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Table 1. Global Carbon Reservoirs and Turnover Times

Reservoir	Gt C[a]	Turnover Time
Sediments, rocks	77×10^6	$>>10^6$ yrs.
Deep ocean (DIC) [b]	38000	2000 yrs.
Soils	1500	$<10 - 10^5$ yrs.
Surface ocean	1000	decades
Atmosphere	750	3 - 5 yrs.
Deep ocean (DOC) [c]	700	5000 yrs.
Terrestrial biomass	550 - 680	50 yrs.
Surface sediments	150	0.1 - 1000 yrs.
Marine biomass	2	0.1 - 1 yrs.

Information in this table is from *Reeburgh* [1997].

[a] 1 Gt = 10^{15} g.

[b] Dissolved inorganic carbon.

[c] Dissolved organic carbon.

Table 2. 1980 - 1990 Global CO_2 Budget (Gt C yr^{-1})

Sources

Fossil fuel	5.5 ± 0.5
Net emissions from changes in land use	1.6 ± 1.0
Total	7.1 ± 1.5

Sinks

Atmospheric storage	3.3 ± 0.2
Oceanic uptake	2.0 ± 0.8
Total	5.3 ± 1.0

Imbalance

Residual terrestrial sink "The Missing Sink"	1.8 ± 1.5

Note: 2.1 g Carbon ⇔ 1 ppm atmospheric CO_2,
where 1 Gt = 10^{15} g.

Information in this table is from *Houghton et al.* [1998].

Table 3. Input (*I*) Rates and Decomposition (*k*) Constants for Surface and Deep Soil Layers

Soil Horizon	Drainage Class	*I*, kg C m^{-2} yr^{-1}	*k*, yr^{-1}
Surface	Well	0.06	0.07
	Moderately well	0.08	0.013
	Imperfect	0.07	0.0105
	Poor		
	Sphagnum moss	0.06	0.008
	Palsa	0.08	0.013
	Very poor		
	Fen	0.0324[a]	0.02[a]
	Collapse scar bog	0.0324[a]	0.02[a]
Deep	Well	0.015	0.01
	Moderately well	0	0.003
	Imperfect	0	0.002
	Poor		
	Sphagnum moss	0	0.0007
	Palsa	0	0
	Very poor		
	Fen	0.064	0.0004
	Collapse scar bog	0.064	0.0004

Information in this table is from *Trumbore and Harden* [1997].

[a] These values are fixed for a C inventory of 13 kg C m^{-2}, so as to give 0.064 kg C m^{-2} yr^{-1}, the input to the deep layers.

From *Rapalee et al.* [1998c].

Table 4. Percent of Total Study Area by Forest Stand Age and Drainage Class / Land Cover Type

Drainage Class/	Time Since Fire, years					
Land Cover Type	13	30-43	45-65	65-90	>90	Total
Well						
Jack pine	0	5	< 1	0	1	6
Moderately well						
Black spruce/Feather moss	5	2	10	2	2	21
Imperfect						
Black spruce/Mixed mosses	3	1	6	1	1	12
Poor						
Black spruce/Sphagnum moss	4	2	9	2	3	20
Palsa	6	< 1	3	1	4	14
Very poor						
Fen						18
Collapse scar bog						1
Other						
Rock, water, lake						8
Total	18	10	28	6	11	100

Note: The reference year for this study is 1994, the year when most of the field work was conducted. Therefore, ages and age ranges shown here represent the age class distribution of the study area in 1994.

From *Rapalee et al.* [1998c].

Table 5. Areal Coverage, Organic Carbon Stocks and Fluxes by Drainage Class, Vegetation Type, and Age Class for 733 km^2 Study Site Within the BOREAS Northern Study Area

Drainage Class	Vegetation Type	Age Class	Area		Carbon Stock							Carbon Flux					
					Area-Weighted Average			Total for Study Area				Area-Weighted Average			Total for Study Area		
					Surface	Deep	Total	Surface	Deep	Total	Total	Surface	Deep	Total	Surface	Deep	Total
			km^2	%	kg C m^{-2}			10^{12} g C			%	g C m^{-2} yr^{-1}			10^9 g C yr^{-1}		
Well	Jack pine	13	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		30-43	33	4.5	0.8	2.8	3.6	0.03	0.09	0.12	0.4	6.6	-13.1	-6.4	0.2	-0.4	-0.2
		45-65	2	0.3	0.8	3.7	4.6	0.00	0.01	0.01	<0.1	0.9	-22.2	-21.3	<0.1	-0.1	<0.0
		65-90	0	0.0	0.0	0.0	0.0	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		>90	11	1.4	0.9	3.1	4.0	0.01	0.03	0.04	0.1	0.1	-16.0	-15.9	0.0	-0.2	-0.2
Moderately well	Black spruce	13	37	5.0	1.0	9.6	10.6	0.04	0.35	0.39	1.4	67.6	-28.8	38.7	2.5	-1.1	1.4
	Feather moss	30-43	12	1.7	2.1	12.7	14.8	0.03	0.16	0.18	0.6	52.8	-38.0	14.8	0.7	-0.5	0.2
		45-65	71	9.6	3.3	11.0	14.3	0.24	0.78	1.01	3.6	36.7	-32.9	3.8	2.6	-2.3	0.3
		65-90	12	1.7	3.7	11.6	15.3	0.04	0.14	0.19	0.7	32.2	-34.9	-2.7	0.4	-0.4	< 0.0
		>90	15	2.1	4.4	9.8	14.2	0.07	0.15	0.22	0.8	22.7	-29.5	-6.8	0.4	-0.5	-0.1
Imperfect	Black spruce	13	21	2.8	0.8	19.6	20.4	0.02	0.41	0.43	1.5	60.8	-39.2	21.7	1.3	-0.8	0.5
	Mixed mosses	30-43	6	0.8	1.9	15.6	17.5	0.01	0.09	0.10	0.4	49.7	-31.2	18.5	0.3	-0.2	0.1
		45-65	46	6.2	3.1	19.7	22.8	0.14	0.90	1.05	3.7	36.9	-39.5	-2.6	1.7	-1.8	-0.1
		65-90	8	1.1	3.4	15.3	18.7	0.03	0.13	0.16	0.6	33.2	-30.6	2.6	0.3	-0.3	0.0
		>90	8	1.1	4.8	19.4	24.2	0.04	0.16	0.20	0.7	25.3	-38.9	-13.6	0.2	-0.3	-0.1
Poor	Black spruce	13	26	3.6	0.7	11.7	12.5	0.02	0.31	0.33	1.2	54.1	-8.2	45.9	1.4	-0.2	1.2
	Sphagnum moss	30-43	14	1.9	1.7	14.1	15.8	0.02	0.20	0.22	0.8	46.5	-9.8	36.7	0.7	-0.1	0.5
		45-65	68	9.3	2.9	12.0	14.9	0.19	0.82	1.01	3.6	37.1	-8.4	28.7	2.5	-0.6	2.0
		65-90	12	1.6	3.2	11.7	15.0	0.04	0.14	0.18	0.6	34.3	-8.2	26.1	0.4	-0.1	0.3
		>90	24	3.3	4.2	14.3	18.4	0.10	0.35	0.45	1.6	26.7	-10.0	16.7	0.7	-0.2	0.4
Poor	Palsa	13	44	6.0	1.0	69.9	70.9	0.04	3.06	3.10	11.0	67.6	0.0	67.6	3.0	0.0	3.0
		30-43	<1	<0.1	2.6	55.9	58.5	<0.01	0.01	0.01	0.1	45.7	0.0	45.7	<0.1	0.0	<0.1
		45-65	23	3.1	3.3	60.8	64.1	0.08	1.39	1.47	5.2	36.7	0.0	36.7	0.8	0.0	0.8
		65-90	8	1.1	3.7	65.3	68.9	0.03	0.51	0.54	1.9	32.2	0.0	32.2	0.3	0.0	0.3
		>90	31	4.2	4.8	70.3	75.1	0.15	2.16	2.31	8.2	21.6	0.0	21.6	0.7	0.0	0.7
Very poor	Fen	N/A	131	17.9	13.0	88.0	101.0	1.7	11.6	13.3	47.0	0.0	28.8	28.8	0.0	3.8	3.8
	Collapse scar bog	N/A	9	1.2	13.0	130.6	143.6	0.1	1.1	1.2	4.4	0.0	11.7	11.7	0.0	0.1	0.1
All soils			673	91.7	4.7	37.3	42.0	3.2	25.1	28.2	100	30.9	-9.2	21.8	20.8	-6.2	14.7
Other	Rock, water, lake	N/A	61	8.3	0.0	0.0	0.0					0.0	0.0	0.0			
Total area			733	100	4.3	34.2	38.5					28.4	-8.4	20.0			

N/A = Not applicable

From *Rapalee et al.* [1998c].

Table 6. Sensitivity Analysis of the Effects of Deep Soil C Decomposition Constants on Simulated Carbon Fluxes

	Scenario Decomposition Constants, yr^{-1}		
Drainage Class/Vegetation Type	Reference	Low	High
Well-drained sand Jack pine	0.01	0.007	0.012
Moderately well-drained clay Black spruce/feather moss	0.003	0.0006	0.006
Imperfectly drained clay Black spruce/mixed mosses	0.002	0.0006	0.003
Poorly drained Black spruce/sphagnum moss	0.0007	0.0005	0.0009
Very poorly drained Fen and collapse scar bog	0.0004	0.0002	0.0005

	Mean Area-Weighted C Flux for Total Study Area[a], g C m^{-2} yr^{-1}		
Soil Horizon	Reference	Low	High
Surface	30.9	30.9	30.9
Deep	– 9.1	+ 4.9	– 21.5
Total profile	21.8	35.8	9.4

[a] Values cover 673 km^2, total area mapped as soils (Table 5).

From *Rapalee et al.* [1998c].

Table 7. Sensitivity Analysis of C Accumulation in Moss and Surface Soil Layers, Assuming Entire Area (Except Fens and Collapse Scar Bogs) Burned 13, 30, 60, or 120 Years Ago

	Mean Area-Weighted C Flux[a], g C m^{-2} yr^{-1}		
Time Since Fire, years	Surface Layers	Deep Layers	Total Profile
Reference case (1994)	30.9	– 9.1	21.8
13	46.4	– 9.1	37.3
30	37.9	– 9.1	28.8
60	26.8	– 9.1	17.7
120	13.9	– 9.1	4.8

[a] Values cover 673 km^2, total area mapped as soils (Table 5).

From *Rapalee et al.* [1998c].

Sample Data Record

The following table is excerpted from the soil polygon spreadsheet that is the database of this study. Because the records are so long, they are presented here in two groups. Short descriptions of each soil attribute follow. The first 31 attributes are from the *Veldhuis and Knapp* [1998] soil survey; the remaining records (32 to 42 -- in bold type) were generated for this study [*Rapalee et al.*, 1998a]. For detailed descriptions of soil attributes, see *Veldhuis and Knapp* [1998] and *Rapalee et al.* [1998a].

Table 8. Sample Data Record

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
POLYNUM	GRIDLOC	COMPONT	RANKNUM	PERCENT	KINDMAT	LANDFRM	PMDEPO1	TXTURE1	TXTMOD1	PMDEPO2	TXTURE2	TXTMOD2	PMDEPO3	TXTURE3	TXTMOD3	COFRAGS	SLOPE	DRAINGE	DEPTHWT	PFDISTR	DPTHACT	ICECTNT	DPTHLFH	DPTHORG
1	F1	D	1	65	R2	h	RK	#	#	#	#	#	#	#	#	#	C	#	#	#	#	#	#	#
1	F1	D	2	20	SO	vh	GL	HC	-	RK	-	-	-	-	-	A	B	MW	-	-	-	-	1	#
1	F1	I	1	15	SO	bh	GL	HC	-	-	-	-	-	-	-	A	B	I	125	-	-	-	1	#
2	F1	D	1	90	R2	h	RK	#	#	#	#	#	#	#	#	#	E	#	#	#	#	#	#	#
2	F1	I	1	10	OR	Bv	B	F	-	GL	HC	-	-	-	-	#	B	P	50	-	-	-	#	1
3	F1	D	1	90	R2	h	RK	#	#	#	#	#	#	#	#	#	C	#	#	#	#	#	#	#
3	F1	I	1	10	OR	Bv	B	F	-	GL	HC	-	-	-	-	#	B	P	50	V	50	H	#	1
4	F1	D	1	60	SO	hb	GL	HC	-	-	-	-	-	-	-	A	D	MW	125	-	-	-	1	#
4	F1	D	2	15	OR	Bv	B	F	-	GL	HC	-	-	-	-	#	B	P	50	V	50	H	#	1
4	F1	S	1	15	OR	Ba	B	M	-	GL	HC	-	-	-	-	#	C	P	*	D	50	H	#	2
4	F1	I	2	10	OR	Fc	FN	F	-	GL	HC	-	-	-	-	#	A	VP	10	-	-	-	#	2

Table 8. (cont.)

1	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
POLYNUM	SOILDEV	VARIANT	SERIES1	SERVAR1	SERIES2	SERVAR2	**TOTLAREA**	**COMPAREA**	**DR CLASS**	**STND AGE**	**STAGE GRP**	**CSURFACE**	**CDEEP**	**CTOTAL**	**FLSURFACE**	**FLDEEP**	**FLNET**
							hectares					**kg C m^{-2}**			**g C m^{-2} yr^{-1}**		
1	#		$AR				**7.7**	**5.0**	**1**	**86**	**90**	**0**	**0**	**0**	**0**	**0**	**0**
1	OGL	L	WRL				**7.7**	**1.5**	**5**	**86**	**90**	**0.85**	**1.97**	**2.82**	**4.97**	**-5.90**	**-0.93**
1	GLGL		ROK		LPR	p	**7.7**	**1.1**	**6**	**86**	**90**	**0.61**	**2.97**	**3.58**	**4.05**	**-5.95**	**-1.90**
2	#		$AR				**68.1**	**61.3**	**1**	**86**	**90**	**0**	**0**	**0**	**0**	**0**	**0**
2	TF		NIC		ROK		**68.1**	**6.8**	**7**	**86**	**90**	**0.38**	**1.17**	**1.56**	**2.92**	**-0.82**	**2.10**
3	#		$AR				**14.2**	**12.8**	**1**	**86**	**90**	**0**	**0**	**0**	**0**	**0**	**0**
3	TF		NIC		ROK		**14.2**	**1.4**	**7**	**86**	**90**	**0.38**	**1.17**	**1.56**	**2.92**	**-0.82**	**2.10**
4	OGL		WBW		ROK		**963.3**	**578.0**	**5**	**86**	**90**	**2.55**	**5.90**	**8.45**	**14.90**	**-17.70**	**-2.80**
4	TF		NIC		LPR	p	**963.3**	**144.5**	**7**	**86**	**90**	**0.58**	**1.76**	**2.34**	**4.38**	**-1.23**	**3.15**
4	TMEOC		PLT				**963.3**	**144.5**	**7**	**86**	**90**	**0.64**	**10.94**	**11.58**	**3.72**	**0**	**3.72**
4	TMEF		TFN	w			**963.3**	**96.3**	**8**	**199**	**1**	**1.30**	**10.43**	**11.73**	**0**	**2.23**	**2.23**

Note: Negative (<0) flux denotes carbon released from the soil or surface horizons to the atmosphere (source). Positive (>0) flux denotes carbon stored in the soil or surface horizons (sink).

Key Soil Attributes

The following key soil attributes of this data set are those listed in Table 8. The polygon numbers in this table correspond to the pixel values in the gridded soils map [*Veldhuis and Knapp,* 1998]. The value of each pixel in the soil map can link to the table in order to extract these parameters.

1 POLYNUM = Polygon number
2 GRIDLOC = Grid location
3 COMPONT = Polygon component (landscape element)
4 NUMBER = Component rank number
5 PERCENT = Percentage distribution of components
6 KINDMAT = Kind of rock outcrop or other material at the surface
7 LANDFRM = Local surface form
8 PMDEPO1 = Mode of deposition or origin of first (upper) parent material
9 TXTURE1 = Texture of first (upper) parent material
10 TXTMOD1 = Texture modifier of first (upper) parent material
11 PMDEPO2 = Mode of deposition or origin of second (middle) parent material
12 TXTURE2 = Texture of second (middle) parent material
13 TXTMOD2 = Texture modifier of second (middle) parent material
14 PMDEPO3 = Mode of deposition or origin of third (lower) parent material
15 TXTURE3 = Texture of third (lower) parent material
16 TXTMOD3 = Texture modifier of third (lower) parent material
17 COFRAGS = Coarse fragment content in control section of mineral soils
18 SLOPE = Slope gradient class
19 DRAINGE = Drainage class
20 DEPTHWT = Depth to water table, average
21 PFDISTR = Permafrost distribution or occurrence
22 DPTHACT = Depth of active layer (average)
23 ICECTNT = Ice content of permanently frozen layer
24 DPTHLFH = Thickness of humus layer (L, F, H)

DPTHORG = Average thickness of peat deposit
SOILDEV = Soil development (soil classification)
VARIANT = Classification variant or phase
SOILTP1 = Dominant soil type associated with polygon component
SOILPH1 = Soil phase or variant associated with dominant soil type
SOILTP2 = Subdominant soil type associated with polygon component
SOILPH2 = Soil phase or variant associated with subdominant soil type
TOTLAREA = Total area (hectares) of each soil polygon
COMPAREA = Area (hectares) of each polygon component
DR_CLASS = Drainage class (numerical code)
STND_AGE = Stand age; time since last fire
ST_AGE_GRP = Stand age; age ranges since last fire
C_SURFACE = Area-weighted carbon stocks of surface layers, including moss
C_DEEP = Area-weighted carbon stocks of deep soil horizons
C_TOTAL = Area-weighted total carbon stock for entire profile (C_SURFACE + C_DEEP)
FL_SURFACE = Area-weighted carbon fluxes of surface layers, including moss
FL_DEEP = Area-weighted carbon fluxes of deep soil horizons
FL_NET = Area-weighted carbon fluxes for entire profile (FL_SURFACE + FL_DEEP)

Table 9. Forest and Land Cover Types

Map Code	Dominant Overstory Species
100	Jack pine (JP)
200	Black spruce (BS)
300	Trembling aspen/Hardwoods (TA/HW)

Map Code	Nonproductive Land
400	Treed muskeg
500	Treed rock
600	Clear muskeg

Note: For this study I simplified the *Knapp and Tuinhoff* [1998] forest cover map layer, which included 66 classes, by reclassifying to the three major forest cover types plus three categories of nonproductive land listed in Table 9.
Note: Forest cover categories (JP, BS, TA) are also listed as Subtypes (Table 11) and Working Groups (Table 12).

Table 10. Cutting Class

Cutting Class	Map Code	Description
	0	No original data over the area.
	60	Unproductive stands. No cutting class given.
0	60	Forest land not restocked following fire, cutting, windfall, or other major disturbances (hence, potentially productive land). Some reproduction or scattered residual trees (with net merchantable volume <20 m^3 ha^{-1}) may be present.
1	10	Stands that have been restocked either naturally or artificially. There may be scattered residual trees present as in Cutting Class 0. The average height of the stand must be <3 m.
2	20	Advanced young growth of post size, with some merchantable volume. The average height of the stand must be >3 m.
3	30	Immature stands with merchantable volume growing at or near their maximum rate, which definitely should not be cut. The average height of the stand should be >10 m and the average diameter should be >9.0 cm at dbh (1.3 m).
4	40	Mature stands, which may be cut as they have reached rotation age ± 10 years on Site 1 or ± 20 years on Site 2.
5	50	Overmature stands, which should be given priority in cutting.

Note: Map code 60 includes stands identified as unproductive and not restocked (Cutting Class 0).

Table 11. Site Classification by Moisture Regime, Landform, and Indicator Plants

Moisture Regime	Landform	Indicator Plants		Subtype and Site Class		
		Abundant	Scattered	JP	BS	TA
Arid	Rock outcrop, higher gravel beach ridges	Reindeer moss, Creeping savin	Bearberry	2	--	3
Dry	Higher beach, outwash, and moraine ridges	Bearberry, Creeping savin, Reindeer moss, Slender mountain rice	Common juniper, Soapberry	2	3	2
Fresh	Lower beach, outwash, and moraine ridge, slopes, and intermediate terraces	Twinflower, Buffaloberry, Common juniper, Rough-grained mountain rice	Bearberry, Bunchberry	1	1	1
Moist (groundwater and vadose water types)	Low positions and flaring-out margins OR Till plains, lacustrine flats, and higher flood plains	Red-ozier dogwood, Bunchberry, *Ribes* spp., Naked miterwort, Creeping snowberry	Buffaloberry, Common juniper, Rough-grained mountain rice, Alder	1	1	1
Very Moist	Depressional positions on beach and outwash and lacustrine deposits	Red-ozier dogwood, Naked miterwort, Bunchberry, *Ribes* spp., Alder	Bog cranberry	1	1	1
Wet	Depressional positions on till and lacustrine material	Alder, Marsh marigold, Bog cranberry		--	1	1
Saturated	Deep organic terrain	*Sphagnum* spp., Labrador tea, Marsh marigold		--	2	--

Note: Arid sites are generally devoid of tree cover.

Table 12. Age Range by Cutting Class and Working Group

	Cutting Class				
	1	2	3	4	5
Working Group	Age Range, years				
Jack pine -- all sites	5 ± 5	18 ± 7	48 ± 22	80 ± 10	91+
Black spruce					
Site 1	7 ± 7	23 ± 7	50 ± 20	80 ± 10	91+
Site 2	15 ± 15	53 ± 22	98 ± 22	140 ± 20	161+
Hardwoods -- all sites	7 ± 7	23 ± 7	50 ± 20	80 ± 10	91+

Note: Tables 11 and 12 show how cutting class and site class tie with forest cover in determining age ranges for the stand age class map layer. For example, the age distribution of a Site 2 black spruce stand in Cutting Class 3 is 98 ± 22 years, where 98 represents the mid-point of the age range. The ranges listed in Table 12 represent forest age distribution in 1988, the year of the MNR forest inventory. Because the reference year for this study is 1994, I added 6 years to the mid-points in Table 12 for data used from the MNR inventory that were incorporated into the forest stand age map (Figure 6A).