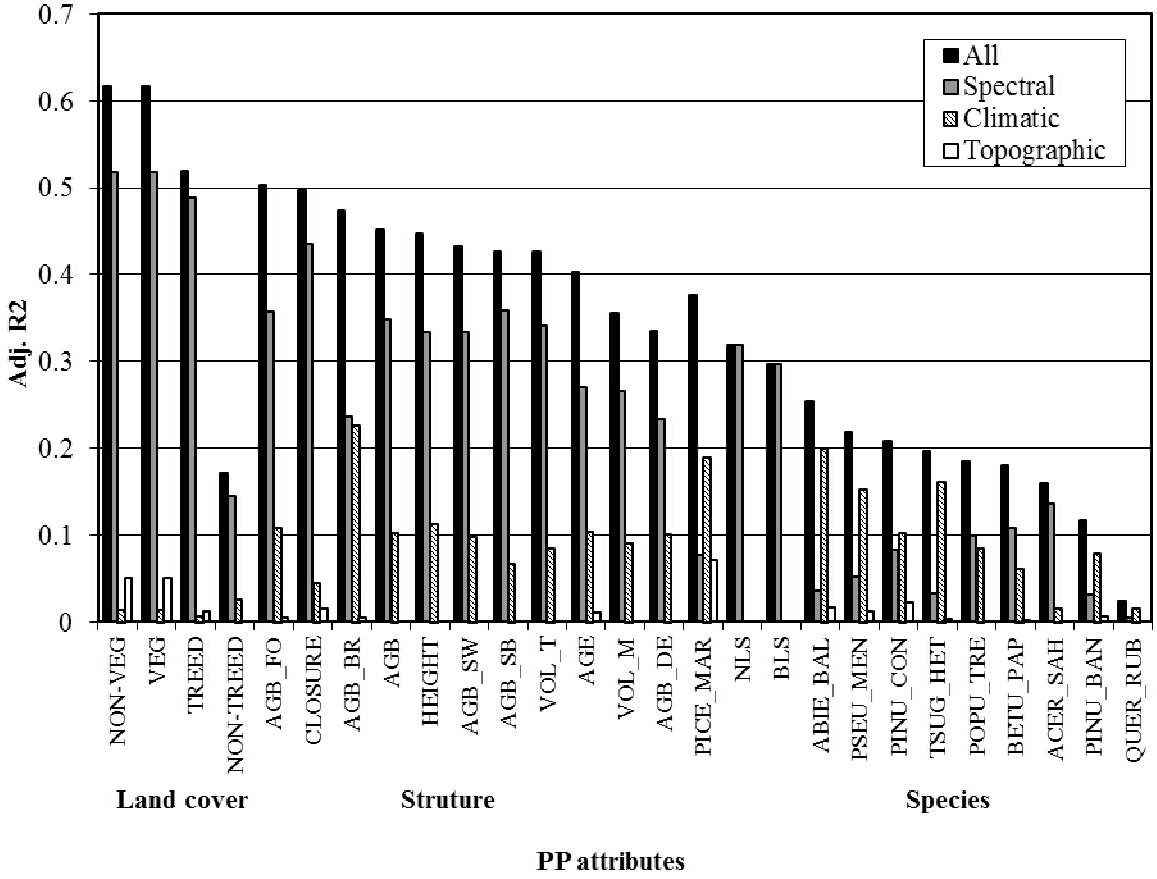


Figure S2a: Values of adj. R^2 (black bars) from hybrid-LASSO (HL) selected features (X) for each categorized NFI PP attribute (27 response variables Y) along with contributions (sum of adj. R^2 change) by feature category (spectral, climatic and topographic: other bars). The single land cover feature water proportion was removed from the graph for clarity as change in adj. R^2 was always below 0.04. See Table S1 for description of PP attributes labels and Table S2 for categorized features.

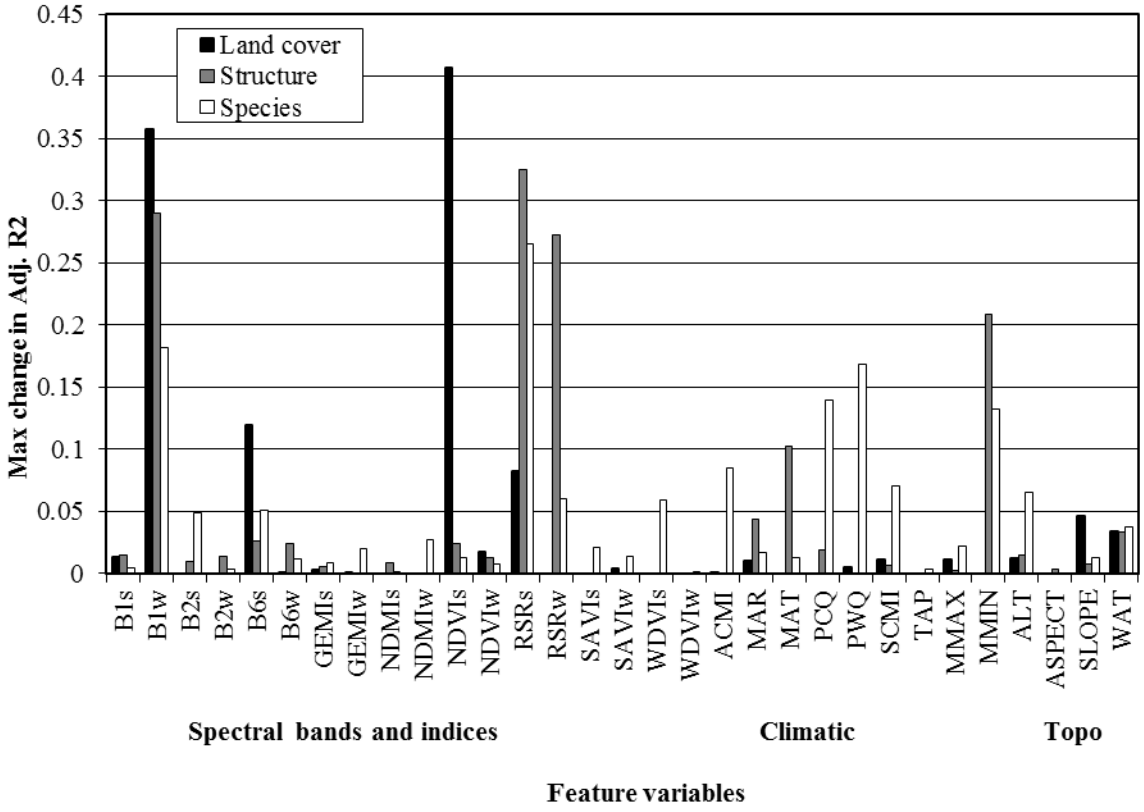
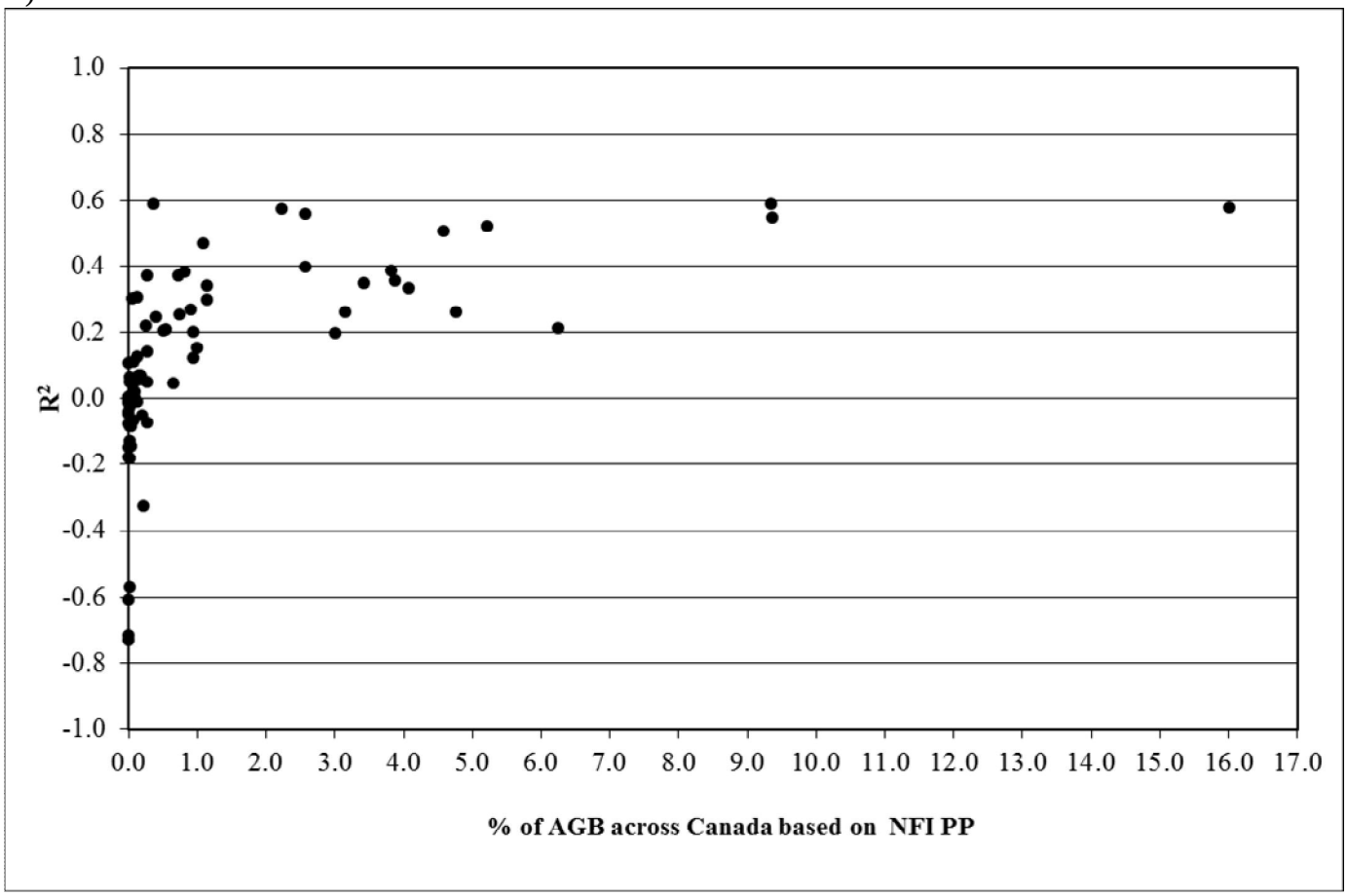
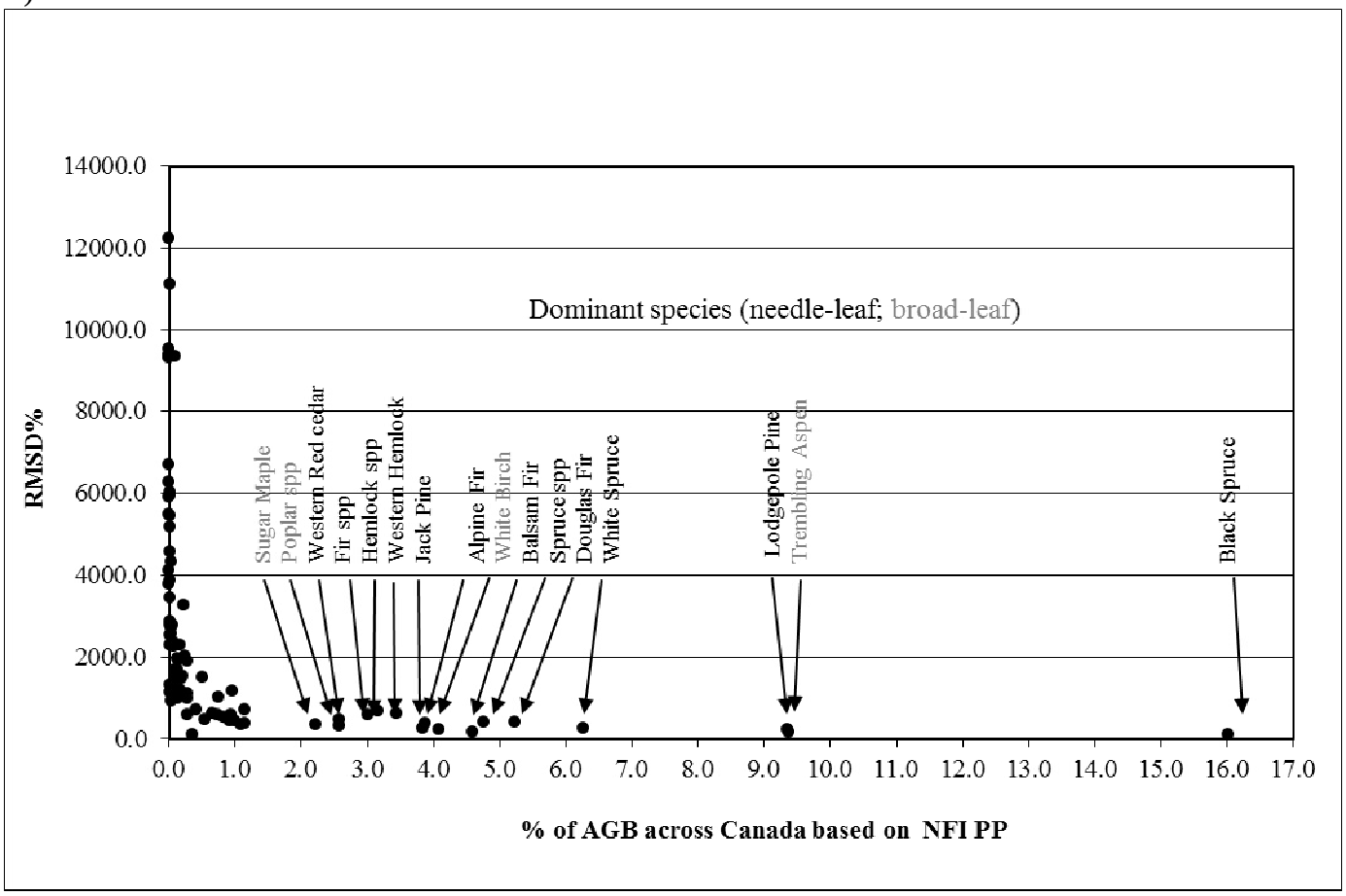


Figure S2b: Maximal change in adj. R^2 caused by each of the 31 feature variables X across the NFI the attribute categories following HL procedure, indicative of their best predictive capacity.

A)


1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
-1.0
R²
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0
% of AGB across Canada based on NFI PP

B)


Dominant species (needle-leaf; broad-leaf)
RMSD%
14000.0
12000.0
10000.0
8000.0
6000.0
4000.0
2000.0
0.0
Sugar Maple
Poplar spp
Western Red cedar
Fir spp
Hemlock spp
Western Hemlock
Jack Pine
Alpine Fir
White Birch
Balsam Fir
Spruce spp
Douglas Fir
White Spruce
Lodgepole Pine
Trembling Aspen
Black Spruce
0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0
% of AGB across Canada based on NFI PP

C)

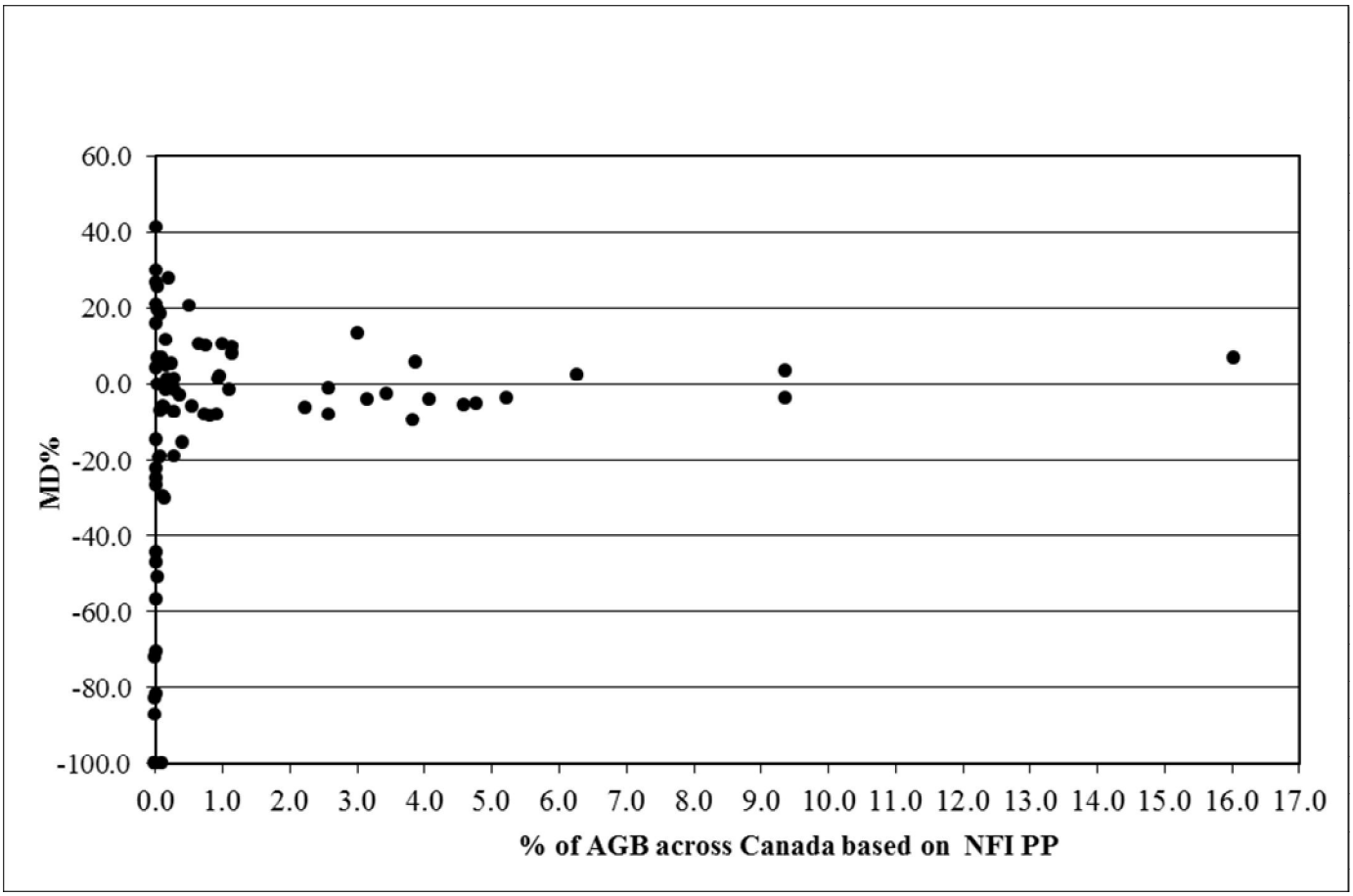


Figure S3: Accuracy measurements across all six well-inventoried ecozones and two poorly inventoried ecozones (N_{val}=8721) for 82 species compositions vs their % of total AGB based on NFI PP as a measurement of their abundance across Canada: A) R^2, B) RMSD% and C) MD% (see Table S2 for tabulated values).