Crown Fire – LCD – 10/19/2022

Fire Recurrence

Source data used:

H_FIRE_PLY_polygon.shp (BC_FireHistory) Acquired from BC Data Catalog (https://catalogue.data.gov.bc.ca/dataset/fire-perimeters-historical) InterAgencyFirePerimeterHistory_All_Years_View.shp (US_Interagency_FireHistory) Acquired from NIFC (AB_FireHistory)

(see: C:\GNLCC_Admin\Landscape_Conservation_Design\CrownofContinent\PHASE_2\Cost_Layers\ Fire\CrownLCD_Fire_Sources.xlsx)

Step 1 – Clips:

In ArcMap: Add Data: R:\Base_Data\CROWN_LCD_Phase2\Project_Area\Crown_LCD_PlanningUnit_Mask.shp

1A – Clip H_FIRE_PLY_polygon.shp to Crown_LCD_Planning_Unit_Mask.shp;

Environments/Output Coordinates: Same as Layer "Crown_LCD_Planning_Unit_Mask"

1B - Clip InterAgencyFirePerimeterHistory_All_Years_View.shp to Crown_LCD_Planning_Unit_Mask.shp;

Environments/Output Coordinates: Same as Layer "Crown_LCD_Planning_Unit_Mask"

1C – Clip 9 [Alberta source data] to Crown_LCD_Planning_Unit_Mask.shp;

Environments/Output Coordinates: Same as Layer "Crown_LCD_Planning_Unit_Mask"

Step 2 – Standardize Attributes:

AB_FireHistory: Add Field: Fire_Year (ShortInt); Rt click Fire_Year field/Field Calculator; Fire_Year = Year; Add Field: Size_HA (Double); Rt click Size_HA field/Field Calculator Size_HA = Hectares_U

InterAgencyFirePerimeterHistory_All_Years_View.shp Add Field: Size_HA (Double); GIS_Acres Rt click Size_HA field/Field Calculator Size_HA = GIS_Acres * 2.41.

Step 3 – Merge

BC_FireHistory.shp, AB_FireHistory.shp and US_Interagency_FireHistory.shp to create Crown_FireHistory.shp Resulting in 4,576 distinct polygons dating from 1919 to 2020.





Step 4 – Identify areas with recurring wildfire since 1990

Select from Crown_FireHistory.shp where Fire_Year >= 1990. Use Count Overlapping Features tool to determine the area of multiple polygon overlaps and multiple instances of overlaps. In ArcGIS Pro, on the Analysis tab, click Tools and search for/open the Count Overlapping Features tool. Input Features = Crown_FireHistory.shp; Output Feature Class = Recurring_Fire_Crown_1990-2021.shp. Click Run.

Step 5 – Score recurring fires

In order to score fire history relative to the threat recurring fires, start with Recurring_Fire_Crown_1990-2021.shp. Add Field: Score (ShortInt). Select from overlaps field where value >= 5; use Field calculator to score selected features 7000. Clear selection. Select from overlaps field where value >= 2 AND value < 5. Use Field calculator to score selected features 3000.

Select by Attributes	×
Enter a WHERE clause to select records in the table window.	
Method : Create a new selection	~
"FID" "Id" "objectid" "overlaps" "Score"	
- <> Like > >= And < <= Or % O Not	
Is In Null Get Unique Values Go To:	
SELECT * FROM Recurring_Fire_Crown_1990-2021 WHERE:	
"overlaps" >= 2 AND "overlaps" < 5	~
Clear Verify Help Load Save.	
Apply Close	

Clear selection.

Use Select by Location to select Crown_FireHistory.shp features that intersect with Recurring_Fire_Crown_1990-2021.shp:



Open Attribute Table for Crown_FireHistory.shp; in Table Options/Switch Selection. Closr Table, rt click Crown_FireHistory.shp/Data/Export and export (selected features) to R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\Crown_OneFire_only.shp. Clear selection.

Open attribute table of Crown_OneFire_only.shp. Add Field: Score (ShortInt) and use Field Calculator to make Score = 1000 for all records.

Field Calculator	×	
Parser VB Script O Python Fields:	Type: Functions:	
FID Shape FIRE_YEAR FIRE_CAUSE SIZE_HA Score	© Number Abs() Abs() ○ String Exp() ○ Date Fix() Int() Log() Sin() Sir() Tan()	
Show Codeblock	* / & + - =	
1000	~	
About calculating fields	Clear Load Save	
	OK Cancel	

Select from Crown_OneFire_only.shp where Fire_year >= 1990 and create layer from selected feature. Rt click/Data/Export to R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\Crown_OneFire_only_from1990.shp. Clear selection.

Step 6 – Feature to Raster

Add R:\Base_Data\CROWN_LCD_Phase2\Project_Area\P2_Snap_Grid\p2_snapgrid to project. GO to Geoprocessing/Environments.../Processing Extent/Snap Raster and select p2_snapgrid.

Feature to Raster (2):

Procentationer Output raster Recording, Free, Conver, 1999-2021 The output raster dataset to be canded. When not saving to a first output raster for the first output raster dataset to be canded. When not saving to a first output raster for the first	🖇 Feature to Raster	- 🗆 X
OK Cancel Feture to Rate Input features Coron, OneFrie, only, from 1990 Score Score Caput rater R: Stase_Data (ROWN_LCD_Phase2/Project_Area@2_Snap_Grid [p2_grappid] Fit Sease_Data (ROWN_LCD_Phase2/Project_Area@2_Snap_Grid [p2_grappid]	Input features [Recurring_Fire_Crown_1990-2021 Field Score Output: raster [R:Base_Data/CROWN_LCD_Phase2!Cost_Layers_P2!Fire!yecur_fire Output: cell size (optional) [R:Base_Data/CROWN_LCD_Phase2!Project_Area\P2_Snap_Grid!p2_snapgrid	Cutput raster The output raster dataset to be created. When not saving to a geodatabase, specify tiff or a TIFF file format, CRF for CRF file format, img for an ERDAS IMAGINE file format, or no extension for an Esri Grid raster format.
	OK Cancel Ef Feature to Raster Input features Input features <td>nvironments < Hide Help Tool Help</td>	nvironments < Hide Help Tool Help
· · · · ·		
OK Cancel Environments << <hide help="" help<="" td="" tool=""><td>OK Cancel Envir</td><td>ronments << Hide Help Tool Help</td></hide>	OK Cancel Envir	ronments << Hide Help Tool Help

To create 2 new grids: recur_fire and single_fire

Use Mosaic to a New Raster to add recur_fire, single_fire, and p2_snapgrid to create f_occur_2. Set Mosaic Operator to SUM.

Reclassify f_occur_2 to create a Fire Recurrence raster with 4 values: 0, 1,000, 3000, 7,000

🔨 Reclassify		– 🗆 X
Click error and warning icons for more information	×	Output raster
Input raster	, ,	
f_occur_2	_	The output reclassified raster.
Reclass field		The output will always be of
VALUE	~	integer type.
Reclassification		
Old values New values	Classify	
1000 1000	Unique	
1001 1000	onque	
3000 3000		
3001 3000	Add Entry	
NoData 0	Delete Entries	
· · · · · · · · · · · · · · · · · · ·		
Load Save Reverse New Values	Precision	
🔇 Output raster		
R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\fire	_recurr 🛛 🛃	
Change missing values to NoData (optional)		
		~ ~
	OK Cancel Environments << Hide Help	Tool Help

Relative Condition	Source cutoffs	Reclass Value/Cost Score
Poor	>= 5 recurring fires since 1990	8000
Fair	2-5 recurring fires since 1990	4000
Good	Zero (0) fires since 1990	1000
Very Good	1 fires since 1990	0

Burn Severity:

Input layers:

BC: BURN_SVRTY_polygon.shp (<u>https://catalogue.data.gov.bc.ca/dataset/fire-burn-severity-historical</u>) R:\Base_Data\Fire\Burn_Severity\BritishColumbia\BCGW_7113060B_1666211812600_11660\VEG_BURN_SEVERITY_SP \BURN_SVRTY_polygon.shp

AB: Wildfire Perimeters 1931 – 2021 (<u>https://wildfire.alberta.ca/resources/historical-data/spatial-wildfire-data.aspx</u>); R:\Base_Data\Fire\historical-wildfire-Alberta\HistoricalWildfirePerimeters\WildfirePerimeters1931to2021v2.shp

MT: mtbs_MT_YYYY.tif where "YYYY" equals Year between 1990-2020. (<u>https://www.mtbs.gov/direct-download</u>) (R:\Base_Data\Fire\Burn_Severity\Montana\MTBS_Mosaics_MT_1984-2020\composite_data\MTBS_BSmosaics\YYYY ...

Relative	Burn Severity	MT	AB	BC	Reclass Value/Cost Score
Condition		(Source)		(BURN_RATE)	
Poor	High	4		High	6000
Fair	Moderate	3	Burned	Medium	4000
Good	Low	1, 2		Low	2000
Very Good	No measurable	0, 5	Unburned	Unburned	0
	severity				

Montana

Preprocessing: US (MT) burn severity data acquired in annual (1990-2020) tiff files. Step 1 was to Mosaic to a New Raster with all source tiffs to create MT_burnsever. Cellsize was set to 30 (though double check due to snap raster) and Mosaic Operator set to LAST (mtbs_MT_2020.tif).

Nosaic To New Raster	- 🗆 X
Input Rasters	Number of Bands
mtbs_MT_2005.tif mtbs_MT_2006.tif mtbs_MT_2007.tif mtbs_MT_2008.tif mtbs_MT_2009.tif mtbs_MT_2010.tif mtbs_MT_2011.tif	output raster will have.
Contraction Output Location R:\Base_Data\Fire\Burn_Severity\Montana	
Raster Dataset Name with Extension Crn_burnsever Spatial Reference for Raster (optional) North America Albers Equal Area Conic CM-112	
Pixel Type (optional) 8 BIT_UNSIGNED Cellsize (optional)	
30 Number of Bands 1	
Mosaic Colormap Mode (optional) Mosaic Colormap Mode (optional)	~
OK Cancel Environments << Hide Help	Tool Help

With Environments/Processing Extent/Extent set to "Same as layer P2_Cost_Mask and Snap Raster at: P2_snapgrid:

¥ Workspace	^	Extent
∕ Output Coordinates		
R Processing Extent		Tools that honor the Extent environment will only process features or rasters that fall
Same as layer P2_Cost_Mask	~ 🖻	within the extent specified in
Top 1304178.235900		this setting.
Left	Right	defines the features or rasters
-326722.275182 Bottom 729779.026608	74785.629820	that will be processed by a tool. It is useful when you need to process only a portion of a
Snap Raster		larger dataset. You can think of
p2_snapgrid	▼ 🖆	this setting as a rectangle used
XY Resolution and Tolerance		to select input features and rasters for processing. Note that
M Values		the rectangle is used only to select features not clin them
Z Values		The extent of the output dataset
Geodatabase		will typically be larger than the
Geodatabase Advanced		features or cells that pass
Fields		through the extent rectangle.
Random Numbers		Options:
Cartography		
Coverage		 Default—The tool you are using will determine the
Raster Analysis		processing extent. All
Paster Storage	~	tools have a default

Output: R:\Base_Data\Fire\Burn_Severity\mt_burnsever

Attributes:

Unique numeric values contained in each raster cell

- 0 Background/No Data
- 1 Unburned/Underburned to Low Burn Severity
- 2 Low burn severity
- 3 Moderate burn severity
- 4 High Burn Severity
- 5 Increased Greenness/Increased Vegetation Response
- 6 Non-Processing Area Mask

Use Reclassify, and the table above to create R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\MT_severity (raster) with appropriate Cost Scores – make sure to change 'No Data' to zero (0)

British Columbia:

BC: BURN_SVRTY_polygon.shp

Attributes: (Burn_Rate)

High Medium Low Unburned Unknown

Starting with BC_BurnSeverity.shp: Add field: Score (ShortInt) and use the BURN_RATE field to calculate scores (see Table above)

Use Feature to Raster to convert shp to a raster (R:\Base_Data\Fire\Burn_Severity\BritishColumbia\bc_burnsever) – cell size 30 m

Use Reclassify to change 'No Data' to zero (0): Output file: R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\ bc_severity (raster) with appropriate Cost Scores

Alberta:

AB: Wildfire Perimeters 1931 – 2021 (WildfirePerimeters1931to2021v2.shp)

Field BURNCODE

Attributes:

Burned

Unburned

Starting with WildfirePerimeters1931to2021v2.shp, Add field: Score (ShortInt) and use the BURNCODE field to calculate scores (see Table above)

Use Feature to Raster to convert shp to a raster (R:\Base_Data\Fire\Burn_Severity\Alberta\ab_burnsever) – cell size 30 m

Use Reclassify to change 'No Data' to zero (0) Output file: R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\ ab_severity (raster) with appropriate Cost Scores

Step 2: Mosaic to a New Raster

Create crn_burn_sevr (raster) by mosaicking bc_severity, ab_severity and mt_severity; use Mosaic operator 'SUM"; output : R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\crn_burn_sevr

Input Rasters		Mosaic Operator
◆bc_severity ◆ab_severity ◆MT_severity	+ ×	The method used to mosaic overlapping areas.
	↑ ↓	 FIRST—The output cell value of the overlapping areas will be the value from the first raster dataset mosaicked into that location.
Output Location	_	 LAST—The output cell value of the overlapping
R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire	6	areas will be the value
Raster Dataset Name with Extension		from the last raster
Crn_burn_sevr		dataset mosaicked into
Spatial Reference for Raster (optional)		that location. This is the
North_America_Albers_Equal_Area_Conic_CM-112	۲	BI END_The output cell
Pixel Type (optional)		value of the overlapping
8_BIT_UNSIGNED	~	areas will be a
Cellsize (optional)		horizontally weighted
	30	calculation of the values
Number of Bands		of the cells in the
	 1	MFAN—The output cell
Mosaic Operator (optional)	_	value of the overlapping
80M	~	areas will be the average
Mosaic Colormap Mode (optional)	- N	value of the overlapping
FIRST	\sim	cells.

** Late Addition** R:\Base_Data\Fire\Burn_Severity\CrownSummary\CCE_FIRES_1980to2019_BURN_SEVERITY1.tif created by the Hi5 Team and modified by Danie Frevola (located at https://app.box.com/folder/177192968279) has novel information about burn severity. To include that in Forest Cost:

Re	class	ify:				
Tał	ble					
0	- 1	} - □	N 🛐	€ ×		
СС	E_FIRE	S_1980to2	2019_BUR	N_SEVERITY1.tif		
	OID	Value	Count	Severity	CBI_Range	
F	OID 0	Value 0	Count 918829	Severity UNBURNED	CBI_Range	
F	OID 0	Value 0 2	Count 918829 2450631	Severity UNBURNED LOW SEVERITY	CBI_Range 0.1 - 1.24	
	0ID 0 1 2	Value 0 2 3	Count 918829 2450631 2861671	Severity UNBURNED LOW SEVERITY MODERATE SEVERITY	CBI_Range 0.1 - 1.24 1.25 - 2.24	
	0ID 0 1 2 3	Value 0 2 3 4	Count 918829 2450631 2861671 4209096	Severity UNBURNED LOW SEVERITY MODERATE SEVERITY HIGH SEVERITY	CBI_Range 0.1 - 1.24 1.25 - 2.24 2.25 - 3	

out raster				. ^	Output raster
CE_FIRES_1980to2019_BURN	I_SEVERITY1.tif		I 🖻		
dass field				.	The output reclassified raster.
alue			~		The output will always be of
classification					integer type.
Old values	New values 🔥	Classifi			
0	0	Classify			
2	4000	Unique			
4	6000				
NoData	0	Add Entry			
	~	Delete Entries			
Load Save	Reverse New Values	Precision			
itput raster					
:\Base_Data\Fire\Burn_Severi	ty\CrownSummary\CCE_burn	_rd	<u> </u>		
1a				·	
UChange missing values to Ivol	Jata (optional)				

To produce R:\Base_Data\Fire\Burn_Severity\CrownSummary\CCE_burn_rcl

Mosaic to a new Raster (crn_burn_sevr + CCE_burn_rcl) using the MAXIMUM Mosaic Operator to incorporate that new data. Output = crn_burn_sev2.

	Manaia Operator
3	(optional)
+ × +	The method used to mosaic overlapping areas. • FIRST—The output cell value of the overlapping areas will be the value from the first raster dataset mosaicked into
<u></u>	that location. LAST—The output cell value of the overlapping areas will be the value from the last raster dataset mosaicked into that location. This is the default
∑ ∽ 30	 BLEND—The output cell value of the overlapping areas will be a horizontally weighted calculation of the values of the cells in the
	or the cells in the overlapping area. • MEAN—The output cell value of the overlapping areas will be the average value of the overlapping cells.

Public, Private and Tribal Lands

The case here: it's generally less costly to initiate conservation actions on public land than tribal land and private land due to permissions and recognition of forest conservation (as opposed to say extraction priorities) as an important landscape conservation objective.

Relative	Ownership	Reclass Value/Cost Score
Condition		
Poor	Private	3000
Fair	Tribal	1000
Good	Public	0

Starting with

R:\Base_Data\Ownership\JurisdictionalComplexity_Jurisdictions_c2012\JurisdictionalComplexity\Jurisdictions_c2012.sh p, a layer developed by the Crown Managers partnership and stored on ScienceBase

(<u>https://www.sciencebase.gov/catalog/item/565f35c1e4b071e7ea54451d</u>), Add Field Pub_Pvt (String, 50) and reclass Jurisdict field as follows:

Public: BLM, Federal Montana FWP, National Park, Provincial/State, Provincially Protected Area, State Trust Land, US Fish and Wildlife, USFS

Private: Local/Municipal Government, Plum Creek, Private, Private Conservation, Uncertain

Tribal: Reservation

Add Field: Score (ShortInt) and score using the Pub_Pvt field and the table above

Clear Selections!

Merge Jurisdictions_c2012.shp with R:\Base_Data\CROWN_LCD_Phase2\Project_Area\P2_Cost_Mask.shp to account for areas not (yet) classified as Pub_Pvt (those areas will receive a score of 1) to create: R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Ownership\Crown_own_part

Insect Impacts

Acquired Mountain Pine Beetle severity index from the Hi5 Working Group and Danie Frivola. It includes 4 levels of pine beetle impact severity (none, low, moderate, and high) with values 0-3:

[able			
🗄 • 🔁 • 🏪	N 🛐	₹	
CE_MBP_1999_20	20_Cumu	IlativeSever	ity
OBJECTID *	Value	Count	MBP_SEVERITY
4	0	78070729	NONE
1	•	10010120	
2	1	6120843	LOW
2	1	6120843 1798972	LOW MODERATE

Reclassify:

Relative	Mountain Pine	Reclass Value/Cost Score			
Condition	Beetle Severity				
Poor High		3000			
Fair	Moderate	2000			
Good	Low	1000			
Very Good	None	0			

put raster		_ ^	Output raster	ç
CE_MBP_1999_2020_CumulativeSeverity		- 🖻		
class field			The output reclassified raster.	
alue		~	The output will always be of	
classification			integer type.	
Old values New values	Classify			
0 0	Cidssify			
2 2000	Unique			
3 3000				
NoData 0	Add Entry			
	Delete Entries			
¥				
Load Save Reverse New Values	Precision			
tput raster				
:\Base_Data\Pests\Crn_betle_sev		F		
Change missing unline to Na Data (antianal)				
Johange missing values to NoData (optional)				
		· · · · · · · · · · · · · · · · · · ·		

To create: R:\Base_Data\Pests\Crn_betle_sev

Semi-final Rasters for creation of Forest Cost layer:

R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\fire_recurr R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Fire\crn_burn_sev2 R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Ownership\Crown_own_part R:\Base_Data\Pests\Crn_betle_sev

Mosaic to a New Raster:

Input Rasters			Mosaic Operator
		- 🖻	(optional)
Fire_recurr		+	The method used to mosaic
crn_burn_sev2		-	overlapping areas.
crn_owners		×	
◇Crn_betle_sev			 FIRST—The output cell
			value of the overlapping
			areas will be the value
			from the first raster
			dataset mosaicked into
			AST_The output coll
Output Location			value of the overlapping
R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Feature	es/FORE	2	areas will be the value
laster Dataset Name with Extension			from the last raster
FORE_Cost_raw			dataset mosaicked into
patial Reference for Raster (optional)			that location. This is the
		P	default.
ivel Type (ontional)			 BLEIND—The output cell value of the everlapping
8 BIT UNSIGNED		~	areas will be a
ellsize (optional)			horizontally weighted
		30	calculation of the values
lumber of Bands			of the cells in the
		1	overlapping area.
Iosaic Operator (optional)			 MEAN—The output cell
SUM		~	value of the overlapping
Iosaic Colormap Mode (optional)			value of the overlapping
FIRST		~ ~	cells.
			- MINIMUM The output

To produce output: R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Features\FORE\FORE_Cost_raw

Run Int to convert to a signed integer:

Int			– 🗆 ×
put raster or constant value FOR_Cost_raw	-	^	Output raster
utput raster		·	The output raster.
λ:βase_Data(CROWN_LCD_Phase2(Cost_Layers_P2)Features/FORE(fore_cost_int			The cell values are the input values converted to integers by truncation.
		~	,
OK Cancel E	Environments << Hide Hel	lp	Tool Help

				OK	Cancel	Environments	<< Hide Help	Tool Hel	2	
		<i>c</i> .		<u> </u>						
Th	en on	e fina	l Reclassi	fy to cap	Cost at	t 10,000):			
Tak	ole									
•	. 🔍	- 15- 5	• M 40 v							
0	- 4		1 - 4 - 6							
for	e_cost_in	t .								
Ц	Rowid	VALUE	COUNT							
Ľ	0	0	34015282							
Н	1	1	166960758							
Ц	2	1000	10382945							
Н	3	1001	3439870							
Н	4	2000	2950473							
Н	5	2001	1828265							
Н	6	3000	22447738							
Н	/	3001	1262400							
Н	0	4000	3328731							
Н	9	4001	1092407							
Н	10	5000	610466							
Н	12	6000	2730709							
Н	12	6001	613563							
Н	14	7000	1343424							
Н	15	7001	259729							
Н	16	8000	380927							
Н	17	8001	12218							
Н	18	9000	866962							
H	19	9001	116178							
Н	20	10000	159221							
П	21	10001	869							
	22	11000	91769							
	23	11001	5740							
	24	12000	14071							
	25	12001	185							
\square	26	13000	75738							
\square	27	13001	2064							
Ш	28	14000	795							
Ц	29	14001	23							
Ц	30	15000	28							
Ц	31	15001	3627							
	32	16001	36							

Resulting in: R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Features\FORE\p2_FORE_Cost

Zonal Statistics as a Table:

Sonal Statistics as Table	- 🗆 X
Input raster or feature zone data	Output table
P2_BASEGRID 🗹 🖻	
Zone field	Output table that will contain
PUID ~	the summary of the values in
Input value raster	each zone.
p2_FORE_cost 🗾 🖻	The format of the table is
Output table	determined by the output
R:\Base_Data\CROWN_LCD_Phase2\Cost_Layers_P2\Features\FORE\zonalst_fore_p2	location and path. By default,
Ignore NoData in calculations (optional)	geodatabase table. If the path is
Statistics type (optional)	format is determined by the
	is .dbf, it will be in dBASE format. If no extension is specified, the output will be an INFO table.