Canadian Fire Effects Model: predicting fire behaviour and fire effects

Bill de Groot

CanFIRE Overview

- CFFDRS science-management integration model
- Stand-level, fire behaviour-based model
- Simulates physical and ecological fire effects
- Small scale (fire behaviour) to large scale (fire regimes)
- new fuel consumption equations
- dynamic fuel model (fully adjustable)

CanFIRE Overview

- CFFDRS is a primary model driver
- Fire weather, fire behaviour

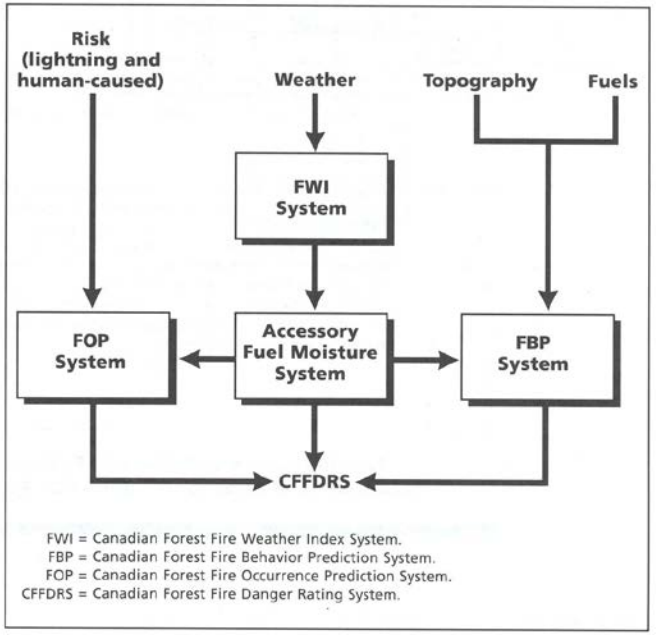


Figure 1. Structure of the Canadian Forest Fire Danger Rating System.

CanFIRE Overview

- CFFDRS is a primary model driver
- Fire weather, fire behaviour
- Need to predict site impacts and ecological effects

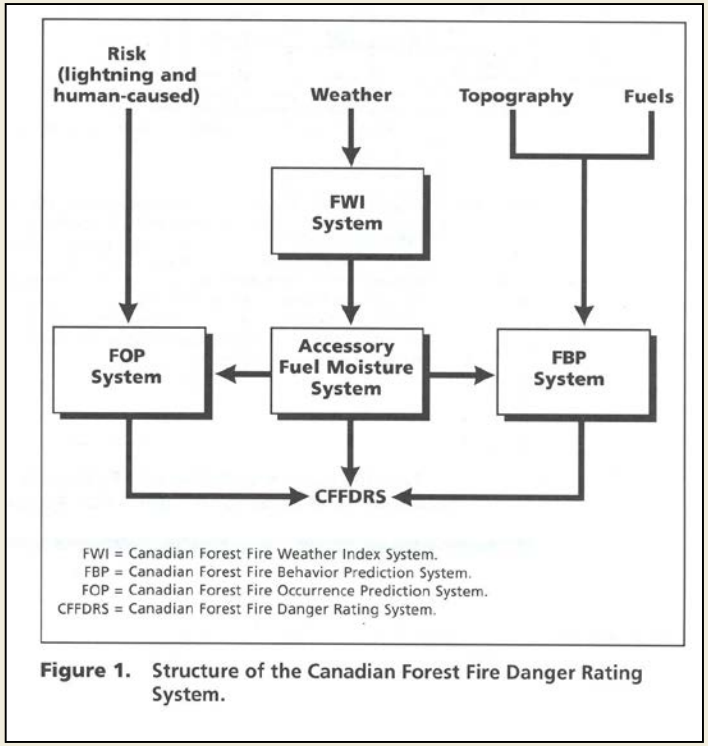


Figure 1. Structure of the Canadian Forest Fire Danger Rating System.

Fire Weather	Fire Behaviour	Fire Effects
FWI System	**FBP System**	**Fire Effects Prediction**
•Fuel moisture	•Rate of spread •Fuel consumption •Fire intensity	•Physical (soil impacts, emissions) •Ecological (mortality, regeneration, growth)
Weather data	Fuels, topography data	Fire ecology, site quality data

Fire Weather

FWI System

Fire Behaviour

FBP System

Fire Effects

Fire Effects Prediction

CanFIRE Model

CanFIRE Overview

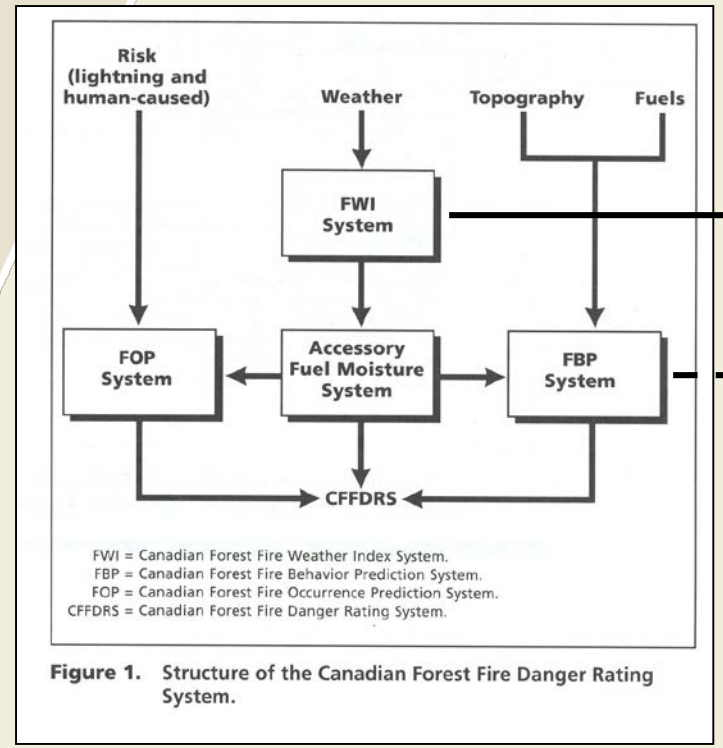


Figure 1. Structure of the Canadian Forest Fire Danger Rating System.

Forest Inventory
or field fuels data

CanFIRE

Fire behaviour:
- rate of spread
- fuel consumption
- fire intensity, type

Physical fire effects:
- depth of burn
- C emissions
- crown scorch ht

Ecological fire effects:
- tree mortality/survival
- regeneration
- postfire succession

Fire Behaviour

FBP System:

- Fire Rate of Spread
- Fuel Consumption
- Head Fire Intensity

Fire Behaviour

FBP System:

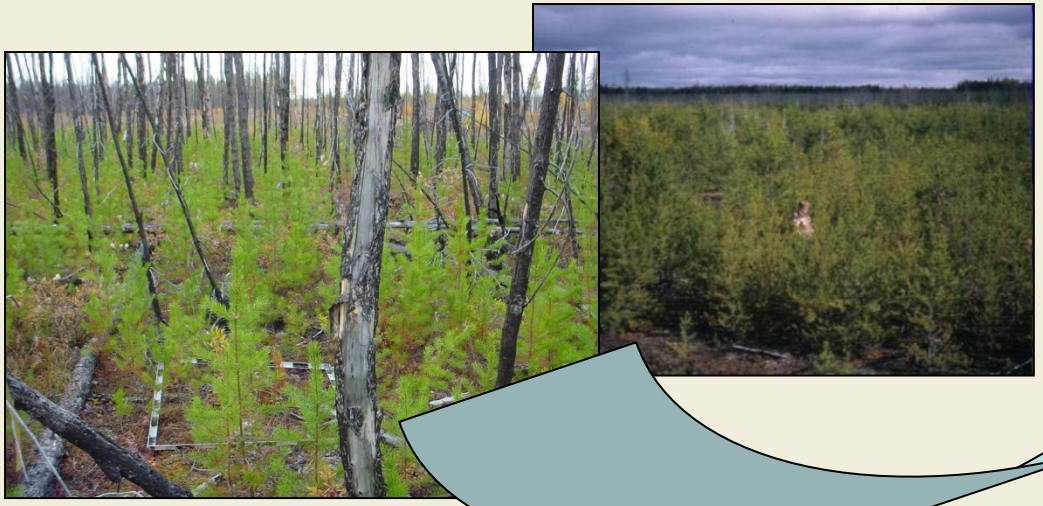
- Fire Rate of Spread
- Fuel Consumption
- Head Fire Intensity

CanFIRE:

- FBP Rate of Spread
- Fuel Consumption – new equations from FBP database and post-wildfire sampling
- Head Fire Intensity – Byram's Equation (I=hwr)

Dynamic Fuels Module

- variable fuel load in different stand components, changing over time
- link to forest inventory or field data



Fuel Type Models

FBP System

- C-1 Spruce lichen-woodland
- C-2 Boreal spruce
- C-3 Mature jack/lodge pole pine
- C-4 Immature jack/lodge pole pine
- C-5 Red and white pine
- C-6 Conifer plantation
- C-7 Ponderosa pine-Douglas fir
- D-1 Leafless aspen
- M-x Boreal mixedwoods (4 types)
- S-x Slash (pine, white spruce-balsam, western cedar-hemlock-fir)
- O-1x Grass

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CanFIRE

- Black spruce
- Jack pine
- White spruce
- Aspen
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- Balsam fir
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CanFIRE

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CanFIRE dll

~ 200 tree species

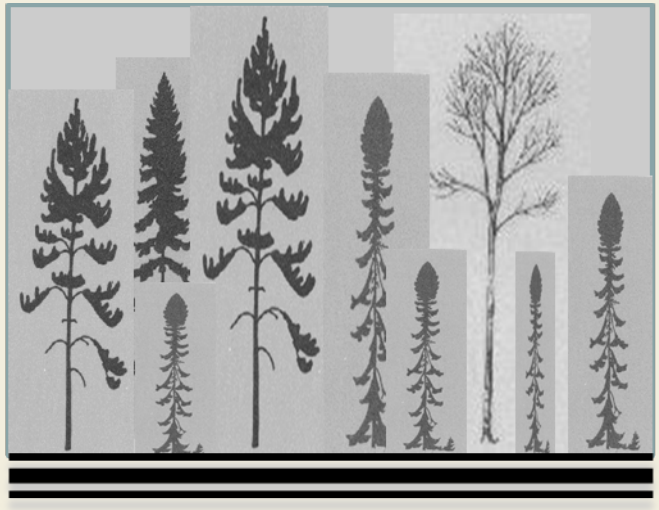
NG-CFFDRS Fuels Module

- NG-CFFDRS emphasis on physical modeling, building on past empirical modeling approach
- NG will maintain CFFDRS modular approach, so will have a single ‘Fuels Module’ for all subsystems (FOP, FBP, etc).
- NG Fuels Module is about modeling fuel structure:
  - quantified and adjustable fuels
  - simulating fuel change over time (dynamic)
  - represent all Canadian ‘fuel types’

NG-CFFDRS Fuels Module

Single standard Fuel Model that is quantified to represent all possible fuel types:

- Forest stand – unit of measure (fuel complex)
- Stand comprised of separate fuel components, each with:
  - fuel load
  - fuel size
  - vertical and horizontal distribution



NG-CFFDRS Fuels Module

Single standard fuel model
with 3 strata:

- Ground (sub-surface) fuels
- Surface fuels
- Crown fuels

Each fuel strata has a separate
fuel consumption model

NG-CFFDRS Fuels Module

Ground fuels criteria:

- LFH, corresponds with:
  - Litter, upper and lower organic layers (duff)
  - FWI fuel moisture codes (FFMC, DMC, DC)
- Depth and load

Used to calculate flaming ground fuel consumption contributing to surface HFI; and to calculate total ground fuel consumption for C emissions

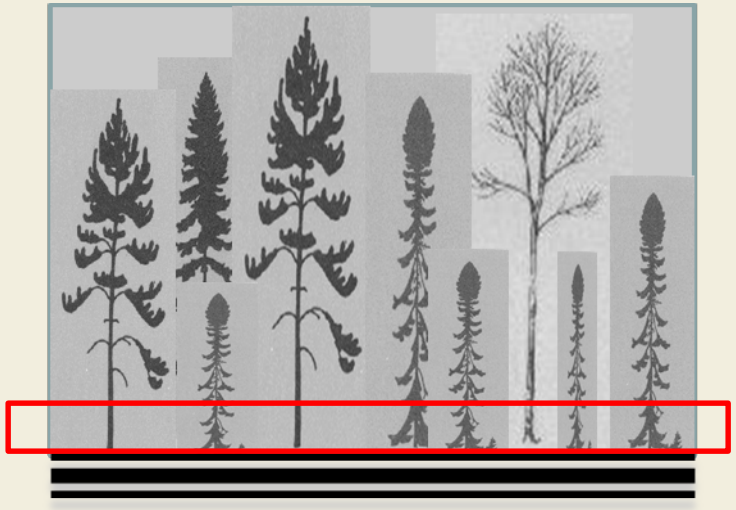
Available data source:
Letang and de Groot. 2012. Can. J. For Res. 42:1551-1565

NG-CFFDRS Fuels Module

Surface fuels criteria:

- Dead Woody Debris (diameter size classes)
- Shrubs*

Used to calculate flaming surface (and ground) fuel consumption to calculate surface HFI and crown fire threshold



Future data source:
Hanes, Letang and de Groot. In prep

CanFIRE Fuel Consumption

Dead and Downed Woody Debris

3 possible calculation methods:

- all size classes (0-1, 1-3, 3-5, 5-7, 7+ cm)
- coarse (7cm+) and medium (<7cm) woody debris
- total woody debris

NG-CFFDRS Fuels Module

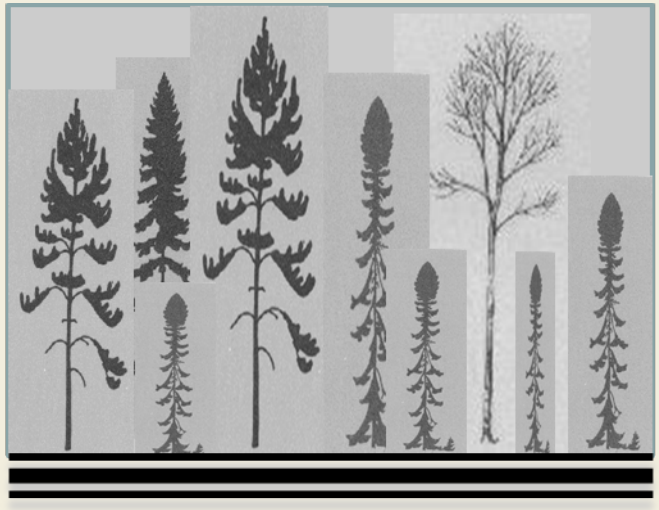
Crown fuels criteria:

- Tree species, height, dbh, stand density
- Separate conifer/broadleaf
- Tree biomass equations for fuel load (foliage, bark, branch, stem)
- Crown fuel consumption equation not applied to hardwoods

NG-CFFDRS Fuels Module

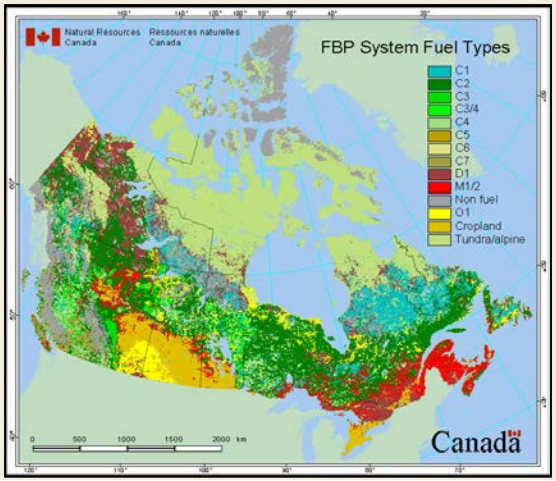
Ground, surface and crown fuel components of the forest stand can be quantified using various data sources:

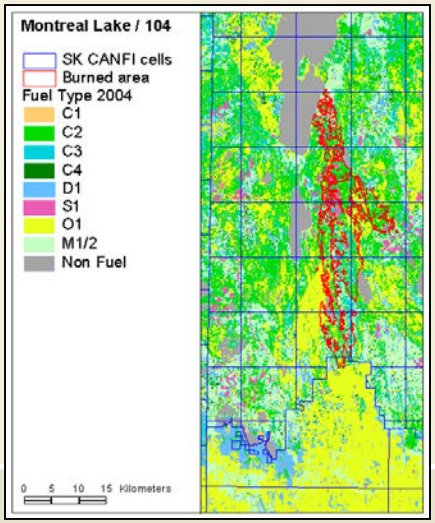
- Forest inventory
- C-pool datasets
- LIDAR
- Other EO and ground-based compilations



CanFIRE Fuels data

Forest Inventory → Spatial fuel load/type databases





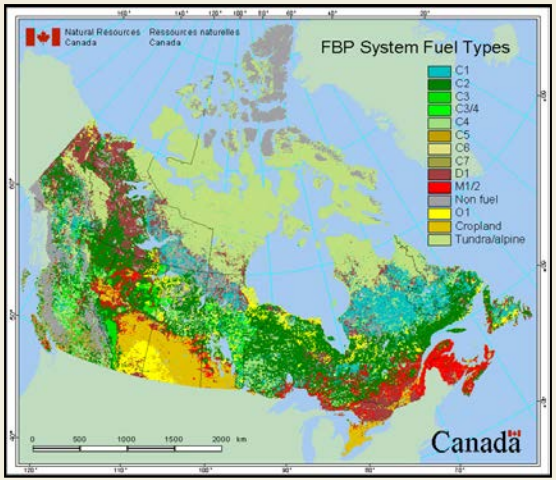
CanFIRE Fuels data

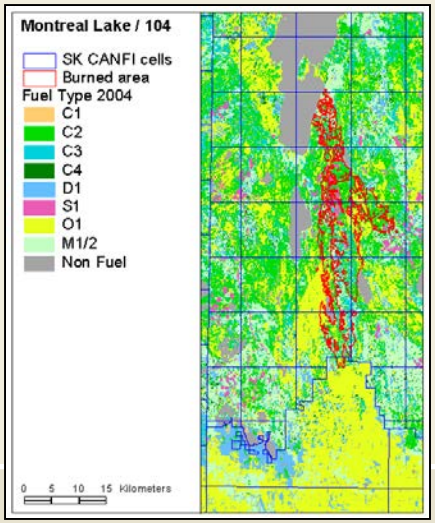
Forest Inventory → Spatial fuel load/type databases

e.g., $Pj_5Sb_3Po_2$
age, site class

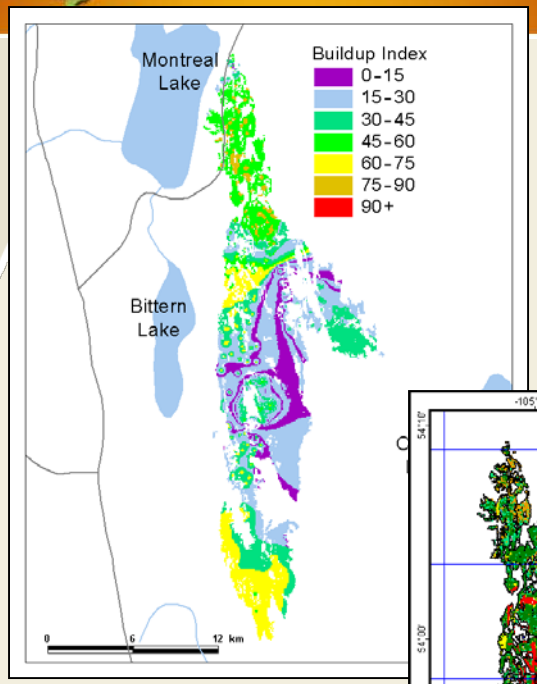
→ Fuels Converter

For each species:
- stocking,ht, dbh, live crown base ht
- fuel load (kg/m^2; wood, bark, branch, foliage)

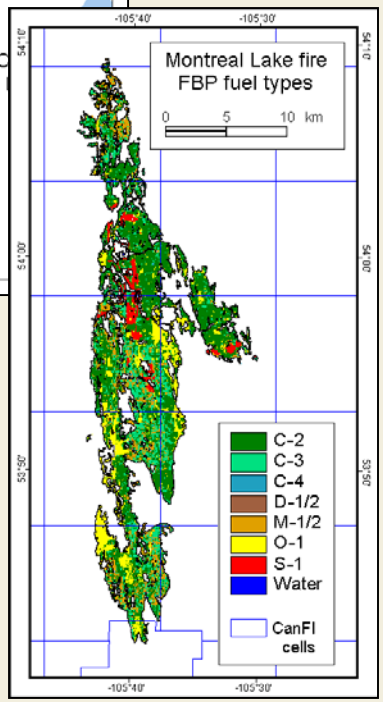




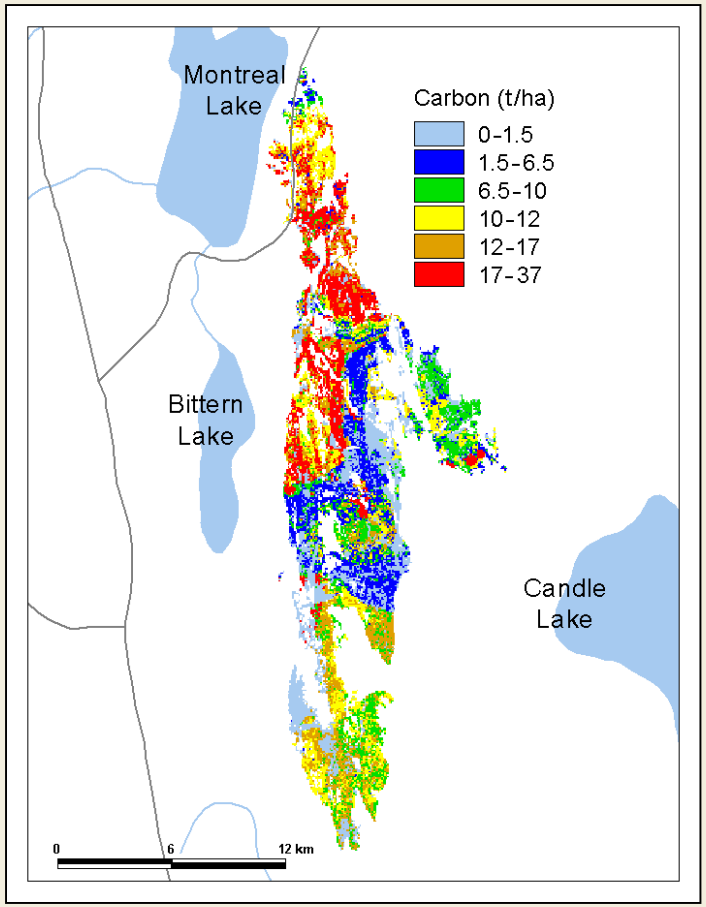
Fire behaviour, fire effects projections



Burning Conditions



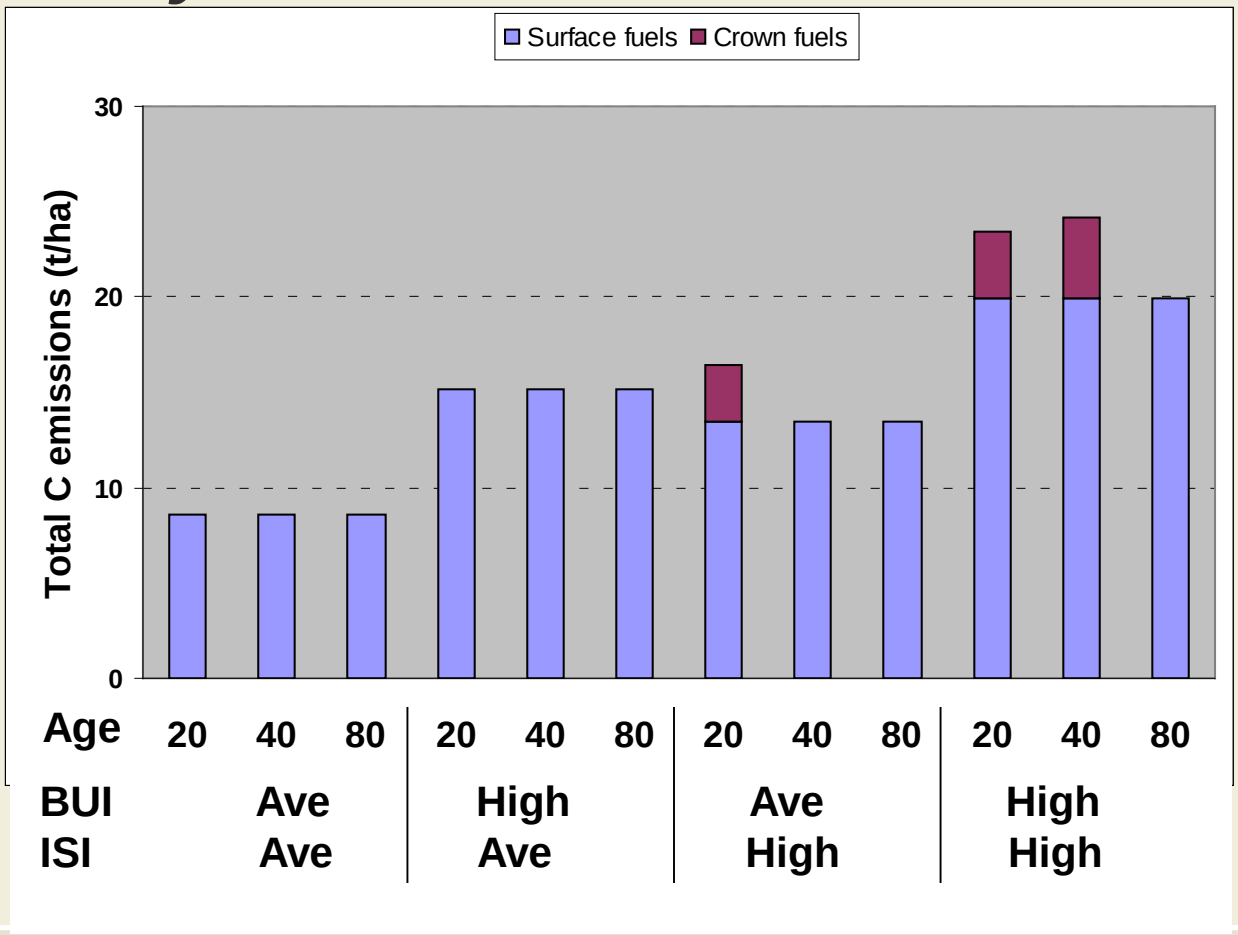
Fuels (load, type)



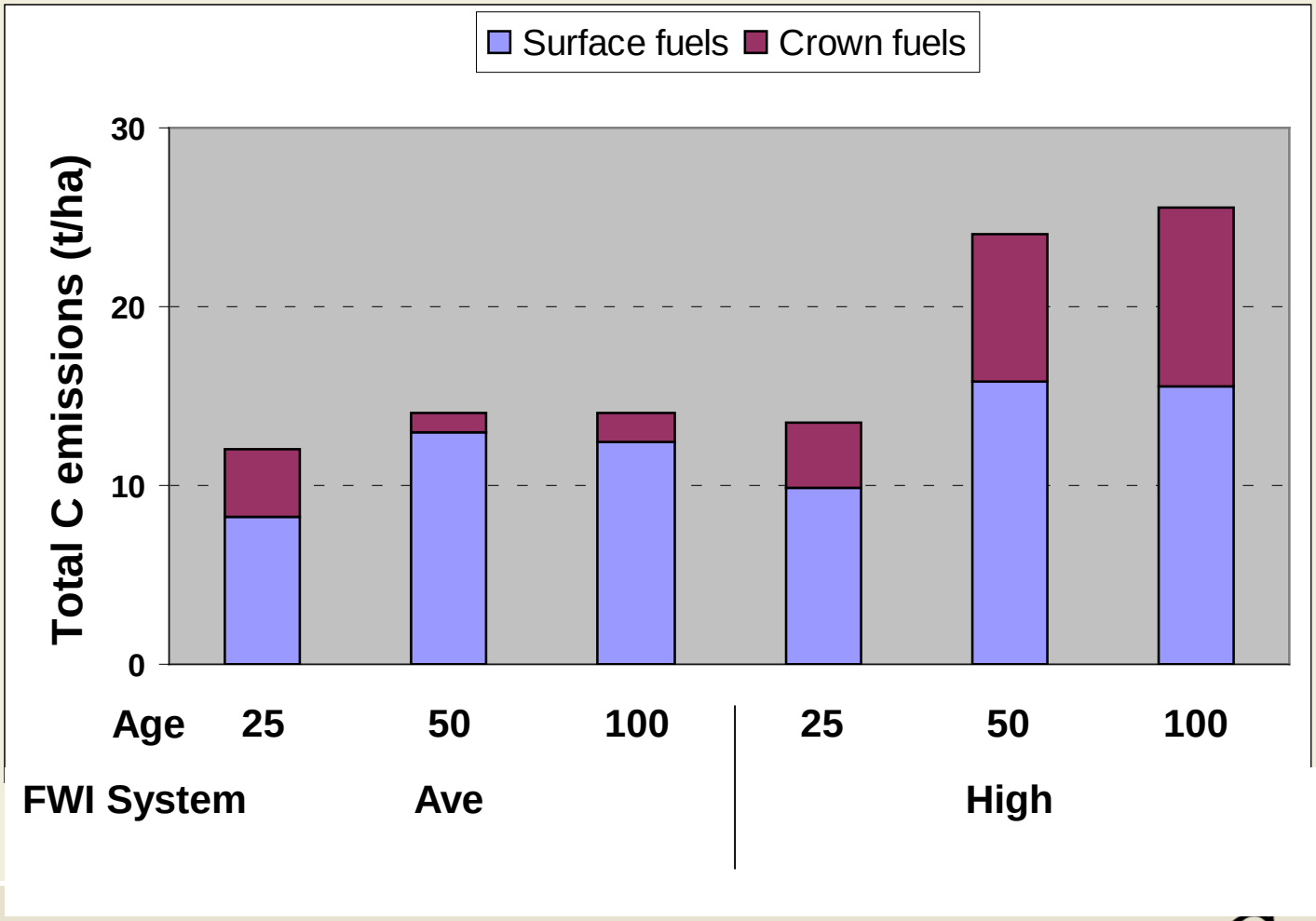
Pinus sylvestris

Pinus banksiana

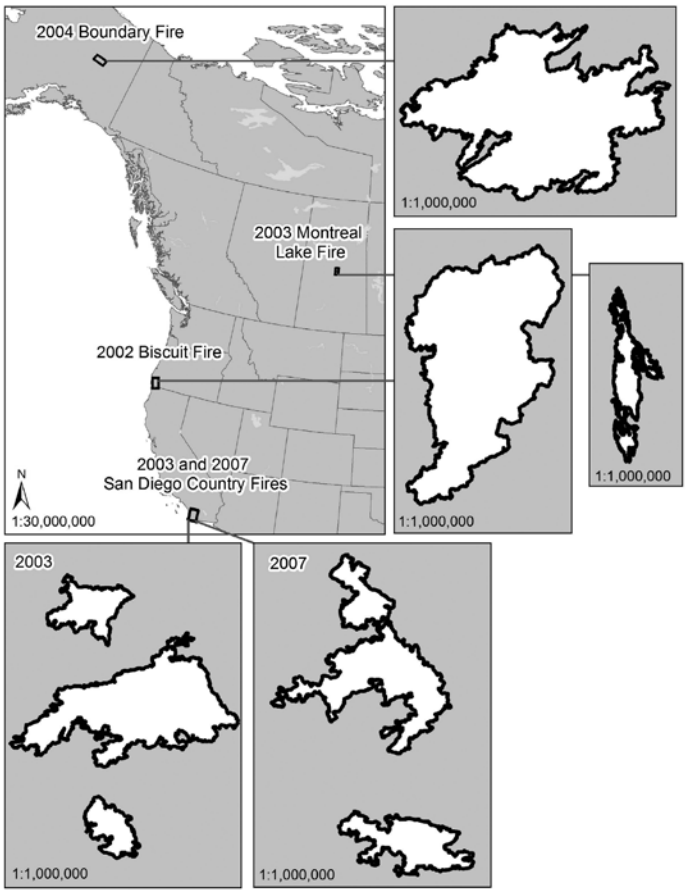
Pinus sylvestris Total C Emissions



Pinus banksiana Total C Emissions



Comparison of North American Fires



- 2002 Biscuit Fire, Oregon
- 2003 Montreal Lake Fire, Saskatchewan
- 2004 Boundary Fire, Alaska

French, N.H.F., de Groot, W.J., Jenkins, L.K., Rogers, B.M., Alvarado, E., Amiro, B., de Jong, B., Goetz, S., Hoy, E., Hyer, E., Keane, R., Law, B.E., McKenzie, D., McNulty, S.G., Ottmar, R., Pérez-Salicrup, D.R., Randerson, J., Robertson, K.M., Turetsky, M., 2011. **Model comparisons for estimating carbon emissions from North American wildland fire**. *J. Geophys. Res*. 116, G00K05.

Biscuit Fire, Oregon 2002

Fuel types:

Douglas-fir -- sugar pine -- tanoak forest

Jeffrey pine -- ponderosa pine -- Douglas-fir -- California black oak forest

Pacific ponderosa pine – Douglas-fir forest

Douglas-fir -- madrone – tanoak forest

Fuel Characteristic Classification System (FCCS):

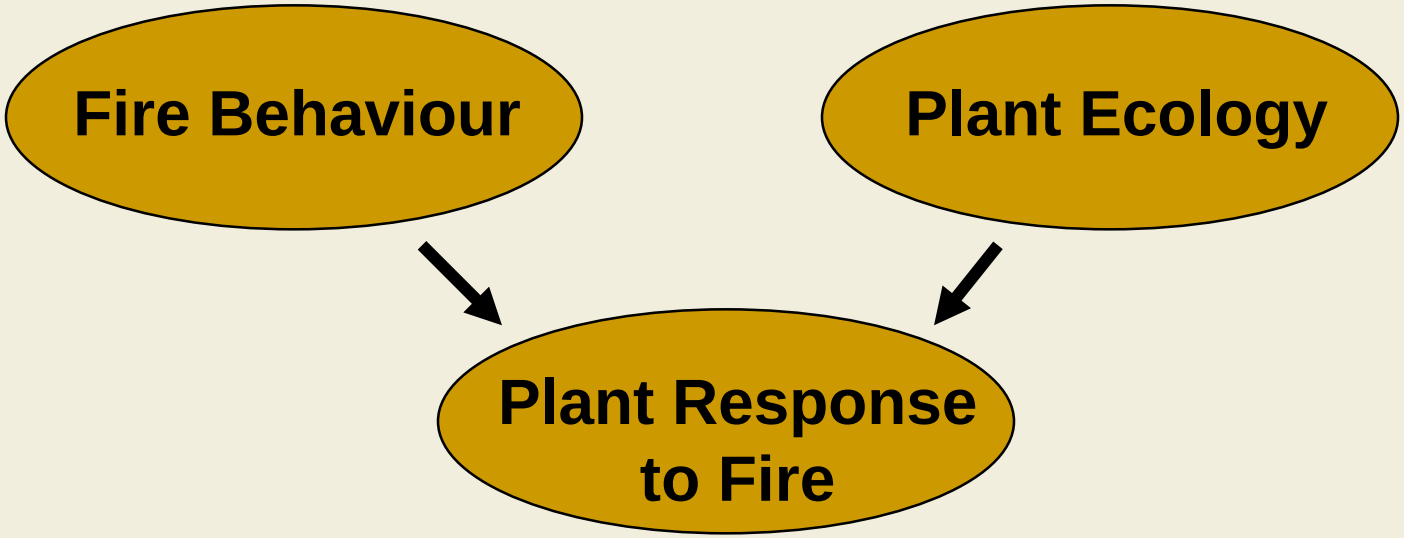
- Forest floor, DWD, tree fuel loads
- tree heights
- LCBH interpreted from ht
- conifer/hardwood (crowning?)

CanFIRE Fire Effects

Physical Effects – crown scorch, depth of burn, smoke/emissions

Ecological effects – mortality, regeneration, species composition, post-fire growth

Simulating interaction of fire and plant ecology (fire ecology)



Fire influences the successional trajectory through its effect on plant survival, regeneration, and post-fire growth response.

Plant Vital Attribute Approach
(Noble and Slatyer 1980)

1. Method of regeneration and reproduction.
2. Ability to establish and grow.
3. Time of critical life stages.

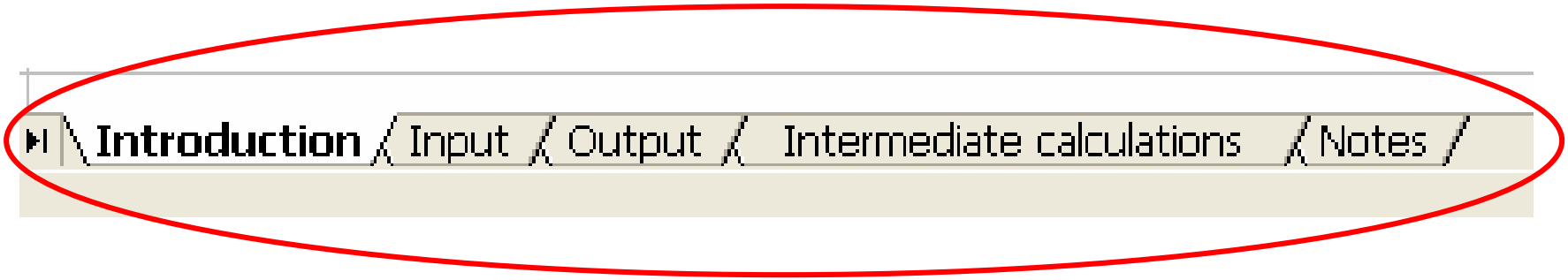
Plant vital attributes

	Pinus banksiana Jack Pine	*Picea mariana* Black Spruce	*Picea glauca* White Spruce	*Populus tremuloides* Aspen	*Betula papyrifera* White Birch	*Abies balsamea* Balsam Fir
Regeneration Method	Canopy-stored seed	Canopy-stored seed	Unstored Seed	Root Suckers	Root Collar Sprouts	Unstored Seed
Fire Resistance	Moderate	Low	Low	Very Low	Very Low	Very Low
Seasonal Fire Effect	None	None	Self-seeds only after Autumn fire	Re-sprouts only after Leaf-flush	Re-sprouts only after Leaf-flush	None
Reproductive Age	20-120 yrs	15-200 yrs	25-250 yrs	5-110 yrs	15-110 yrs	20-140 yrs
Shade Tolerance	Intolerant	Tolerant	Tolerant	Intolerant	Intolerant	Tolerant

CanFIRE Applications

Prescribed Burning

- Detailed fuels data provide more accurate estimation of fire behaviour
- Natural or disturbed stands of any composition
- Use to determine prescription window based on fire behaviour or fire effects criteria


Introduction
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D1

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CANFIRE-Excel v1.1 Model
Release date:
April 6, 2009

Location data

Area burned (ha)	20
Latitude (N)	50
Longitude (W)	118
Elevation (m)	200

FWI System data

FFMC =	
DMC =	
DC =	370
ISI =	7
BUI =	85
FWI =	

Standing Timber Fuel Types (Conifer, Deciduous, Mixedwood)

Stand stocking (0.1-1.0): 1

Species	% Dead balsam fir	Proportion of stand (%)	Age (yrs)	Site class 50 yr Ht (m)	DBH (cm)	Ht (m)	Density (#/ha)	Live crown base height (m)
Jack pine		60	20	14				
Black Spruce		40	10	13				
White Spruce								
Aspen								
White Birch								
Balsam fir (live)								
Dead balsam fir MW								
Total stand		100						

Ground and Surface Fuel data

Forest floor depth (cm):	15

Forest Floor fuel load (kg/m2):

Litter,moss,lichen	0.4
Duff -Ferm.	1.7
Duff - Humus	0.6

Dead woody debris fuel loads (kg/m2):

0-1 cm	0.1
1-3 cm	0.2
3-5 cm	0.4
5-7 cm	0.5
0-7 cm total	1.2
MWD (0-7 cm)	
CWD (7cm+)	0.8

Season of burn data

Julian date of burn:	180
Aspen leaf flush	135
Aspen leaf-fall	273
Understory spring greenup	146
Tree condition	2
Understory condition	2

For Grass (O-1) fuel type only:

Fuel load (kg/m2):	
Degree of curing (%):	
Matted (%)	
Standing (%)	

For Slash (S) fuel types only:

	% composition
Jack pine	
Bl spruce	
Wh spruce	
Balsam fir	
BC Coastal	
Total	0

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5																
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10	Elevation (m)	200			DC =	370		Species	% Dead balsam fir	Proportion of stand (%)	Age (yrs)	Site class 50 yr Ht (m)	DBH (cm)	Ht (m)	Density (#/ha)	base height (m)
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14								Black Spruce		40	10	13				
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16								Aspen								
17	**Ground and Surface Fuel data**							White Birch								
18								Balsam fir (live)								
19	***Forest floor depth (cm):***		15					Dead balsam fir MW								
20																
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31	0-7 cm total		1.2		Tree condition	2								BC Coastal		
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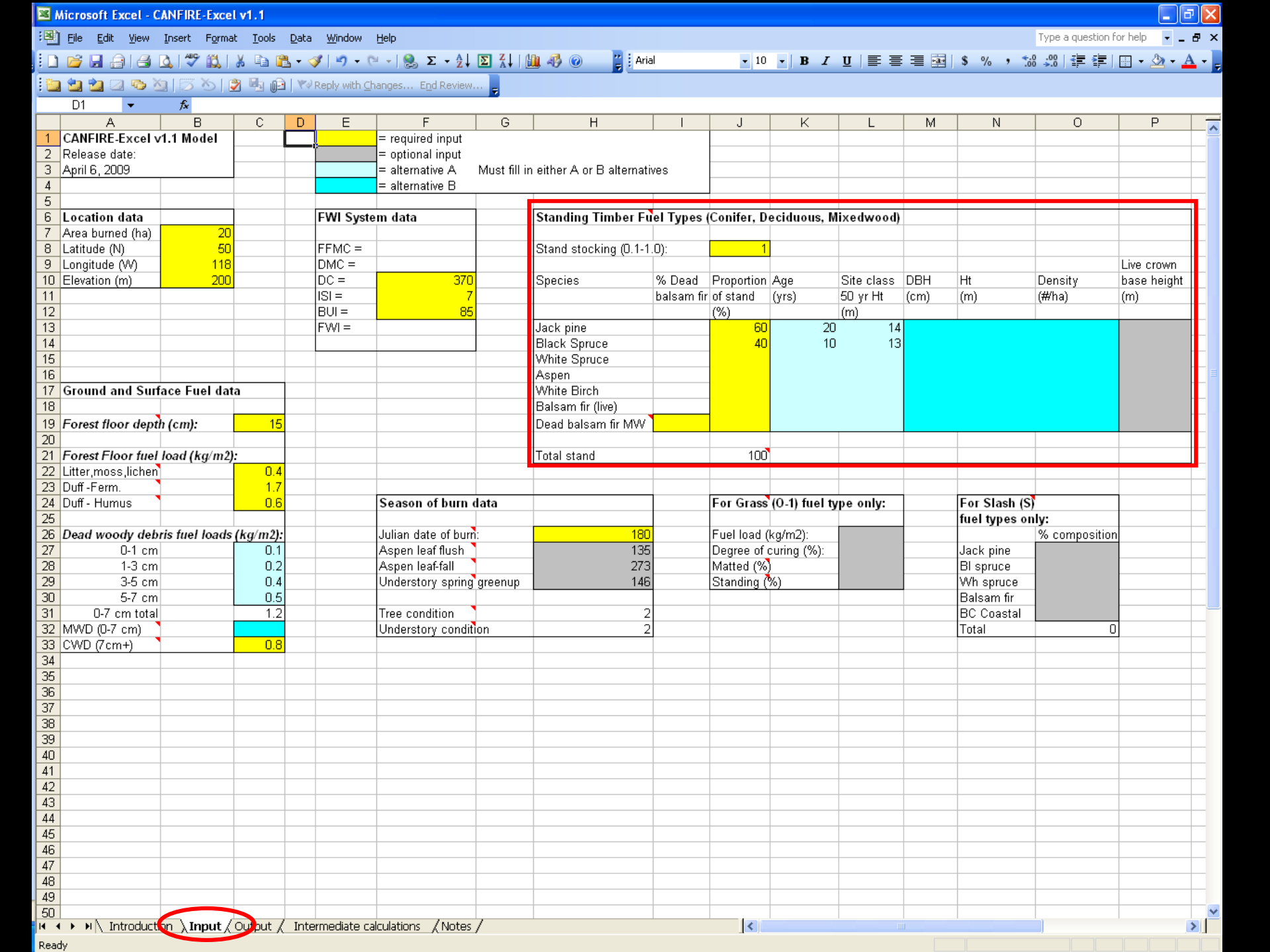

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28	1-3 cm		0.2		Aspen leaf flush			135								
29	3-5 cm		0.4		Aspen leaf-fall			273								
30	5-7 cm		0.5		Understory spring greenup			146								
31	0-7 cm total		1.2													
32	MWD (0-7 cm)				Tree condition			2								
33	CWD (7cm+)		0.8		Understory condition			2								
34																
35																
36																
37																
38																
39																
40																
41																
42																
43																
44																
45																
46																
47																
48																
49																
50																

Standing Timber Fuel Types (Conifer, Deciduous, Mixedwood)

Stand stocking (0.1-1.0): 1

Species	% Dead balsam fir	Proportion of stand (%)	Age (yrs)	Site class 50 yr Ht (m)	DBH (cm)	Ht (m)	Density (#/ha)	Live crown base height (m)
Jack pine		60	20	14				
Black Spruce		40	10	13				
White Spruce								
Aspen								
White Birch								
Balsam fir (live)								
Dead balsam fir MW								
Total stand		100						

For Grass (O-1) fuel type only:

Fuel load (kg/m2):	
Degree of curing (%):	
Matted (%)	
Standing (%)	

For Slash (S) fuel types only:

	% composition
Jack pine	
Bl spruce	
Wh spruce	
Balsam fir	
BC Coastal	
Total	0

Introduction | Input | Output | Intermediate calculations | Notes

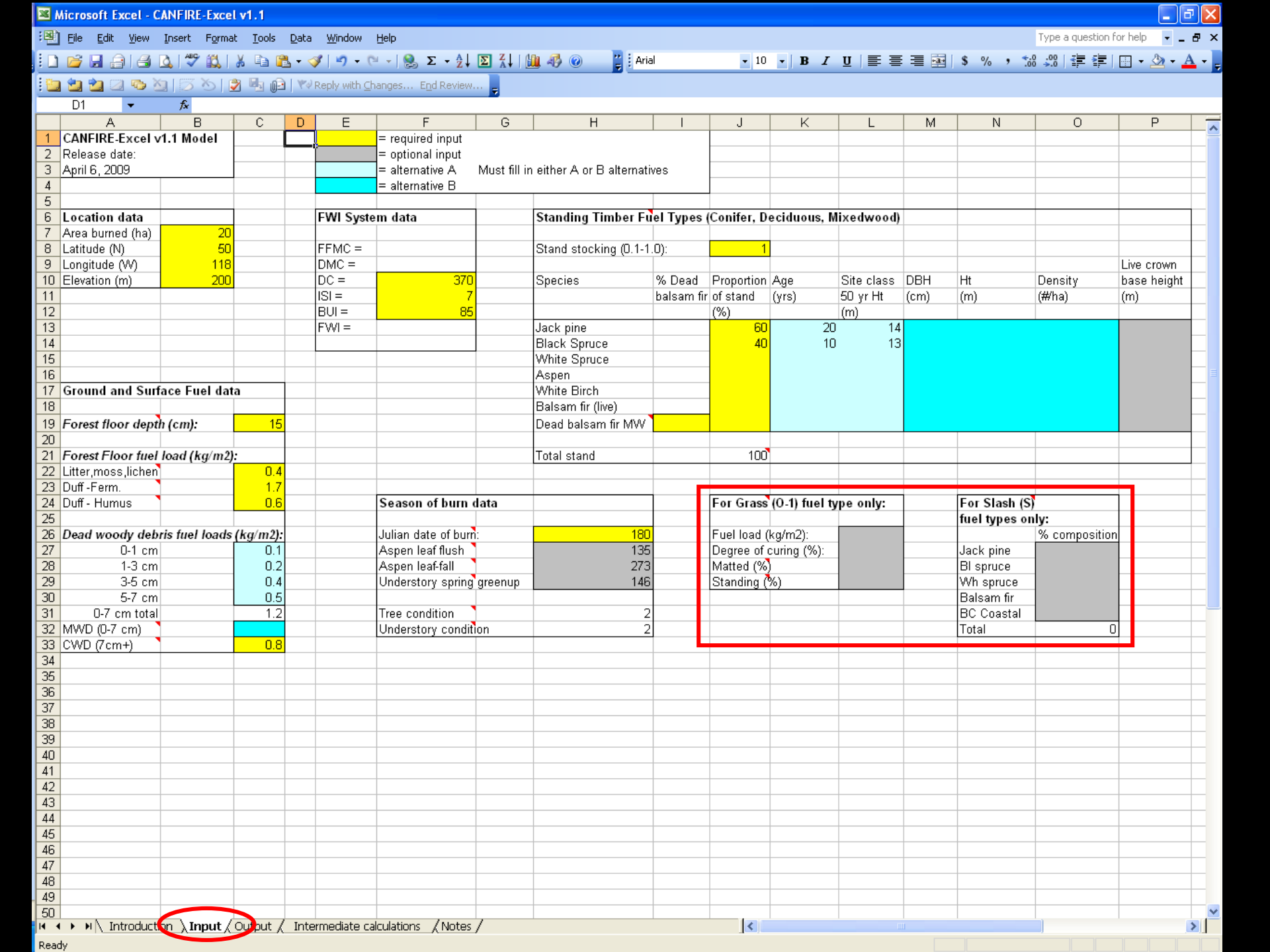
Ready

bdegroot:
Only fill in data for species that are present in the stand

Standing Timber Fuel Types (Conifer, Deciduous, Mixedwood)

Stand stocking (0.1-1.0): 1

Species	% Dead balsam fir	Proportion of stand (%)	Age (yrs)	Site class 50 yr Ht (m)	DBH (cm)	Ht (m)	Density (#/ha)	Live crown base height (m)
Jack pine		60	20	14				
Black Spruce		40	10	13				
White Spruce								
Aspen								
White Birch								
Balsam fir (live)								
Dead balsam fir MW								
Total stand		100						



Microsoft Excel - CANFIRE-Excel v1.1

File Edit View Insert Format Tools Data Window Help

Type a question for help

Arial 10

Reply with Changes... End Review...

D1

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	**CANFIRE-Excel v1.1 Model**					= required input										
2	Release date:					= optional input										
3	April 6, 2009					= alternative A	Must fill in either A or B alternatives									
4						= alternative B										
5																
6	**Location data**				**FWI System data**			**Standing Timber Fuel Types (Conifer, Deciduous, Mixedwood)**								
7	Area burned (ha)	20														
8	Latitude (N)	50			FFMC =			Stand stocking (0.1-1.0):		1						
9	Longitude (W)	118			DMC =											Live crown
10	Elevation (m)	200			DC =	370		Species	% Dead	Proportion	Age	Site class	DBH	Ht	Density	base height
11					ISI =	7			balsam fir	of stand	(yrs)	50 yr Ht	(cm)	(m)	(#/ha)	(m)
12					BUI =	85				(%)		(m)				
13					FWI =			Jack pine		60	20	14				
14								Black Spruce		40	10	13				
15								White Spruce								
16								Aspen								
17	**Ground and Surface Fuel data**							White Birch								
18								Balsam fir (live)								
19	***Forest floor depth (cm):***		15					Dead balsam fir MW								
20																
21	***Forest Floor fuel load (kg/m2):***							Total stand		100						
22	Litter,moss,lichen		0.4													
23	Duff -Ferm.		1.7													
24	Duff - Humus		0.6													
25																
26	***Dead woody debris fuel loads (kg/m2):***					**Season of burn data**										
27	0-1 cm		0.1			Julian date of burn:	180									
28	1-3 cm		0.2			Aspen leaf flush	135									
29	3-5 cm		0.4			Aspen leaf-fall	273									
30	5-7 cm		0.5			Understory spring greenup	146									
31	0-7 cm total		1.2													
32	MWD (0-7 cm)					Tree condition	2									
33	CWD (7cm+)		0.8			Understory condition	2									
34																
35																
36																
37																
38																
39																
40																
41																
42																
43																
44																
45																
46																
47																
48																
49																
50																

For Grass (O-1) fuel type only:	
Fuel load (kg/m2):	
Degree of curing (%):	
Matted (%)	
Standing (%)	

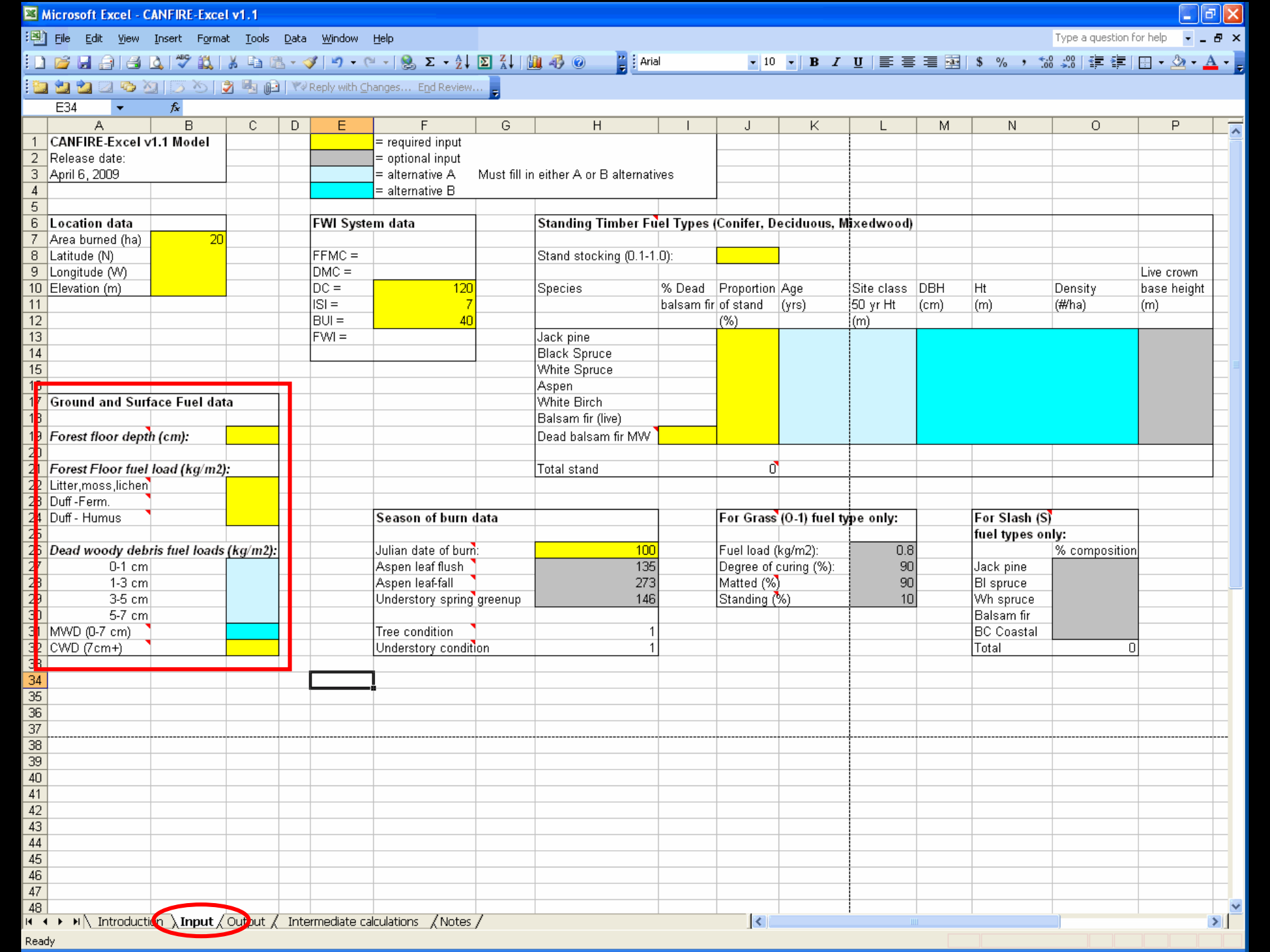
For Slash (S) fuel types only:	
	% composition
Jack pine	
Bl spruce	
Wh spruce	
Balsam fir	
BC Coastal	
Total	0

Introduction | Input | Output | Intermediate calculations | Notes

Ready

For Grass (O-1) fuel type only:	
Fuel load (kg/m2):	
Degree of curing (%):	
Matted (%)	
Standing (%)	

For Slash (S) fuel types only:	
	% composition
Jack pine	
Bl spruce	
Wh spruce	
Balsam fir	
BC Coastal	
Total	0


Microsoft Excel - CANFIRE-Excel v1.1
File Edit View Insert Format Tools Data Window Help
Type a question for help
Arial 10
Reply with Changes... End Review...
E34
CANFIRE-Excel v1.1 Model
Release date:
April 6, 2009
= required input
= optional input
= alternative A
= alternative B
Must fill in either A or B alternatives
Location data
Area burned (ha) 20
Latitude (N)
Longitude (W)
Elevation (m)
FWI System data
FFMC =
DMC =
DC = 120
ISI = 7
BUI = 40
FWI =
Standing Timber Fuel Types (Conifer, Deciduous, Mixedwood)
Stand stocking (0.1-1.0):
Species
% Dead balsam fir
Proportion of stand (%)
Age (yrs)
Site class 50 yr Ht (m)
DBH (cm)
Ht (m)
Density (#/ha)
Live crown base height (m)
Jack pine
Black Spruce
White Spruce
Aspen
White Birch
Balsam fir (live)
Dead balsam fir MW
Total stand 0
Ground and Surface Fuel data
Forest floor depth (cm):
Forest Floor fuel load (kg/m2):
Litter,moss,lichen
Duff -Ferm.
Duff - Humus
Dead woody debris fuel loads (kg/m2):
0-1 cm
1-3 cm
3-5 cm
5-7 cm
MWD (0-7 cm)
CWD (7cm+)
Season of burn data
Julian date of burn: 100
Aspen leaf flush 135
Aspen leaf-fall 273
Understory spring greenup 146
Tree condition 1
Understory condition 1
For Grass (O-1) fuel type only:
Fuel load (kg/m2): 0.8
Degree of curing (%): 90
Matted (%) 90
Standing (%) 10
For Slash (S) fuel types only:
% composition
Jack pine
Bl spruce
Wh spruce
Balsam fir
BC Coastal
Total 0
Introduction
Input
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Notes
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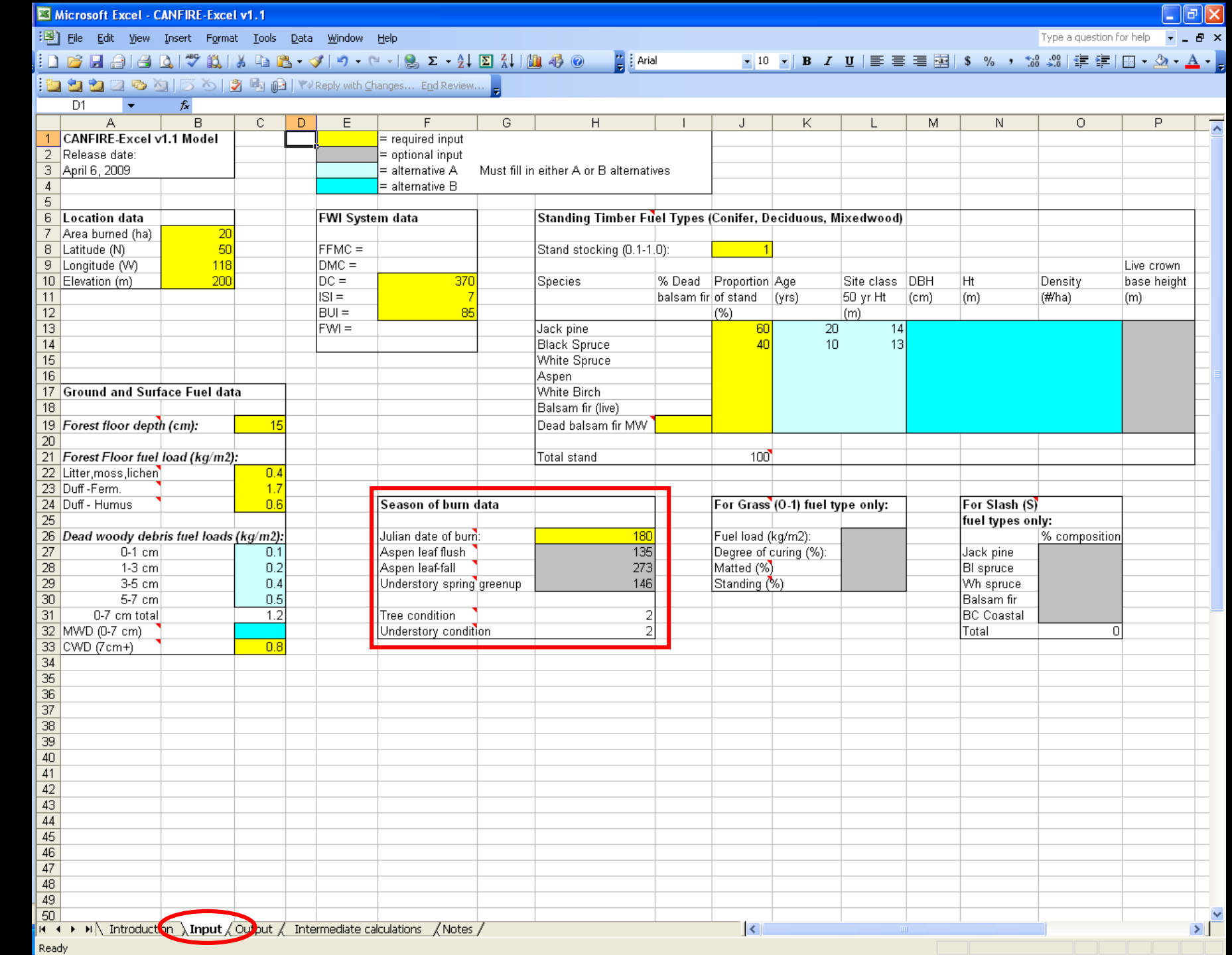
Ground and Surface Fuel data	
Forest floor depth (cm):	
Forest Floor fuel load (kg/m2):	
Litter,moss,lichen	
Duff -Ferm.	
Duff - Humus	
Dead woody debris fuel loads (kg/m2):	
0-1 cm	
1-3 cm	
3-5 cm	
5-7 cm	
MWD (0-7 cm)	
CWD (7cm+)	


Microsoft Excel - CANFIRE-Excel v1.1
File Edit View Insert Format Tools Data Window Help
Type a question for help
Arial 10
Reply with Changes... End Review...
D1
CANFIRE-Excel v1.1 Model
Release date:
April 6, 2009
= required input
= optional input
= alternative A Must fill in either A or B alternatives
= alternative B
Location data
Area burned (ha) 20
Latitude (N) 50
Longitude (W) 118
Elevation (m) 200
FWI System data
FFMC =
DMC =
DC = 370
ISI = 7
BUI = 85
FWI =
Standing Timber Fuel Types (Conifer, Deciduous, Mixedwood)
Stand stocking (0.1-1.0): 1
Species | % Dead balsam fir | Proportion of stand (%) | Age (yrs) | Site class 50 yr Ht (m) | DBH (cm) | Ht (m) | Density (#/ha) | Live crown base height (m)
Jack pine 60 20 14
Black Spruce 40 10 13
White Spruce
Aspen
White Birch
Balsam fir (live)
Dead balsam fir MW
Total stand 100
Ground and Surface Fuel data
Forest floor depth (cm): 15
Forest Floor fuel load (kg/m2):
Litter,moss,lichen 0.4
Duff -Ferm. 1.7
Duff - Humus 0.6
Dead woody debris fuel loads (kg/m2):
0-1 cm 0.1
1-3 cm 0.2
3-5 cm 0.4
5-7 cm 0.5
0-7 cm total 1.2
MWD (0-7 cm)
CWD (7cm+) 0.8
Season of burn data
Julian date of burn: 180
Aspen leaf flush 135
Aspen leaf-fall 273
Understory spring greenup 146
Tree condition 2
Understory condition 2
For Grass (O-1) fuel type only:
Fuel load (kg/m2):
Degree of curing (%):
Matted (%)
Standing (%)
For Slash (S) fuel types only:
% composition
Jack pine
Bl spruce
Wh spruce
Balsam fir
BC Coastal
Total 0
Introduction Input Output Intermediate calculations Notes
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Season of burn data	
Julian date of burn:	180
Aspen leaf flush	135
Aspen leaf-fall	273
Understory spring greenup	146
Tree condition	2
Understory condition	2

Microsoft Excel - CANFIRE-Excel v1.1

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H32

CANFIRE-Excel v1.1 Model
Release date:
April 6, 2009

Fire behaviour summary

Surface fuel consumption (kg/m2)			ROS	Surface	Crown	Crown	Total	Final	Depth
Forest floor (cured grass and LFH)	Dead woody debris	Total surface	(m/min)	HFI kW/m	fire? 1=yes 0=no	FC kg/m2	FC kg/m2	HFI (kW/m)	of Burn (cm)
3.18	**1.07**	**4.25**	**11.9**	**7894**	**1**	**0.64**	**4.89**	**10063**	**5.9**

Fuel Consumption (kg/m2)

Surface		Flaming	Smouldering	Total
	Grass	0.00	0.00	**0.00**
	Litter	1.90	0.10	**2.00**
	Upper Duff	0.10	0.90	**1.00**
	Lower Duff	0.00	0.18	**0.18**
	Total FF	2.00	1.18	**3.18**
	DWD, Slash	0.21	0.85	**1.07**
	Total Surface	2.21	2.04	**4.25**
Crown	**Jack pine**	0.61	0.03	**0.64**
	Bl. spruce	0.00	0.00	**0.00**
	Wh. spruce	0.00	0.00	**0.00**
	Aspen	0.00	0.00	**0.00**
	Wh. Birch	0.00	0.00	**0.00**
	Balsam fir	0.00	0.00	**0.00**
	Dead Balsam fir	0.00	0.00	**0.00**
	Total crown	0.61	0.03	**0.64**
Total		2.82	2.07	**4.89**

Medium Woody Debris total: 1.1
Coarse Woody Debris total: 2

Emissions Rate (t/ha)					Total Emissions (tonnes)
Emission species	Forest floor	DWD	Crown	**Total**	
Total C	15.90	5.34	3.20	**24.44**	**488.9**
PM (100)	0.43	0.17	0.08	**0.68**	**13.5**
PM10	0.29	0.12	0.05	**0.46**	**9.2**
PM2.5	0.24	0.10	0.04	**0.38**	**7.6**
CO	2.13	0.99	0.31	**3.43**	**68.6**
CO2	38.70	12.46	8.03	**59.20**	**1184.0**
CH4	0.09	0.05	0.01	**0.16**	**3.1**
NMHC	0.11	0.05	0.02	**0.17**	**3.5**

Introduction / Input / **Output** / Intermediate calculations / Notes /

Ready

Fire behaviour summary

Surface fuel consumption (kg/m2)			ROS	Surface	Crown	Crown	Total	Final	Depth
Forest floor (cured grass and LFH)	Dead woody debris	Total surface	(m/min)	HFI kW/m	fire? 1=yes 0=no	FC kg/m2	FC kg/m2	HFI (kW/m)	of Burn (cm)
3.18	**1.07**	**4.25**	**11.9**	**7894**	**1**	**0.64**	**4.89**	**10063**	**5.9**

	Fuel Consumption (kg/m2)			
Surface		Flaming	Smouldering	Total
	Grass	0.00	0.00	**0.00**
	Litter	1.90	0.10	**2.00**
	Upper Duff	0.10	0.90	**1.00**
	Lower Duff	0.00	0.18	**0.18**
	Total FF	2.00	1.18	**3.18**
	DWD, Slash	0.21	0.85	**1.07**
	Total Surface	2.21	2.04	**4.25**
Crown	**Jack pine**	0.61	0.03	**0.64**
	Bl. spruce	0.00	0.00	**0.00**
	Wh. spruce	0.00	0.00	**0.00**
	Aspen	0.00	0.00	**0.00**
	Wh. Birch	0.00	0.00	**0.00**
	Balsam fir	0.00	0.00	**0.00**
	Dead Balsam fir	0.00	0.00	**0.00**
	Total crown	0.61	0.03	**0.64**
Total		2.82	2.07	**4.89**

Medium Woody Debris total:	1.1
Coarse Woody Debris total:	2

Emissions Rate (t/ha)					Total Emissions (tonnes)
Emission species	Forest floor	DWD	Crown	**Total**	
Total C	15.90	5.34	3.20	**24.44**	**488.9**
PM (100)	0.43	0.17	0.08	**0.68**	**13.5**
PM10	0.29	0.12	0.05	**0.46**	**9.2**
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CO	2.13	0.99	0.31	**3.43**	**68.6**
CO2	38.70	12.46	8.03	**59.20**	**1184.0**
CH4	0.09	0.05	0.01	**0.16**	**3.1**
NMHC	0.11	0.05	0.02	**0.17**	**3.5**

Fire ecology summary

Species	Tree Mortality (%)	Potential Seedlings (#/ha)	Actual Regen (#/ha)	Potential Sprouts
Jack pine	100	4222	4222	
Bl spruce	100	11016	11016	
Wh spruce	100	1381	1381	
Aspen	100		10610	13724
Wh birch	100	1278	1555	277
Balsam fir	100	0	0	

Wh Spruce seed ripe? 1

CanFIRE Inputs

Stand data:

- Species composition
- Age
- Forest floor fuel load
- Dead woody debris fuel load
- FWI System values

(Optional: site class, DBH, ht, density, forest floor depth)

CanFIRE Outputs

Fire behaviour:

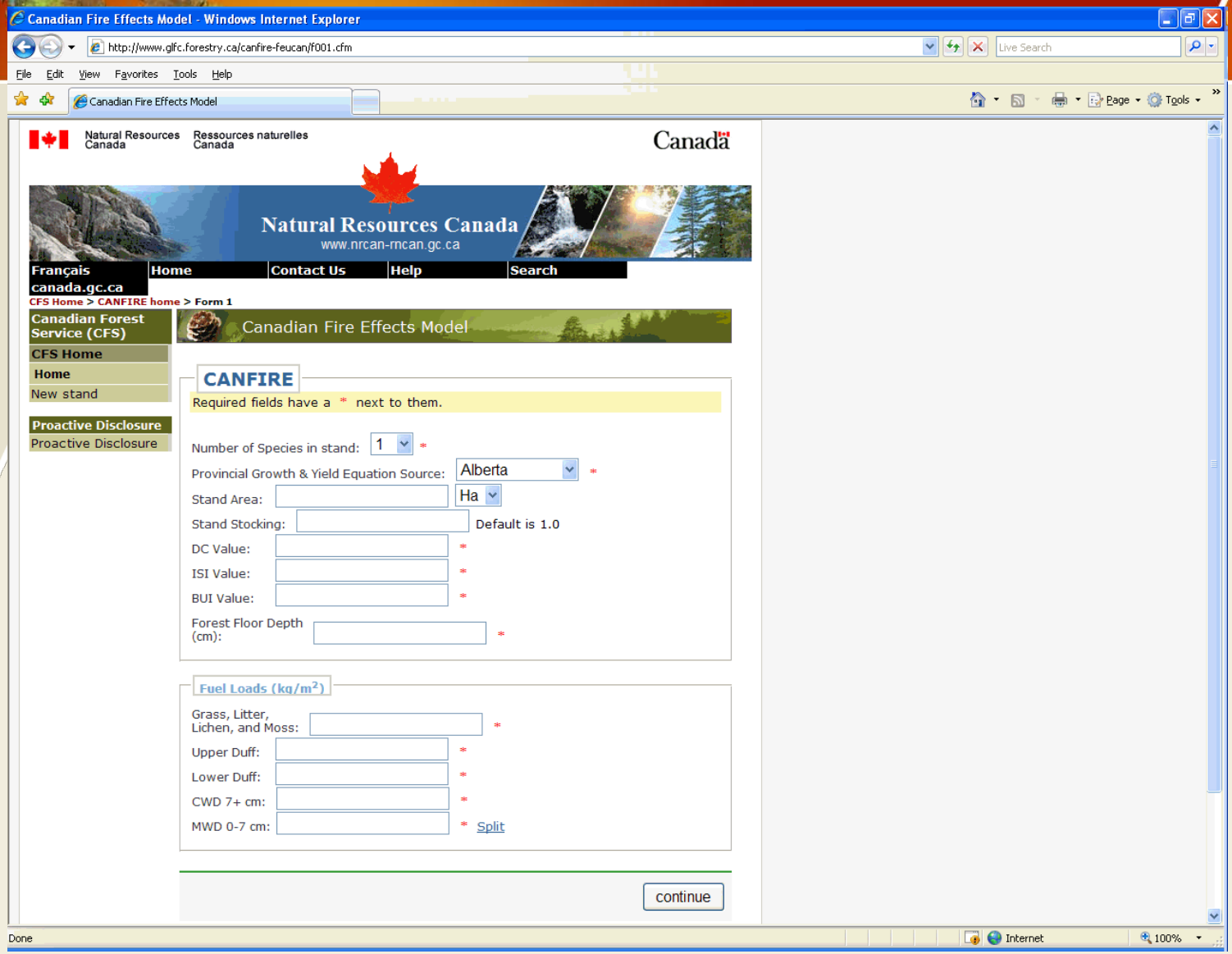
- ROS, fuel consumption, head fire intensity

Immediate fire effects:

- Mortality rate, crown scorch
- Forest floor depth of burn
- Emissions rates
- Regeneration species and density

Long-term changes:

- Post-fire succession (seedling establishment and competition)
- Landscape - fire regime dynamics


Canadian Fire Effects Model - Windows Internet Explorer
http://www.glfc.forestry.ca/canfire-feucan/f001.cfm
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Natural Resources Canada
Ressources naturelles Canada
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Natural Resources Canada
www.nrcan-rncan.gc.ca
Français
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CFS Home > CANFIRE home > Form 1
Canadian Forest Service (CFS)
CFS Home
Home
New stand
Proactive Disclosure
Proactive Disclosure
Canadian Fire Effects Model
CANFIRE
Required fields have a * next to them.
Number of Species in stand: 1 *
Provincial Growth & Yield Equation Source: Alberta *
Stand Area: Ha
Stand Stocking: Default is 1.0
DC Value: *
ISI Value: *
BUI Value: *
Forest Floor Depth (cm): *
Fuel Loads (kg/m2)
Grass, Litter, Lichen, and Moss: *
Upper Duff: *
Lower Duff: *
CWD 7+ cm: *
MWD 0-7 cm: * Split
continue
Done
Internet
100%