Crown LCD Leadership Meeting Notes
December 15, 2020

Action Items (December):

What?	Who?	When?
Thorough review of complete set of Leadership Team input	Sean and Natalie	By February LT call (2/23)
Continue conceptual models for selected features; bridge to Key Ecological Attributes	Natalie, Erin, Phil, Sean	Initiated, Ongoing
Identify, recruit and engage Subject Matter Expert (SME) Teams	Everyone (esp. Sean & Natalie)	Schedule calls starting in February
Draft an 'expectations' document for SMEs	Sean	DRAFTED (see 1/21/21 email)
Finish Feature Selection Report	Sean (Erin edits)	By February LT call (2/23)

Action Items (Prior):

What?	Who?	When?
Incorporate connectivity, intactness	Sean, Analysis Team in collaboration with Kathy Zeller, Technical Team and other subject matter experts	Throughout 2021
Continue data acquisition	Analysis Team & Kathy	On-going but ASAP
Integrate guild approach to spatial design	Analysis Team	Through modeling effort (started - but ongoing)
Get started on Social, Cultural, Economic features (emphases on cultural sites, recreation, timber and ranching economies)	Sean and Analysis Team	ASAP
Continue data evaluations for selected coarse features	Analysis Team and Technical Team	Ongoing
Identify Subject Matter Experts for select features	Everyone	Through January
Continue generating maps describing focal landscape features; post on website	Mary, Phil, Aubin, Sean	Ongoing; revisit monthly
Continue conceptual models for selected features; bridge to Key Ecological Attributes	Natalie and Sean	Initiated, Ongoing
Continue analytical work on cold water salmonids (and	Analysis Team	Initiated, Ongoing

climate refugia) as a likely focal landscape feature		
Think about how we can recruit social, cultural and economic experts	Leadership Team	Ongoing; several excellent nominees

Meeting Notes and Materials:

Recording: https://meet39041854.adobeconnect.com/pox1uwoc33ys/

Presentation Slides: Attached (Leadership_Team_call_12-15-2020_LT_distribution)

Next Call: February 23, 2021 at 11 am

Attendees

- Adam Collingwood: Parks Canada, LCD Tech team
- Alisa Wade: North Central Climate Adaptation Science Center
- Brooke Kapeller: CPAWS Southern Alberta
- Connie Simmons: Y2Y - Alberta
- Constanza von der Pahlen: Flathead Lakers, Critical Lands Program Dir.
- Craig Harding: Nature Conservancy Canada
- Erin Sexton: UM FLBS, CMP
- Kathy Zeller: Aldo Leopold Wilderness Research Institute
- Kelly Cooley
- Kris Tempel: Habitat Conservation Biologist, MFWP
- Linh Hoang: Inventory Monitoring Climate change Coord US Forest Service
- Mary McFadzen: MSU for FWS, Science Comms/Outreach
- Mary T. McClelland
- Natalie Poremba, Coordinator, Crown Managers Partnership
- Phil Matson: Flathead Lake Biological Station
- Richard Klafki: NCC - Canadian Rockies BC region
- Sean Finn: US Fish and Wildlife Service, Science Coordinator
- Tara Carolin

Agenda

1. Updates: Website, Meeting Notes
2. NULL Optimization Models
3. Parameterizing Models
4. Cost layers and Expert Input
5. New Year's Resolutions

Updates: Website, Meeting Notes (slide 3)

Mary provides a quick tour of the LCD website emphasizing additions to the Priority Habitats and Species page. Sean follow with a mea culpa on monthly meeting notes and a promise to get caught up.

Chat box Comments:

Erin Sexton: Looks amazing Mary!
Brooke Kapeller: Love the landcover bubbles!
Mary McFadzen: webpage: https://www.crownmanagers.org/priority-habitats-species
Kelly Cooley 2: Finally got Adobe Connect to work. Glad we're switching to Zoom in 2021!

Mary T. McClelland: incredible work Mary McF!! Had trouble signing in on Adobe but finally have audio by phone and can follow slides on computer
Constanza von der Pahlen: regarding webiste maps: urban and develppment areas include roads?
Constanza von der Pahlen: edit: not maps, but the bubbles/statistics analysis..

NULL Optimization Models (slides 4-26)

Sean discusses the 'first run' Null models created for the Montana portion of the LCD project area. Discussion starts with some of the modeling framework, including a review of how 'planning units' were drafted and how they play in to the models; basic approach, justification and objectives of optimization modeling; a review of our focal features and populating the species input data. We then reviewed a set of null models for Montana. The focus is on Montana because that is the most complete data we have in hand (we're working on completing data acquisition for AB and BC). Further, we call these 'null models' because we use a single cost layer for all models (global human modification). As we iterate models, we will customize cost data to each feature. We run through and discuss single feature, guild, and whole null models.

Chat box Comments:
Alisa Wade (NC CASC): How does Marxan opt. models handle "edges" - do they bias aganist locations at the edge of an area?
Kelly Cooley 2: The forest and shrubland maps would be interesting to overlay, showing the overall dominance west of The Divide and the gradual reduction to grassland east of the Divide.
Constanza von der Pahlen: MNHP in Montana mapped intermittent and ephemeral streams as well
Kelly Cooley 2: Should have said transition not reduction
Mary McFadzen: Constanza: I'll have to check on your road inclusion question.
Linh Hoang: assuming this suitability is for current condition?
Brooke Kapeller: for aquatic SAR (trout) - will buffers be included in +1500 for critical habitat?
Linh Hoang: can
Constanza von der Pahlen: What is the percent habitat target set? Is it related to a bottleneck calculation?
Constanza von der Pahlen: Sorry/. How. Not what
Connie Simmons 2: I am wondering about the 'Nature Needs Half' focus that EO Wilson et al have been championing - how would this be addressed in the LCD project? What level of retention would this actually require?
Kelly Cooley 2: The interesting thing when you go to 70% are all the islands - they look small on a map of this scale, but on the ground, they are much larger islands
Connie Simmons 2: I agree, Kelly. And fracture areas in connectivity.
Connie Simmons 2: sorry, didn't finish this... concerned about the fractures in connectivity with lower retention.
Kelly Cooley 2: I was just going to say, the whitebark pine may not be moving around, but the nutcracker is moving them around
Linh Hoang: we are considering connectivity in the WBP work and size of polygons
Alisa Wade (NC CASC): I had an interruption at door, so I probably missed it, but when does climate come into this?
Linh Hoang: alisa I think it is a cost benefit layer

Model Parameterizing, Cost Layers and Expert Opinion (Slide 27-29)

Following great conversation and critique of the modeling approach, we move on to what the next round of models will look like. We are just getting started and moving forward there will be a lot of decisions – some will be data and expert driven but there will also be some output comparisons and sensitivity-type analyses. Not all of these decisions will be guided by solid 'knowns' but we will use whatever information is available and they next year will include synthesizing our collective knowledge – including and expanding set of subject matter experts.

Chat box Comments:
Constanza von der Pahlen: I agree that percent target needs to be adjusted for specific species., with possible considerations fpr what is optimal versus minimum target for survival- which would be a way of pointing to when reality approaches a percent target where red flas need to be raised.
Constanza von der Pahlen: edit: flags..
Connie Simmons 2: are you still short on BC data?

Alisa Wade (NC CASC): I unfortunately have to sign off early. Thanks for all your work Sean et al! My comments: climate! connectivity! :)
Connie Simmons 2: The tough work will come with the trade offs between what is a priority retention (target) and the expansion of industry or other human use. We are running up against this in SW Alberta with coal mines, motorized recreation expansion and increased AA C for logging
Sean Finn: LH: what is the magnitude of the difference among today and future desired? It is achievable? Or do we let that go?
Sean Finn: LH: the estimated difference itself is a parameter. It's integrated with optimization settings
Kelly Cooley 2: I would agree with Linh that it is in itself a parameter.
Sean Finn: What is the desired future condition (amount of that actual feature?
Connie Simmons 2: I am wondering about how the play in desired future condition of some features may go with or agains t the retention of other features, and do we address a the highest value knowing that erosion with human use will be a constant pressure.
Constanza von der Pahlen: If I understand Linh, that brings other considerations: future projections may make an area less optimal, but a management action could change that, so we shouldn't ride all those areas off. They just help us project optimal and at risk areas
Constanza von der Pahlen: Great job Sean and team. Thanks!
Kelly Cooley 2: Looking forward to seeing the Canadian data as well!
Craig Harding-NCC: This looks great Sean. As a few have mentioned, the future state is something we have struggles with internally and I am excited to see how we tackle and discuss this at a broader scale than we work at in our planning units. Looking forward to conversations in the new year!
Kelly Cooley 2: Appreciated from my perspective.

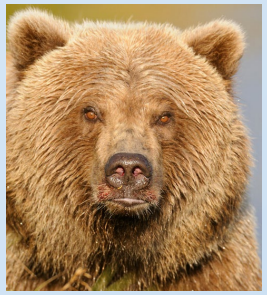
New Year's Resolutions (Slide 30)

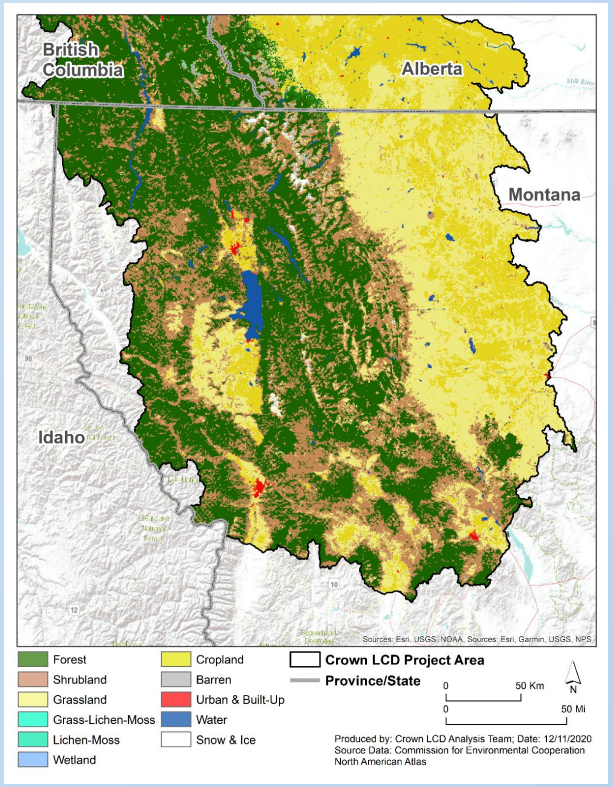
- ✓ Thorough review of complete set of Leadership Team input
- ✓ Draft comprehensive conceptual models for all conservation features
- ✓ Identify, recruit and engage Subject Matter Expert Teams
    - Refine our estimates of feature-specific costs – current and future
- ✓ Process, scrub and prepare data for Alberta and BC
    - Continue very studious data documentation
- ✓ Get started on social, cultural and economic features
- ✓ Finish Feature Selection Report and update other project documentation
- ✓ Switch to Zoom for Leadership Team calls starting in January (26that 11am Mountain Time)

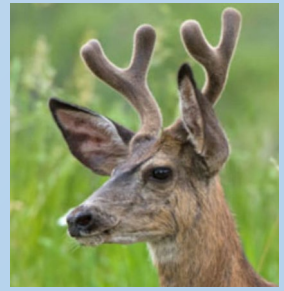
Chat box Comments:

Kelly Cooley 2: Thanks for all the good work!
Erin Sexton: Amazing work Sean, Mary, Phil, everyone on the technical team!!!
Sean Finn: Document to recruit SME Teams members
Mary T. McClelland: Stay safe and thank you to all for your professional analysis in this huge effort. You all are amazing!. - I hope to be of more help on the social, cultural and economic features. Many thanks and good health and hope for the new year.
Connie Simmons 2: Thanks for all this, Sean. Wishing all a wonderful Christmas!
Linh Hoang: yes awesome work by all the tech and analysis tea, too. happy new year all!!
Kris Tempel: We have accomplished so much this year. Great work!
Kelly Cooley 2: Cheers!
Richard Klafki: Happy holidays as well!

Crown of the Continent Landscape Conservation Design







Leadership Team call

December, 15 2020

Outline:

- Updates: Website, Meeting Notes
- NULL Optimization Models
- Parameterizing Models
- Cost layers and Expert Input
- New Years Resolutions

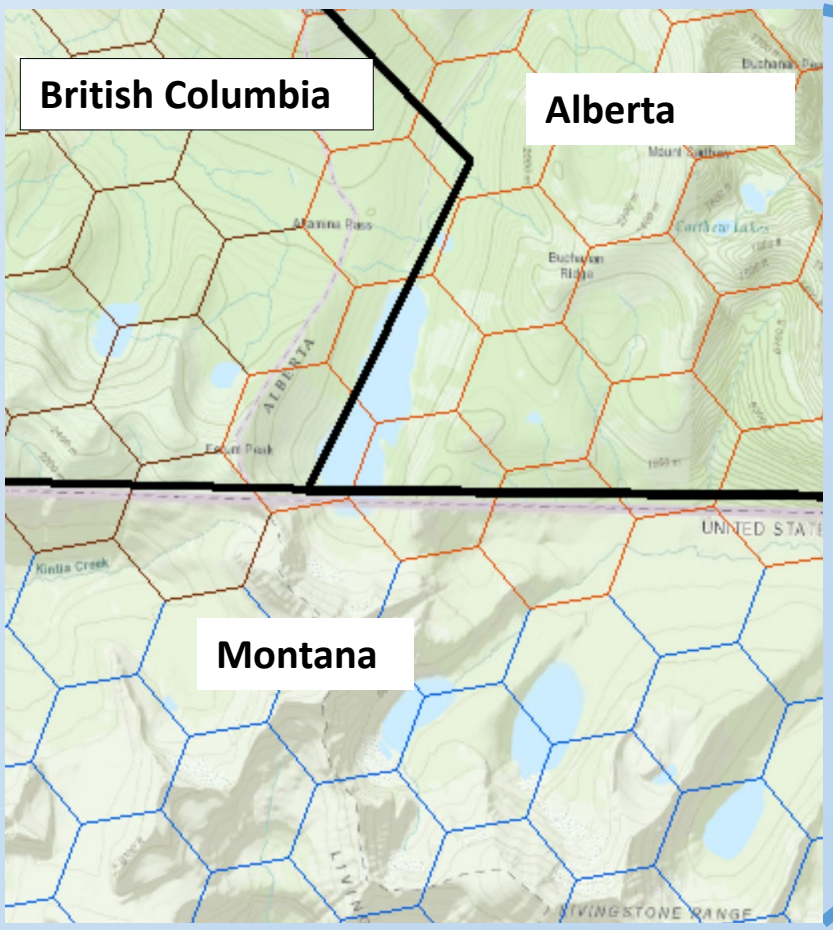
Meeting Notes Update

- September Notes attached to email (and will be posted to Website)
- November & December Notes completed posted before End of Year
- Thorough review of all feedback, comments and Action items before January Leadership Team call

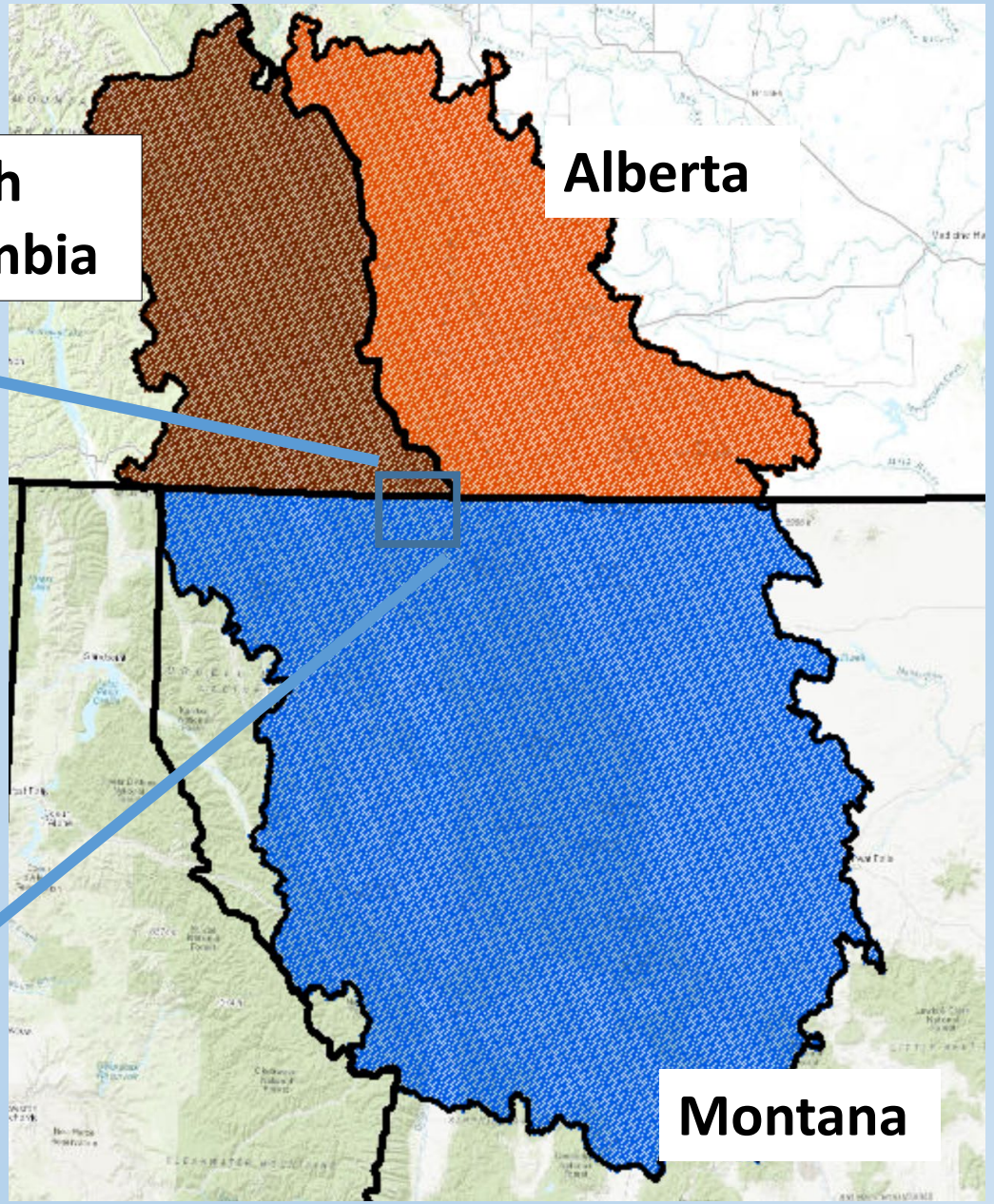
Project Area & Planning Units

For optimization modeling, we divide the Project Area into sub-units called Planning Units

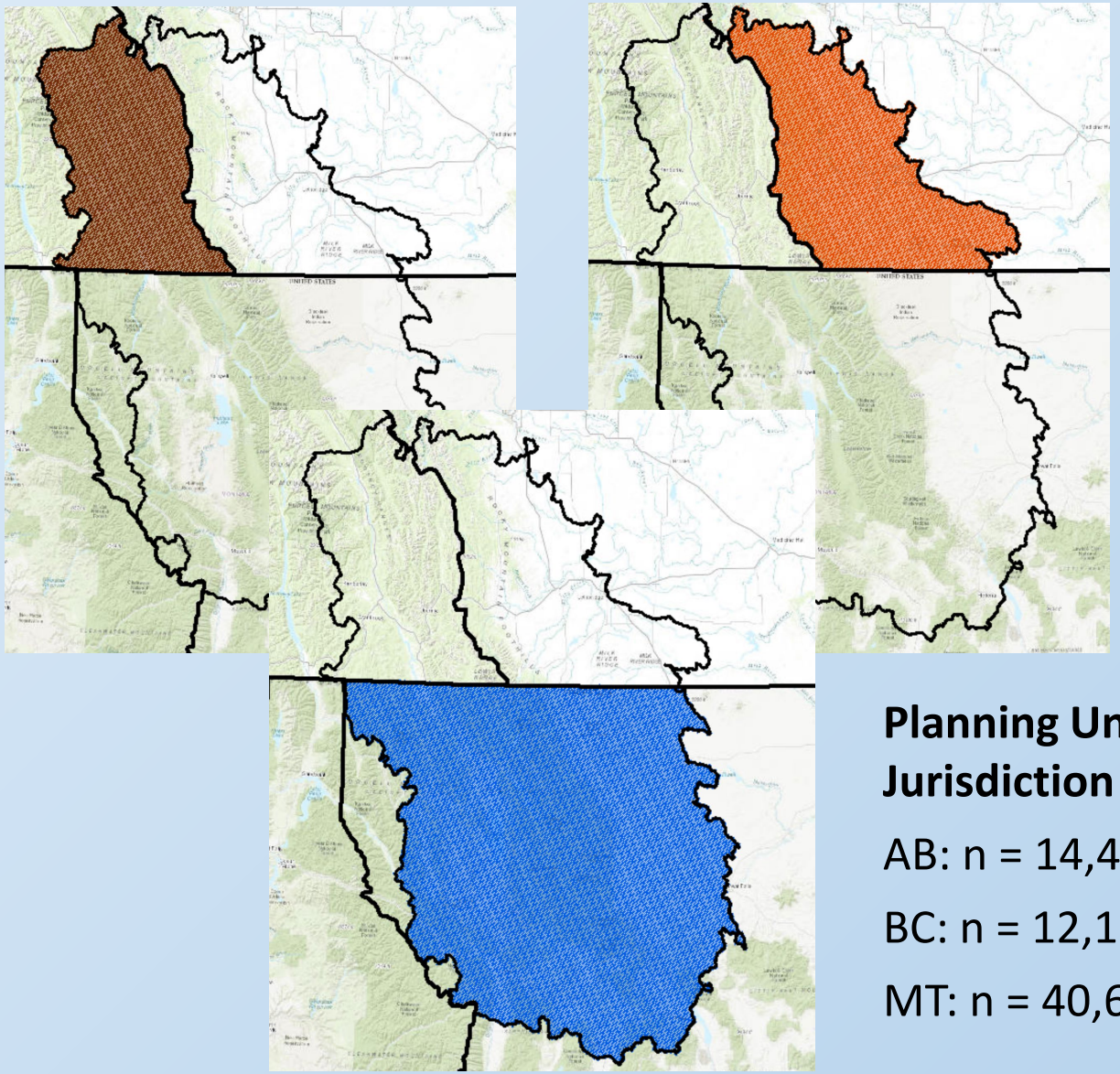
Planning Unit: 2km² each



Crown LCD Project Area



For Starters: Three Parallel Optimization Models



Planning Units by Jurisdiction

AB: n = 14,471

BC: n = 12,193

MT: n = 40,692

Why?

- Primarily disparate data & sources
- Explore data handling techniques

Benefits

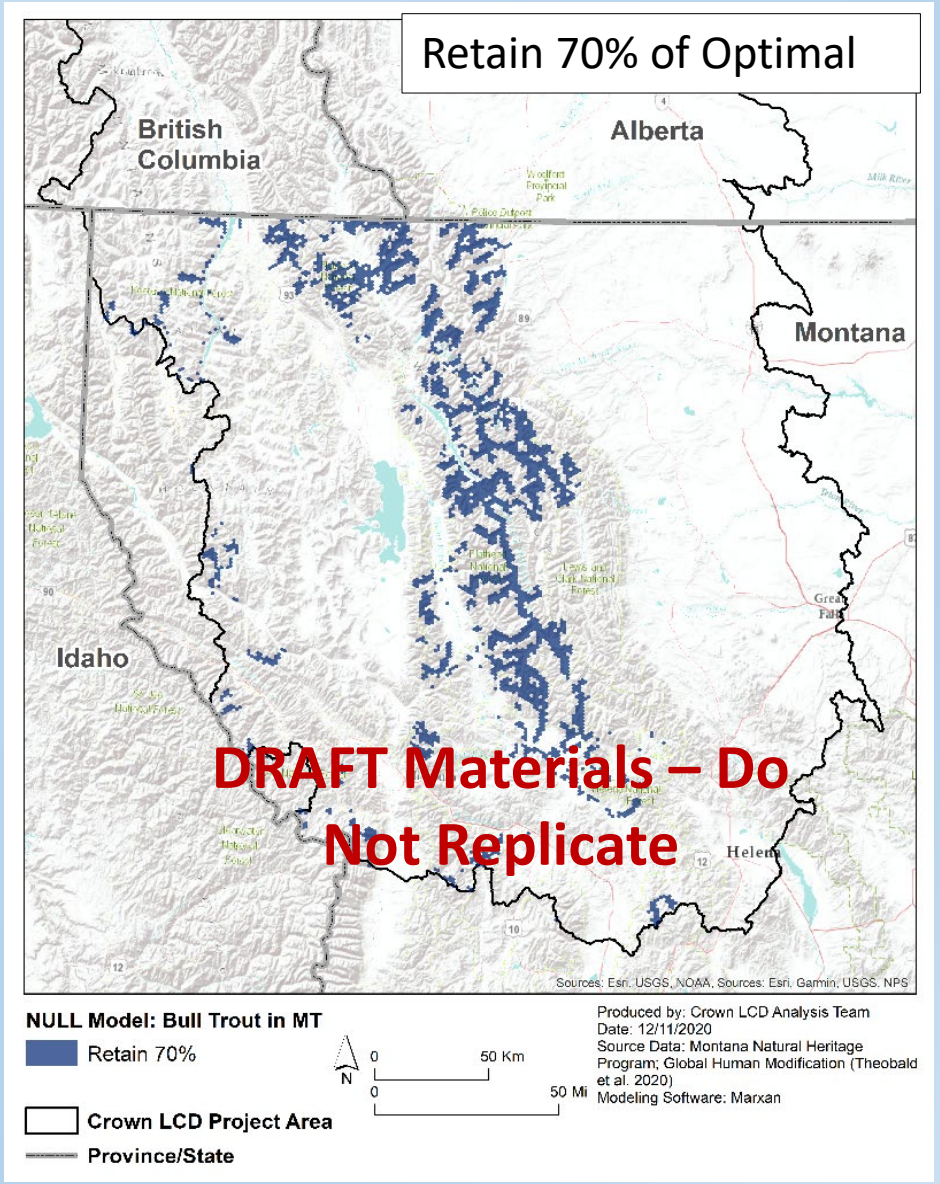
- Finer resolution planning units
- More efficient iterations
- Can always ‘scale up’ when appropriate

Drawbacks

- More onerous data & processing documentation

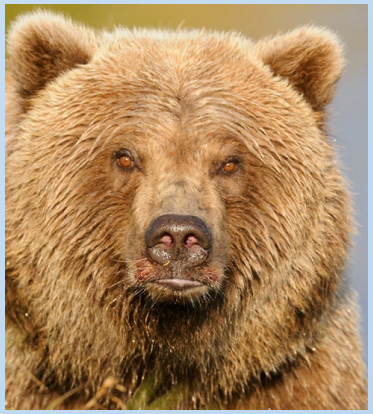
A Spatial Design using Optimization Modeling

- An implementation of Systematic Conservation Planning (Pressy and Bottrill 2009)
- A ‘Minimum Set Problem’ … conserve the most priority resources possible in the most efficient way possible
- Marxan software (Game and Grantham 2008) supports spatial optimization for selected features in a given landscape
- Features, functions and software extensions support model validation, sensitivity analysis and knowledge-based iteration

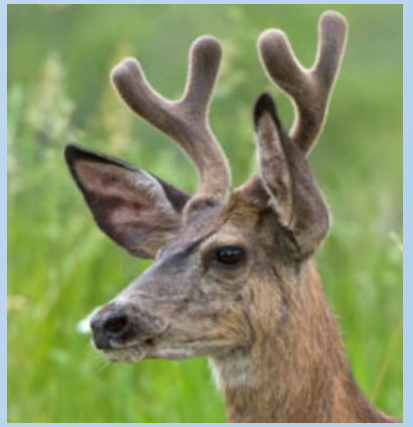


Priority Fine Features (8) and Guilds (3)

Mesocarnivores

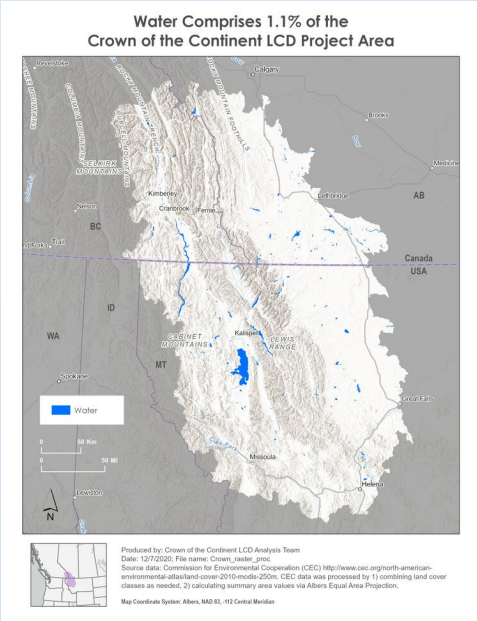


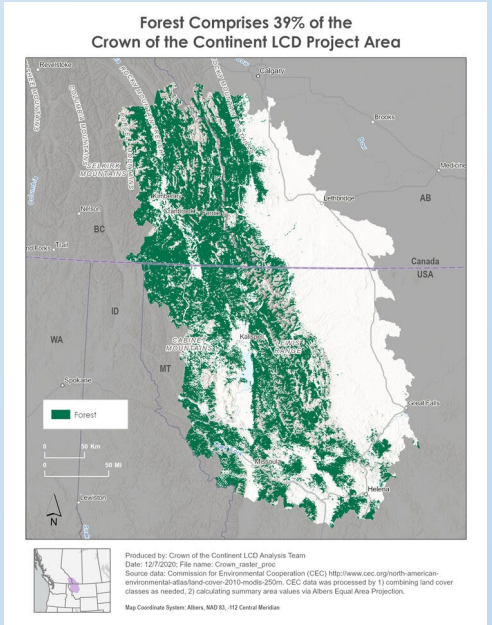
Ungulates

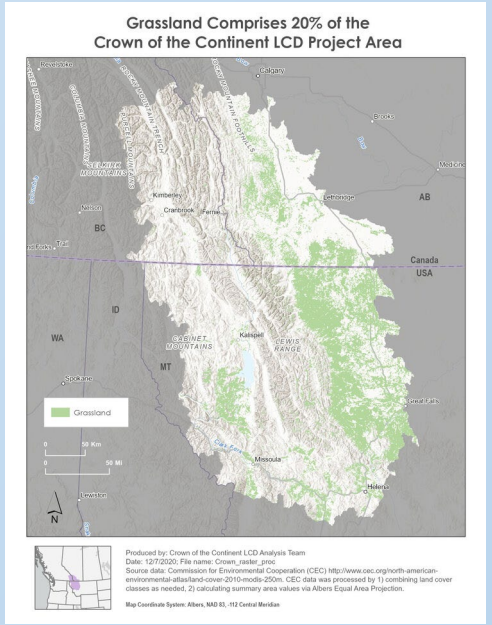


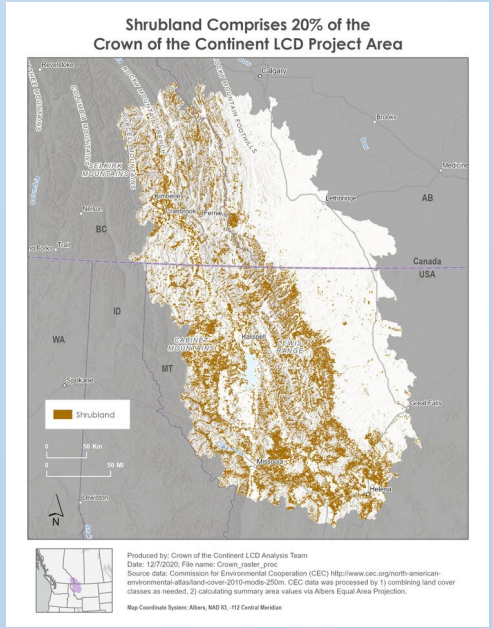
Cold Water Salmonids

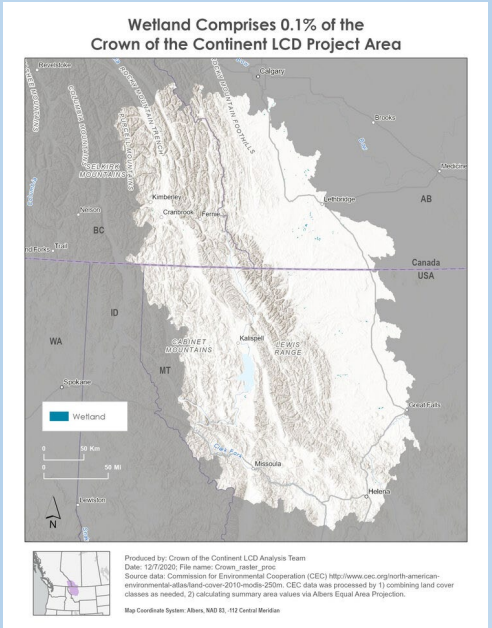
Priority Coarse Features: Landcover (6) and Ecological Connectivity











*** Still working on riparian landcover and ecological connectivity**

Setting the Marxan Environment

Sum of selected Planning Unit Costs

Sum of Planning Unit Value for priority features

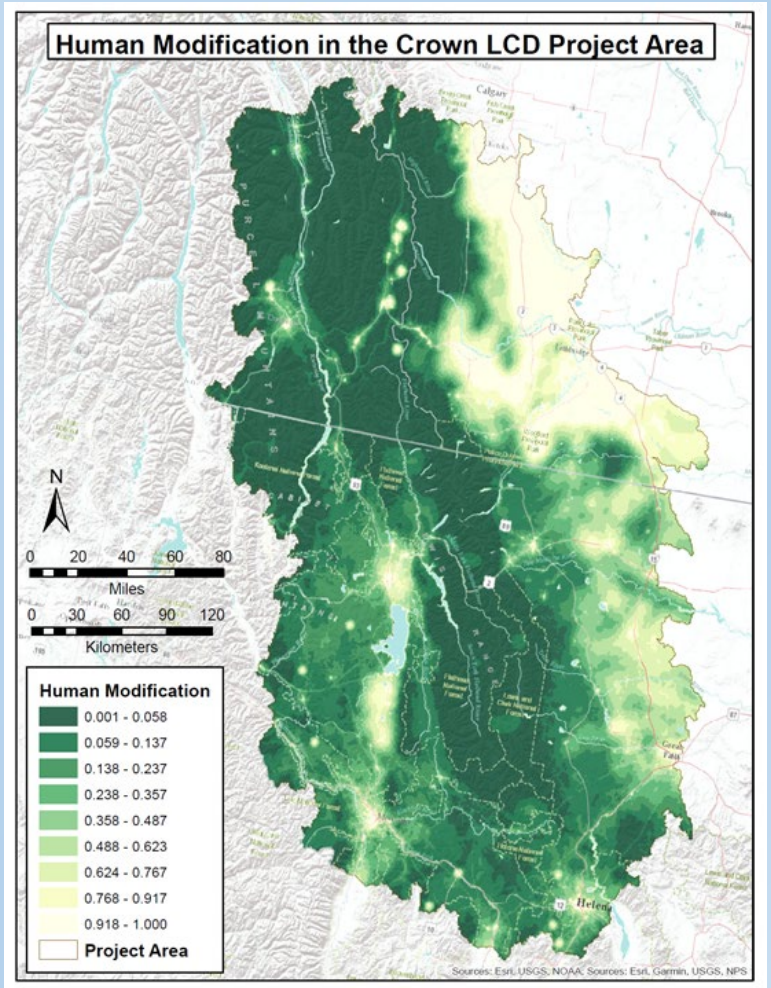
Total perimeter of selected Planning Units

$$1 \quad 2 \quad 3$$

$$\sum_{PUs} Cost + \text{BLM} \sum_{PUs} Boundary + \sum_{Con.Targ.} SPF \times \text{Penalty} = \textbf{Marxan Score}$$

Example Geography: Montana portion of Crown LCD Project Area

Example Cost: Global Human Modification (Theobald et al. 2020)



Example Feature: Canada Lynx in Montana

- Montana Natural Heritage Program Habitat Suitability Model

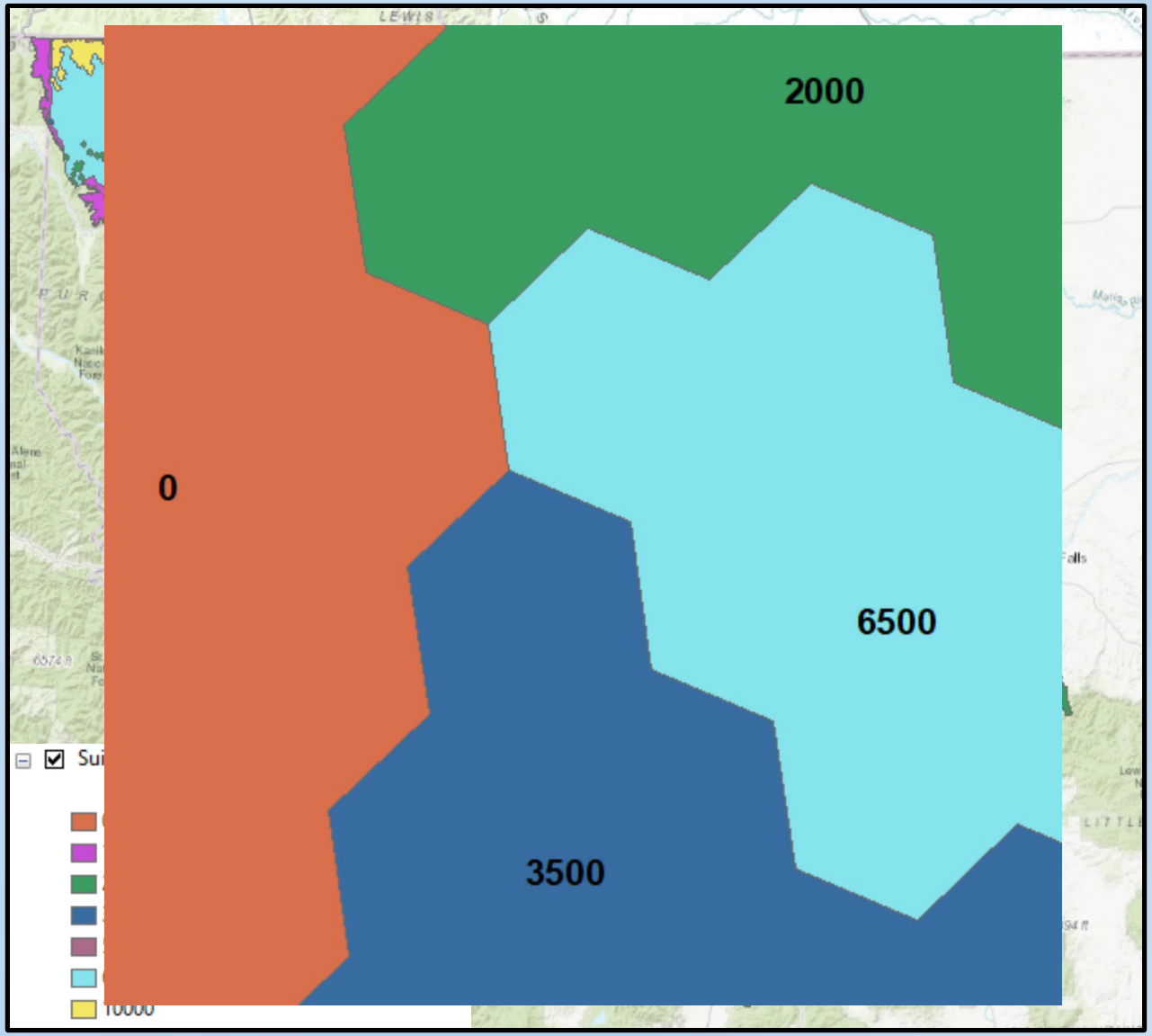
  Scoring

  - Optimal Suitability – 10,000
  - Moderate Suitability – 5,000
  - Low Suitability – 2,000
  - Generally Unsuitable - 0

- USFWS Critical Lynx Habitat Designation

  Scoring

  - Critical Habitat – +1,500



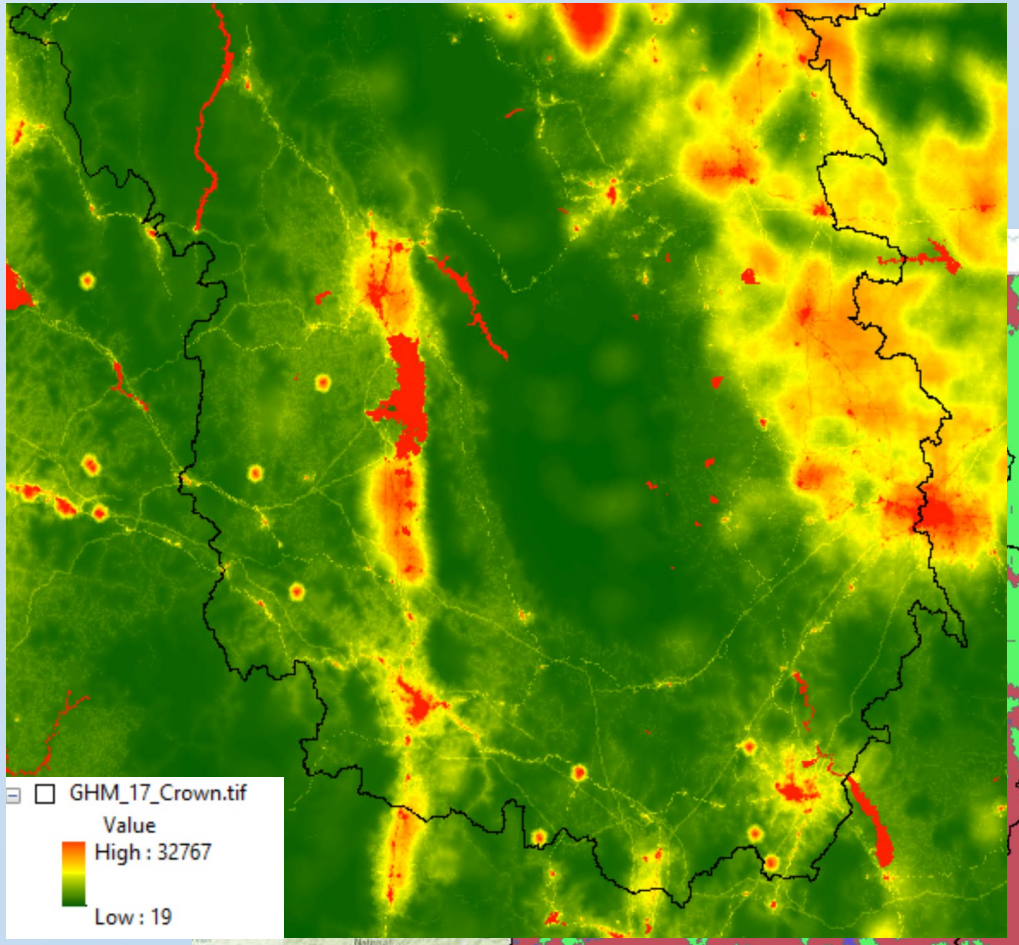
Features + Cost

Example Geography: Montana portion of Crown LCD Project Area

Example Features: Carnivores

Example Cost: Global Human Modification (Theobald et al. 2020)

Human Modification "Cost"



Grizzly Bear

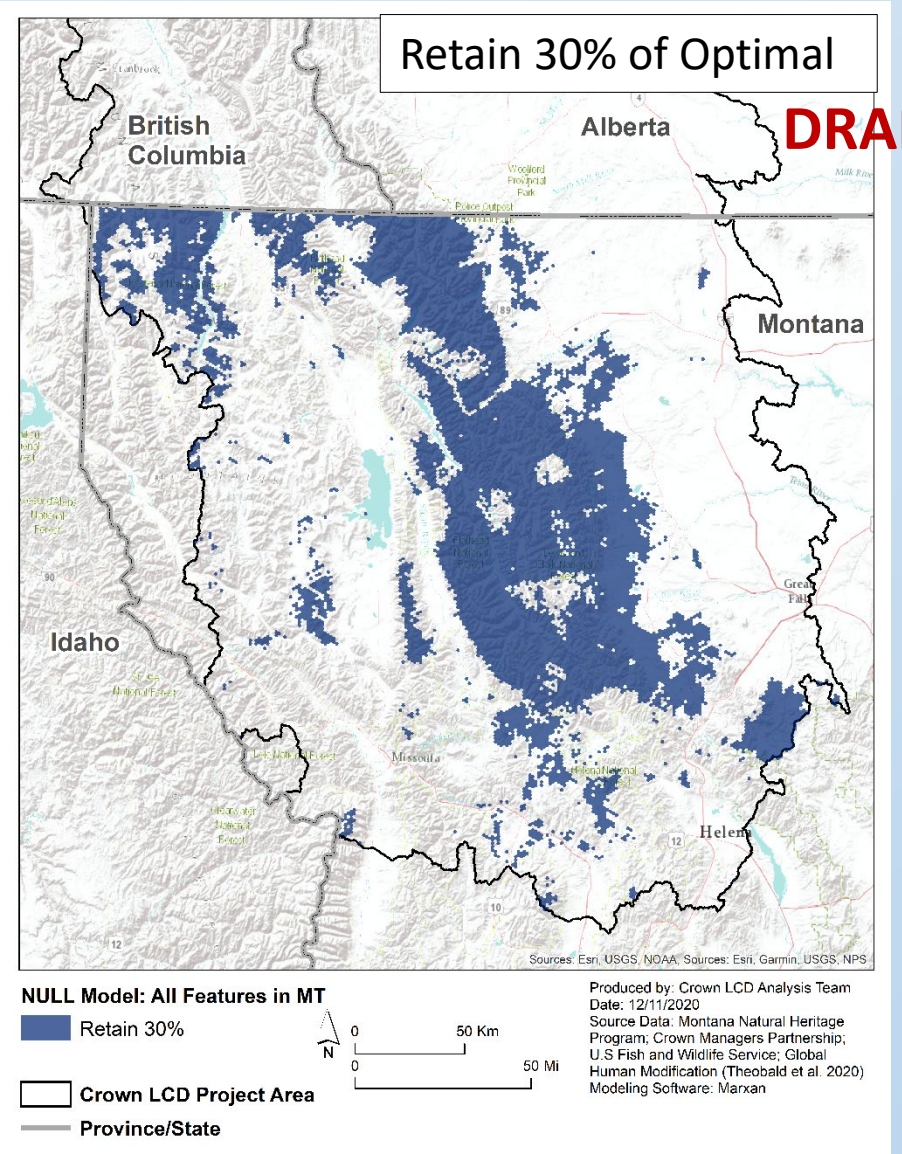
Wolverine

Canada Lynx

$$\underbrace{\sum_{PUs} Cost}_{1} + \text{BLM} \underbrace{\sum_{PUs} Boundary}_{2} + \underbrace{\sum_{Con.Targ.} SPF \times \text{Penalty}}_{3} = \text{Marxan Score}$$

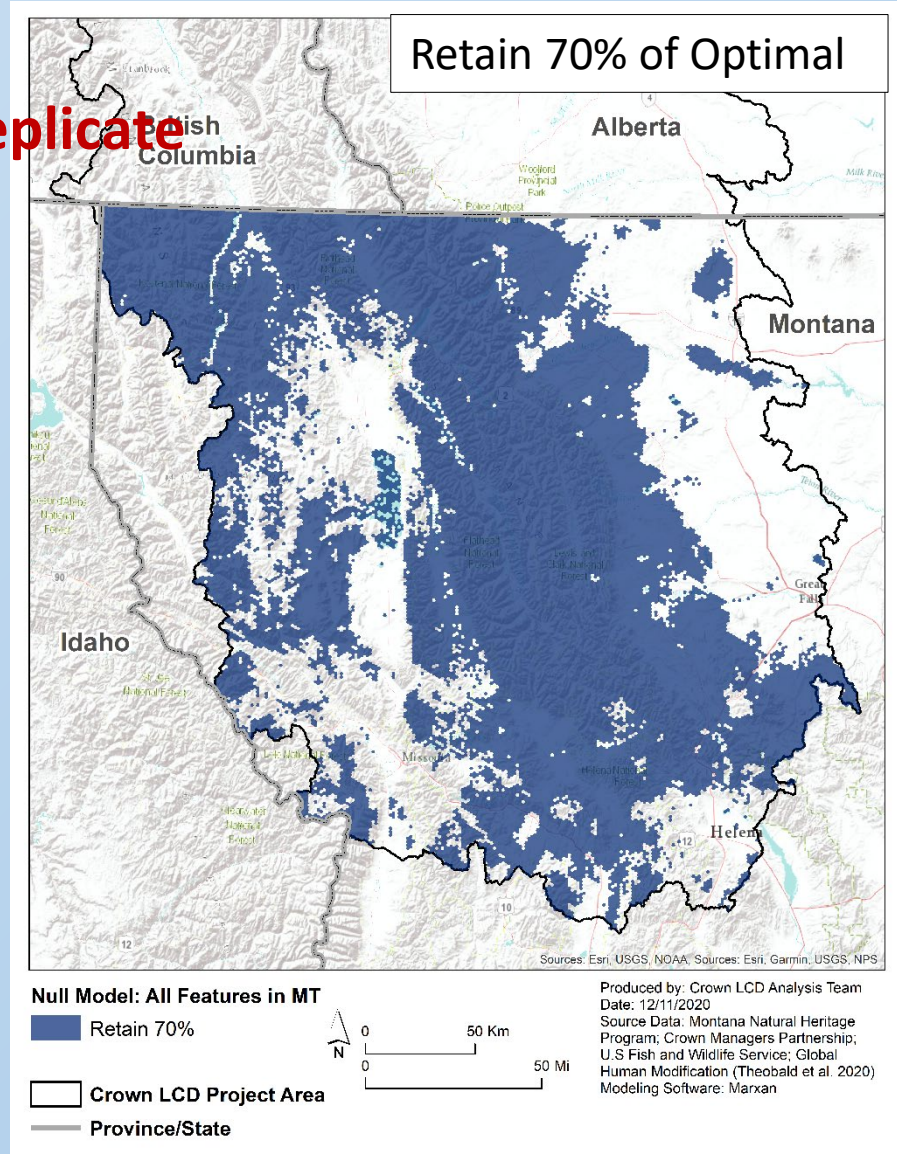
NULL Model: All Conservation Features in Montana

*Except ecological connectivity



DRAFT Materials – Do Not Replicate

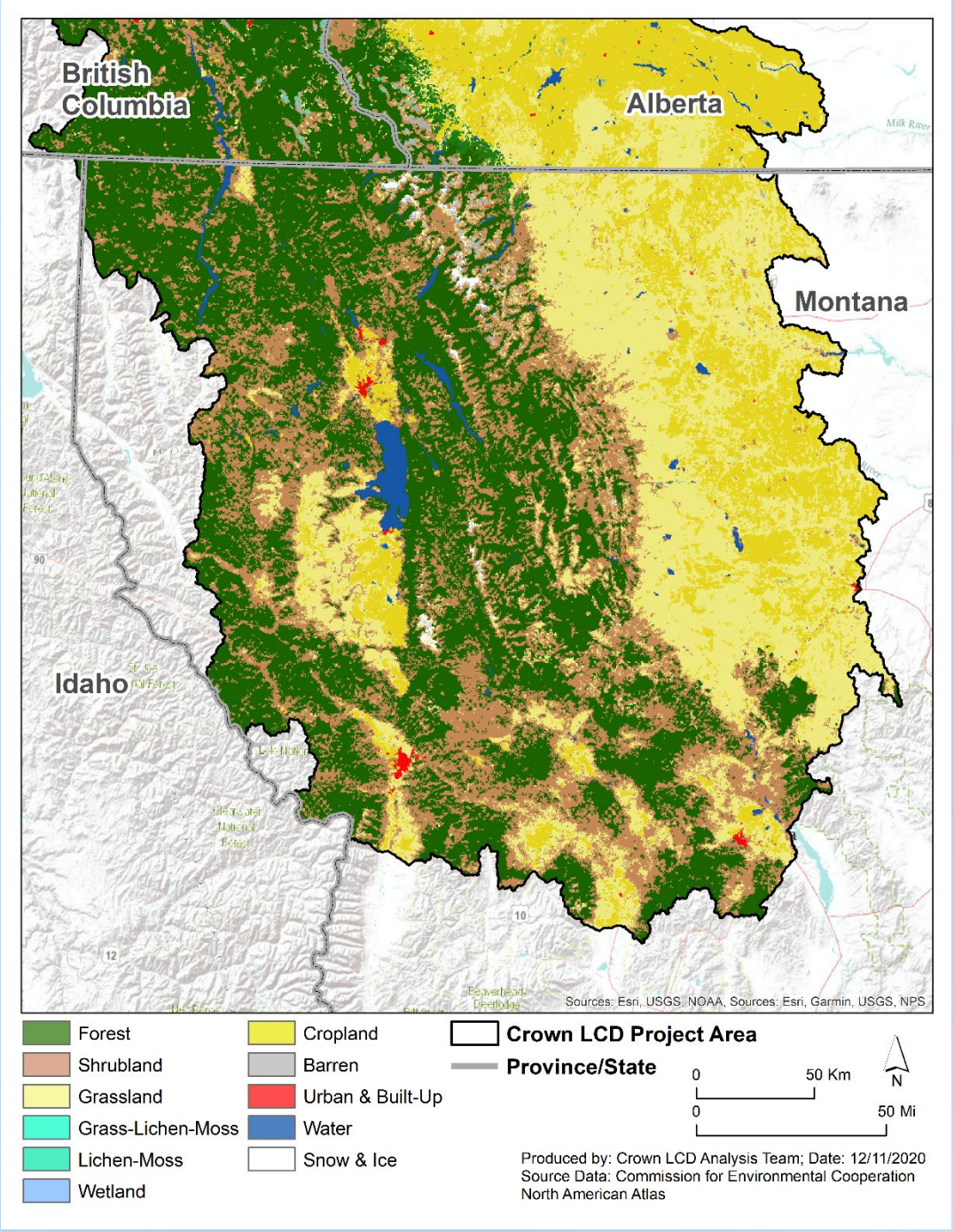
- Models created using Marxan
- 2 km^2 Planning Units
- Cost or Resistance Layer:
  - Global Human Modification (Theobald et al. 2020)
- Data sources:
  - MT Natural Heritage Program
  - US Fish and Wildlife Service
  - Crown Managers Partnership



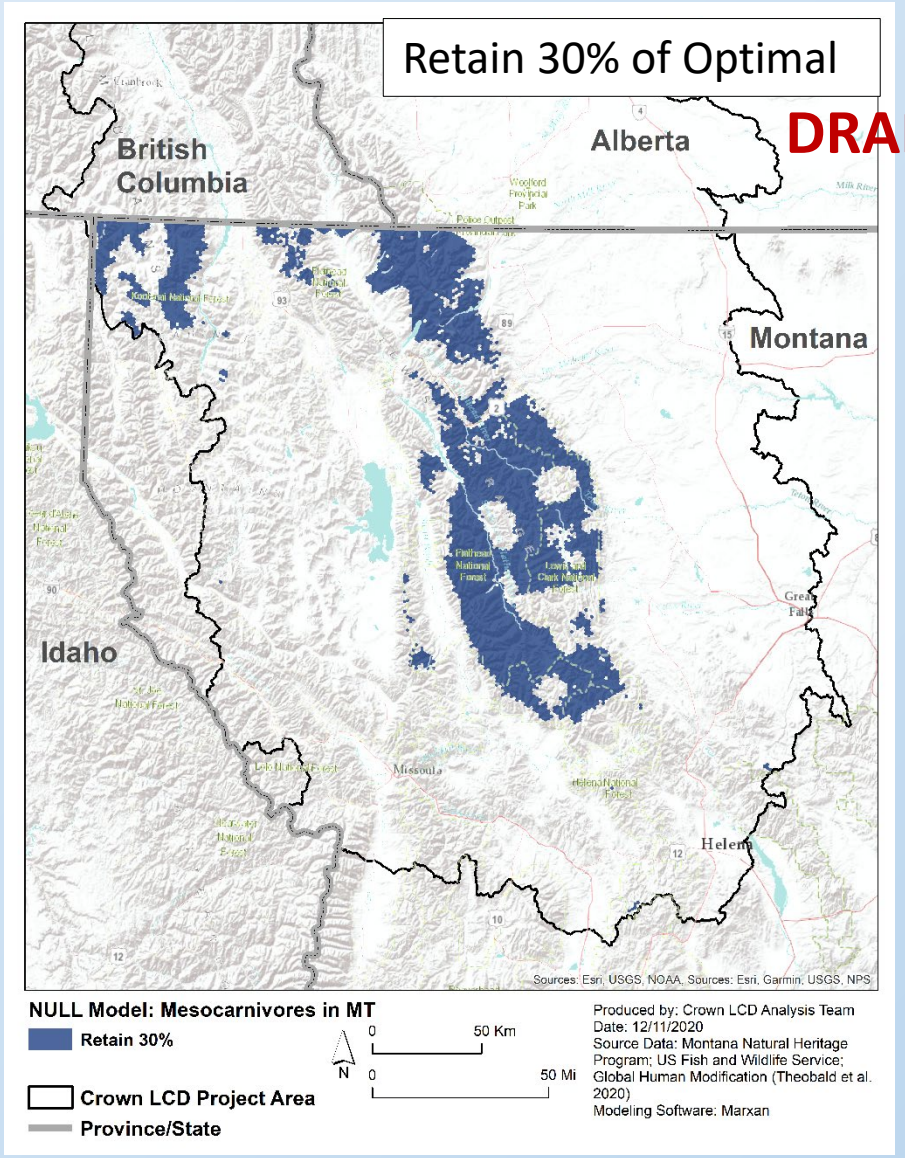
Landcover in Montana

Landcover Data source:

- Riparian:
  - MT NHP; Crown Managers
- All Others:
  - Commission for Environmental Cooperation
- Crown LCD Priority Landcover Types
  - **Aquatic (Open Water)**
  - **Forest**
  - **Grassland**
  - **Shrubland**
  - **Riparian**
  - **Wetland**



NULL Model: Landcover in Montana



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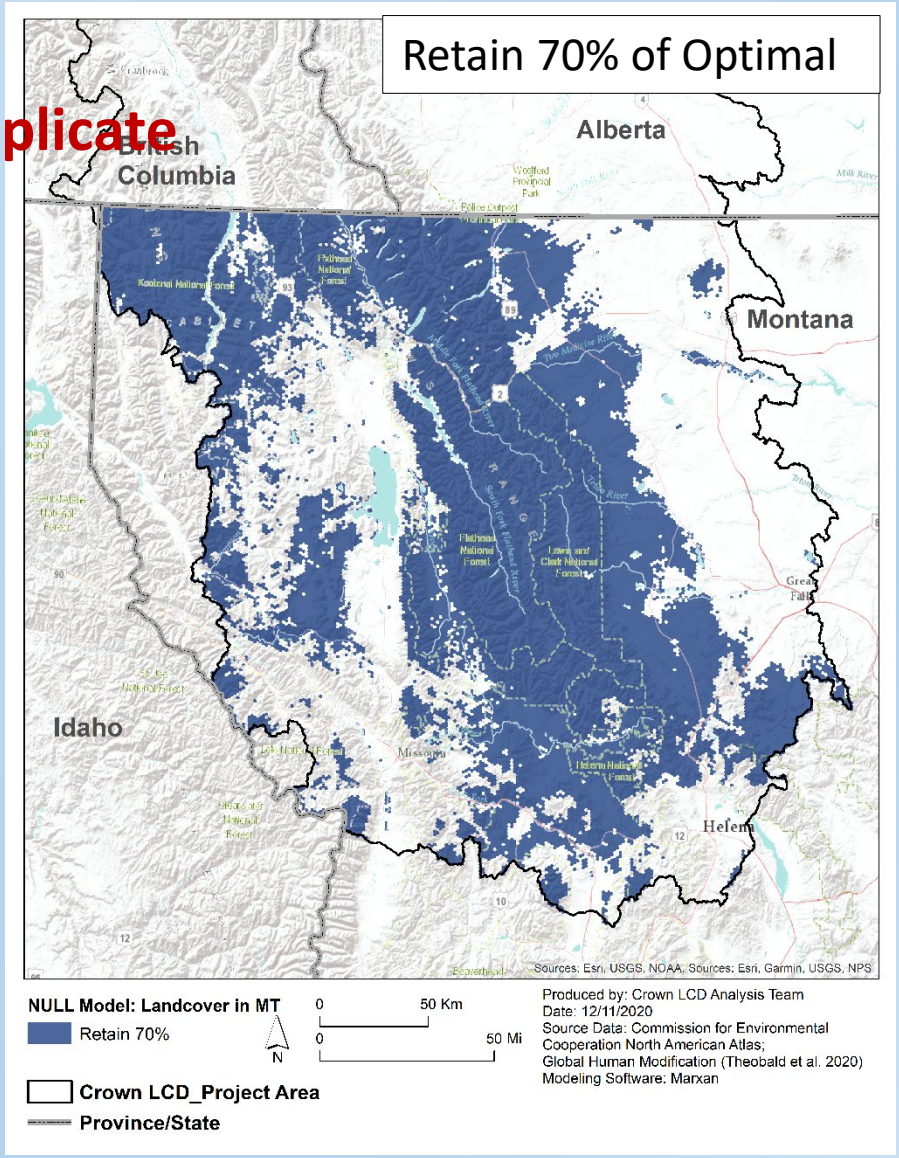
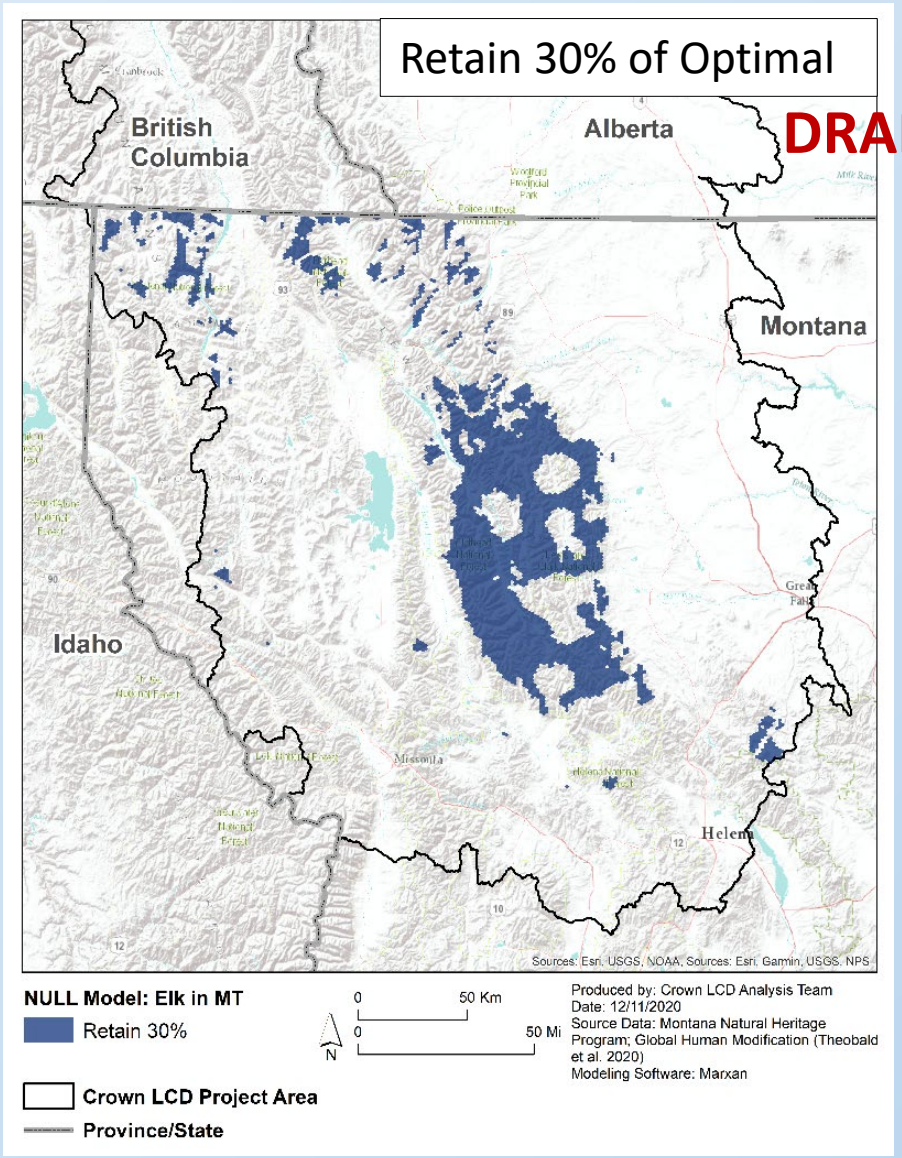


NULL Model: Elk in Montana



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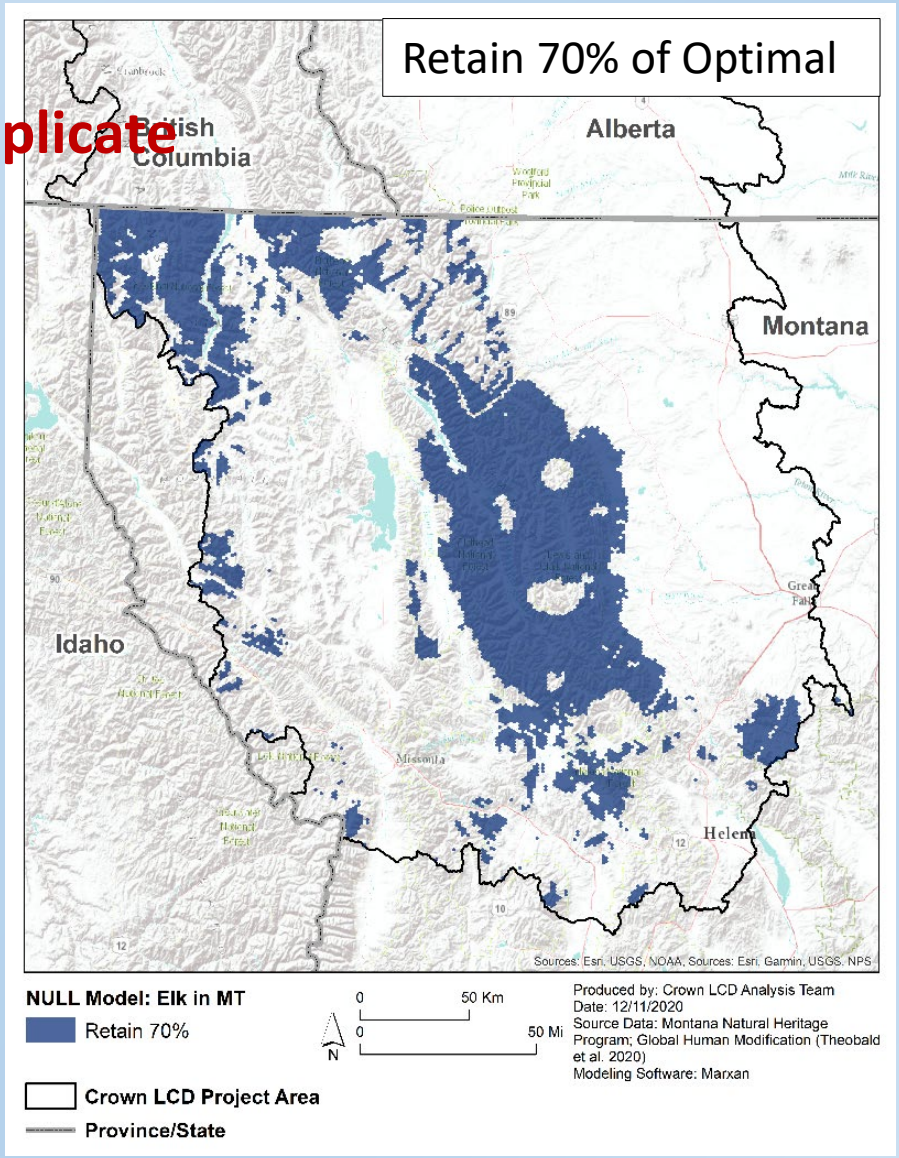
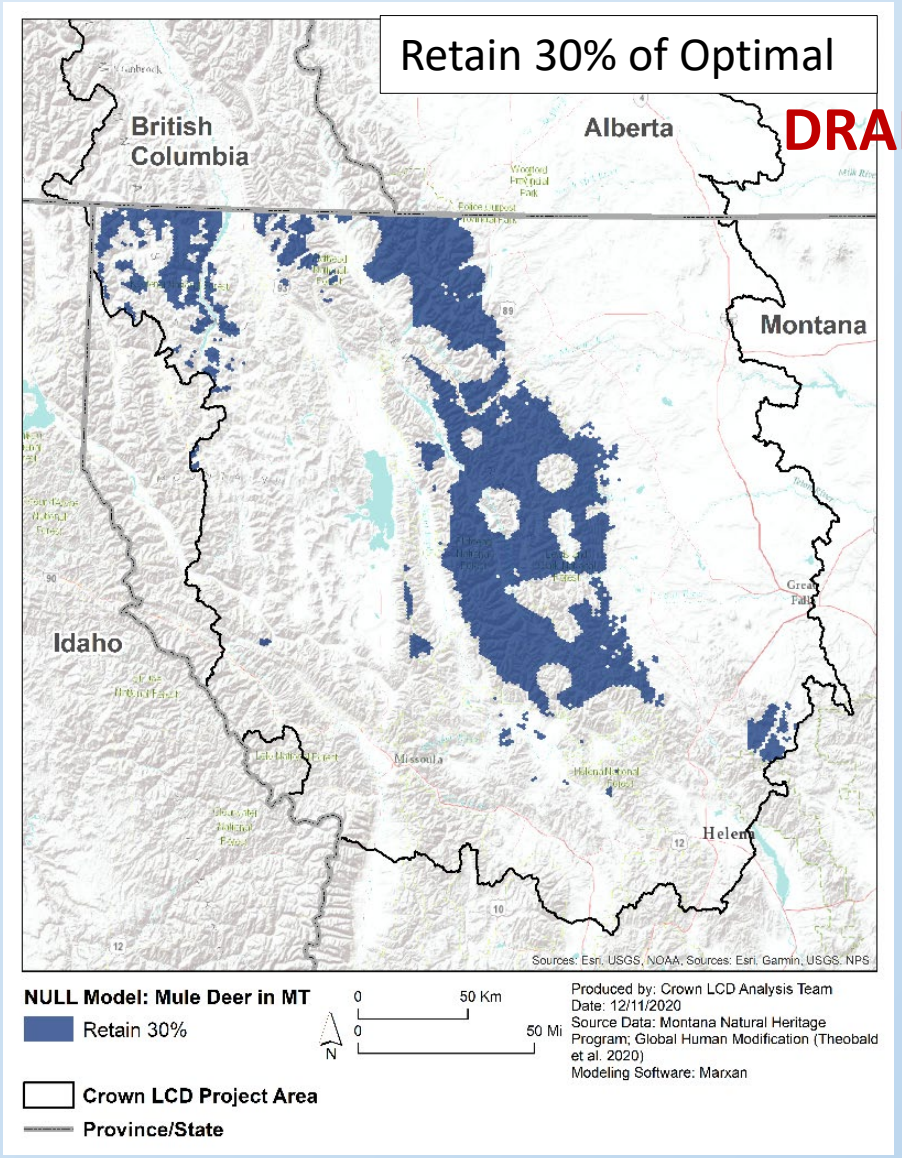


NULL Model: Mule Deer in Montana



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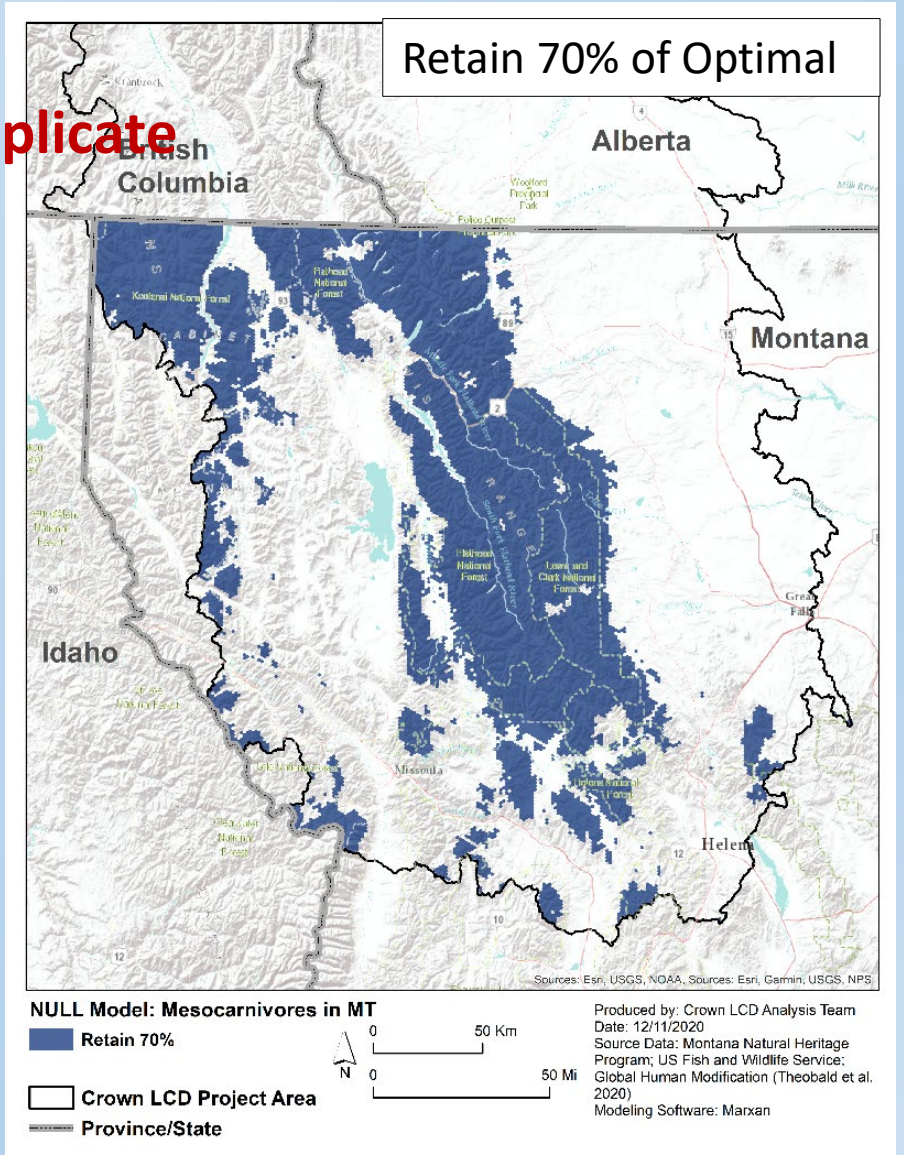
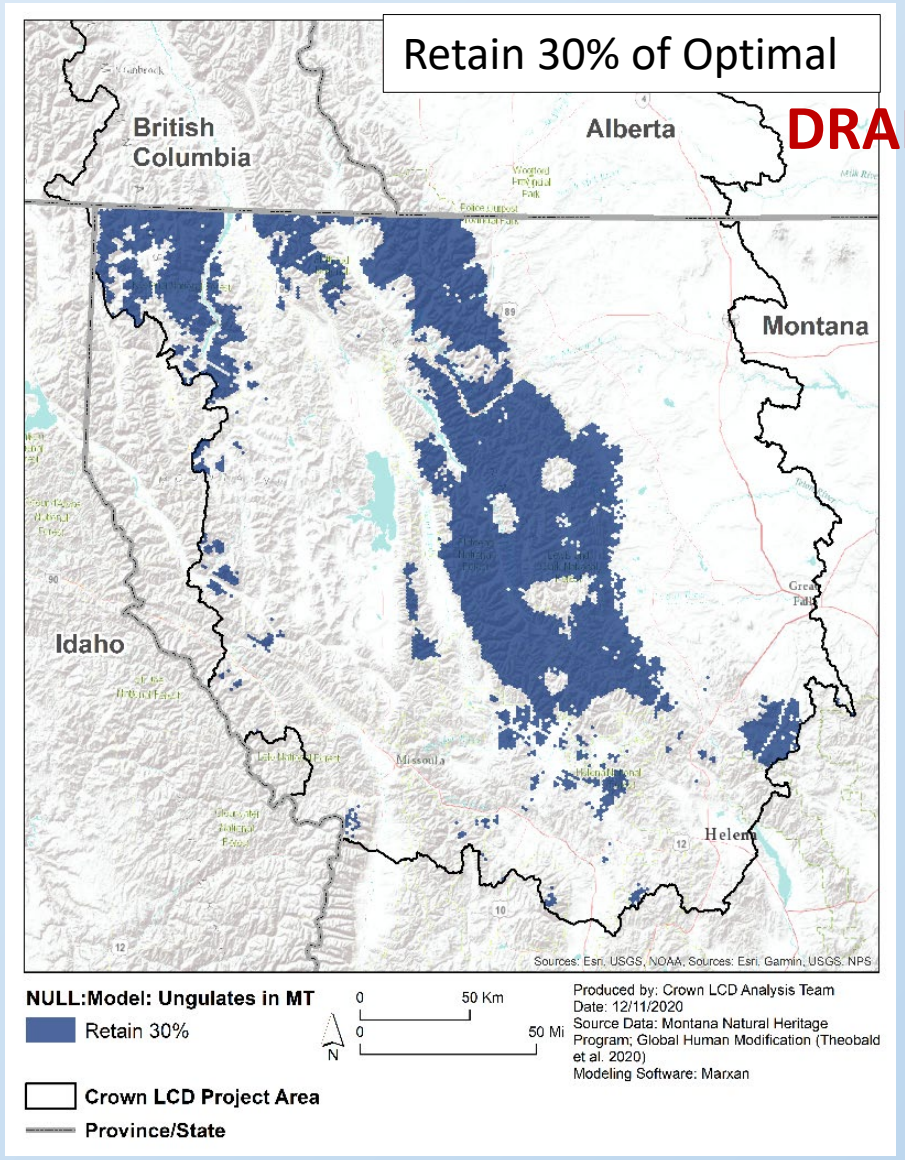


NULL Model: Ungulate Guild in Montana

Elk and Mule Deer



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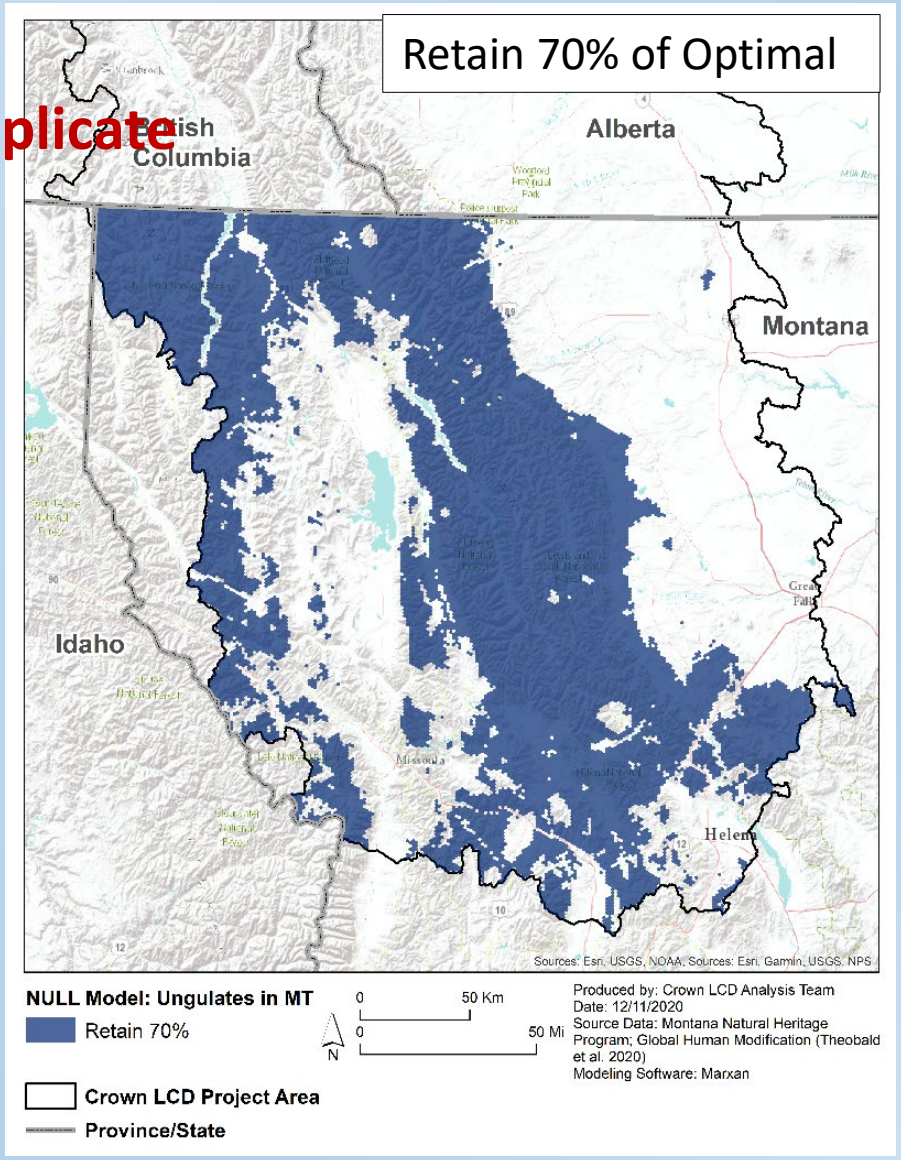
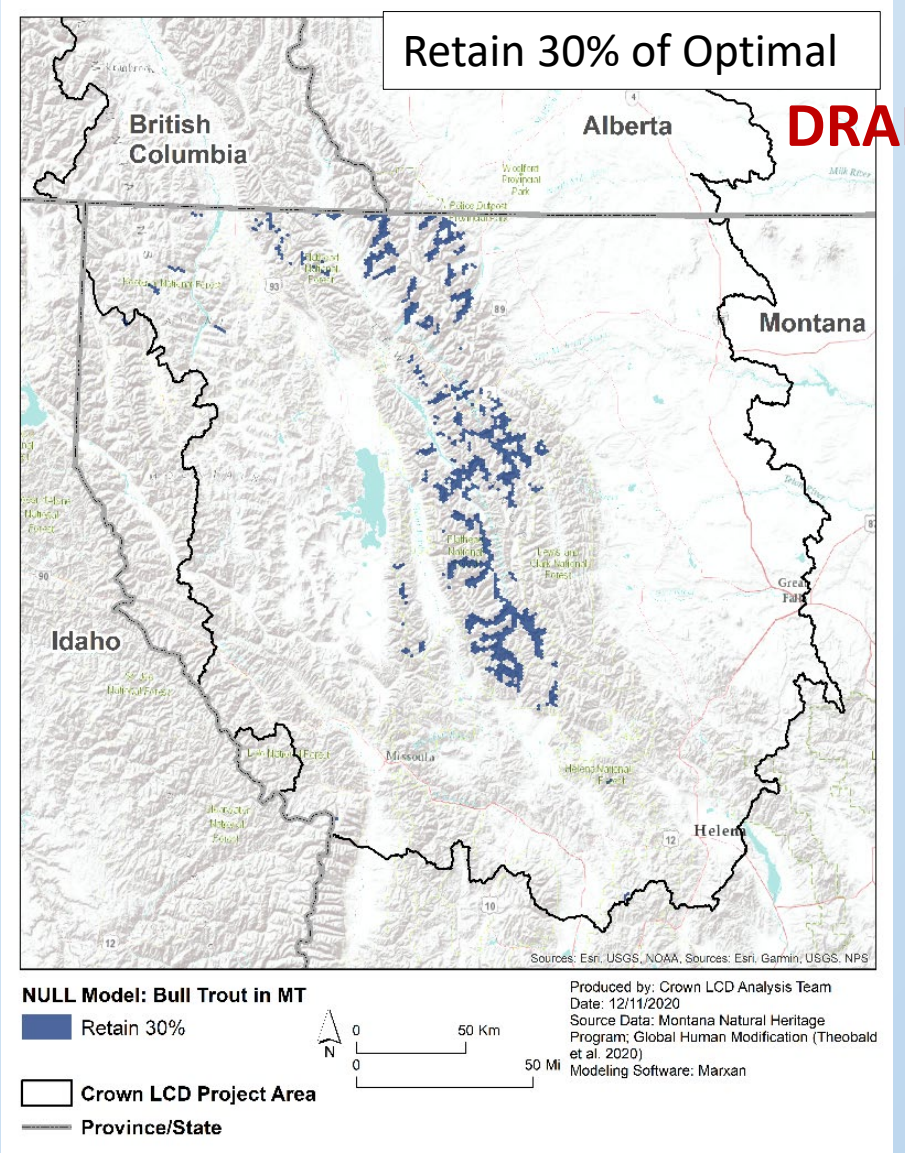


NULL Model: Bull Trout in Montana



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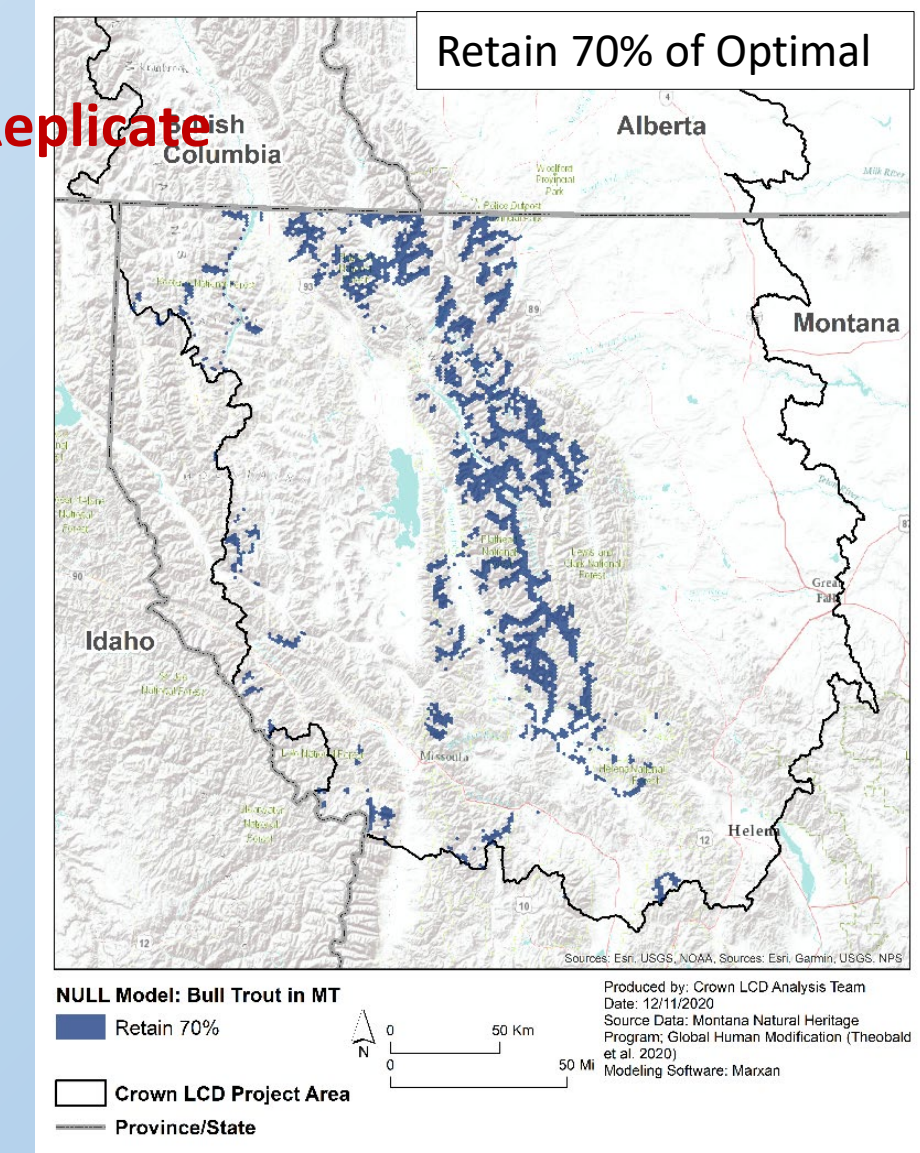
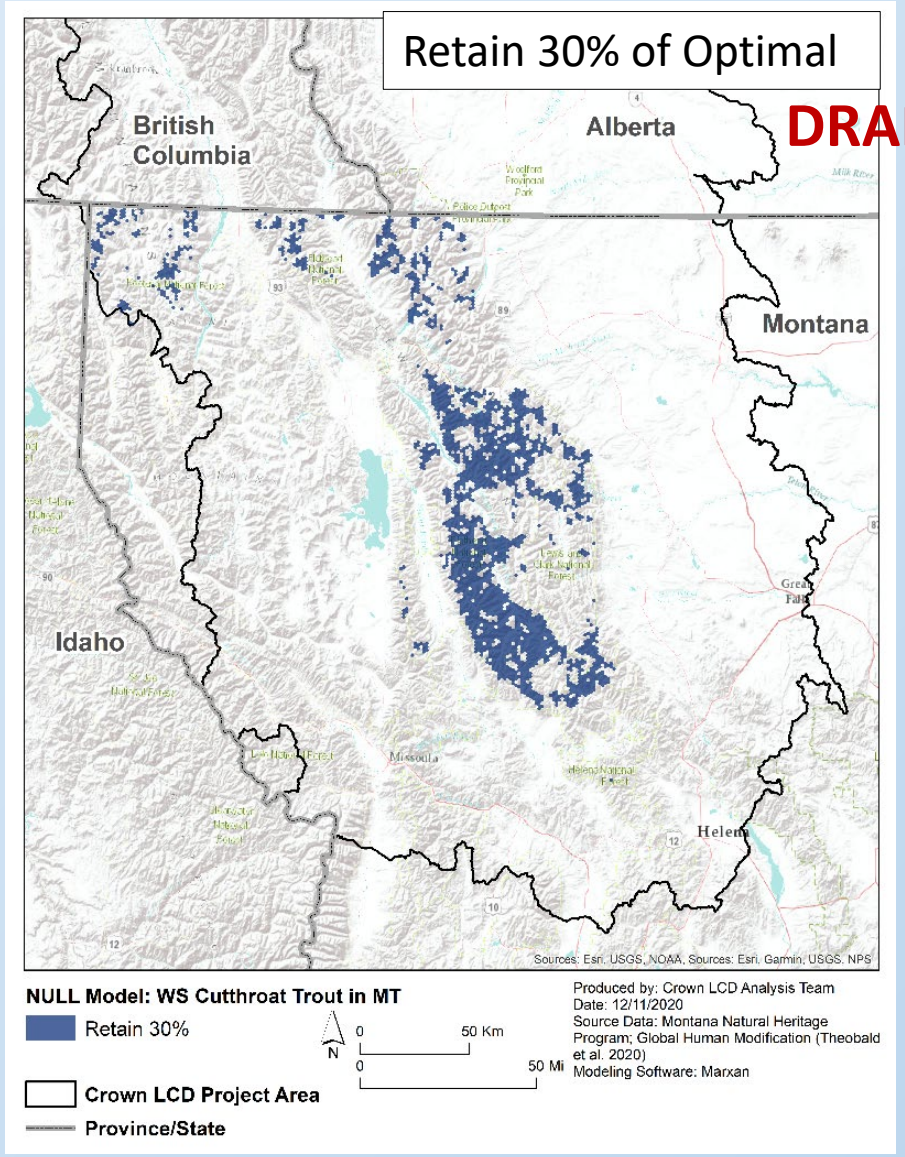


NULL Model: Westslope Cutthroat Trout in Montana



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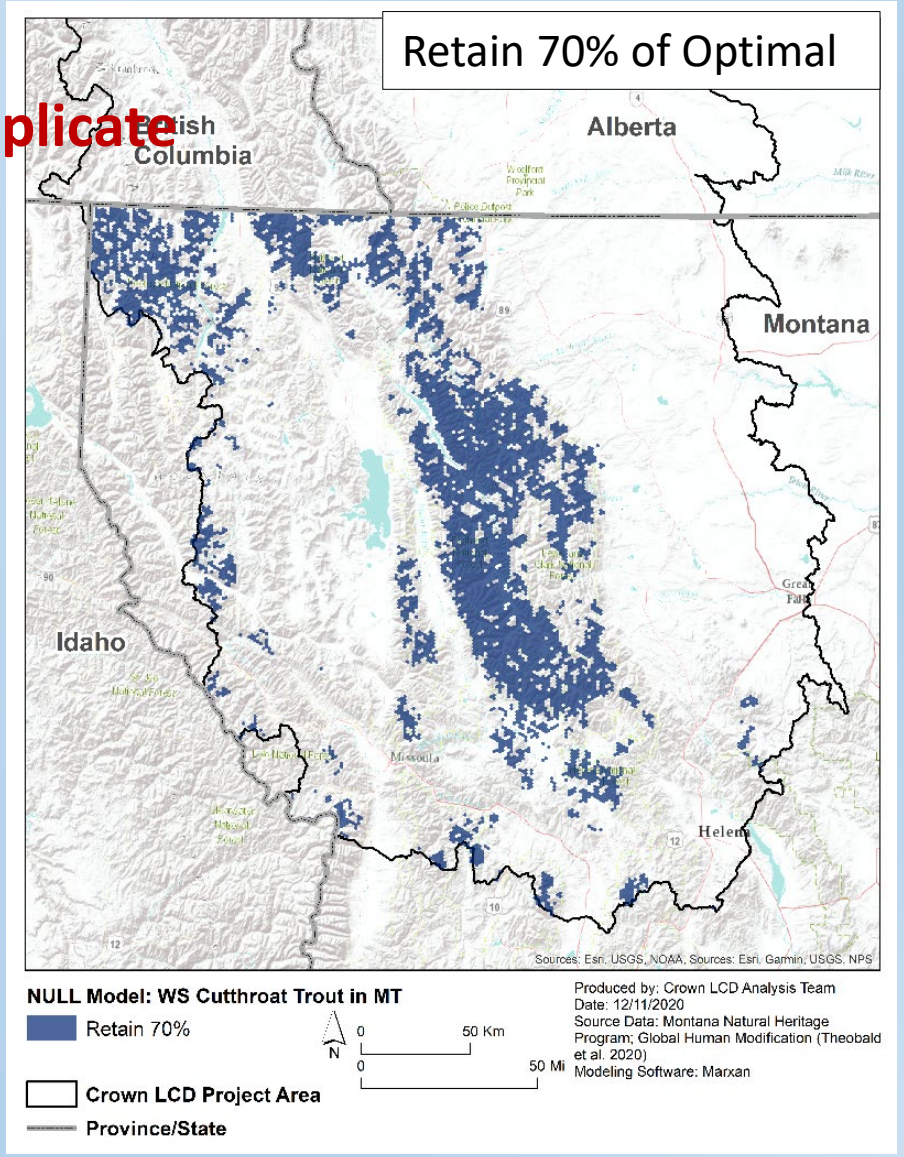
- Cost or Resistance Layer:
  - Global Human Modification (Theobald et al. 2020)
- Westslope Cutthroat Trout Data sources:
  - MT Natural Heritage Program



NULL Model: Salmonid Guild in Montana

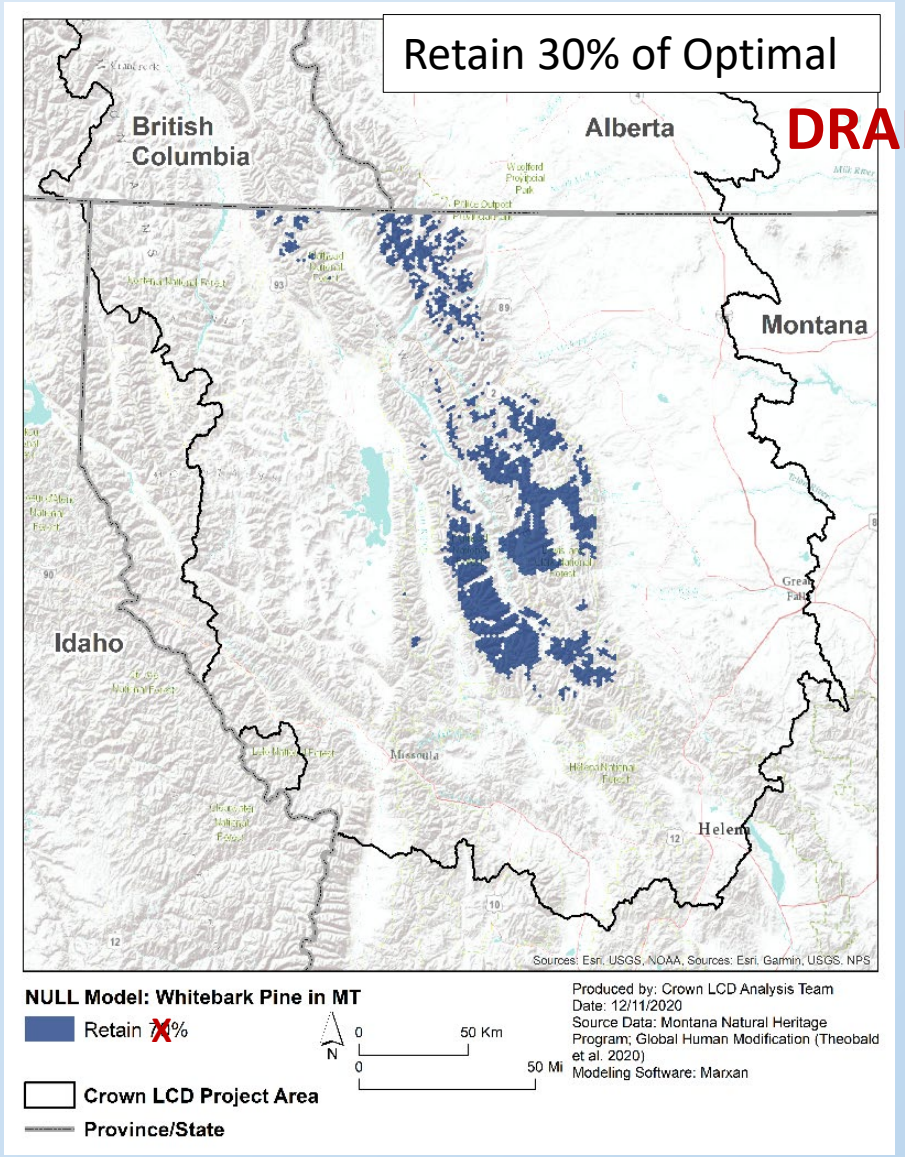
Bull Trout and Westslope Cutthroat Trout

Coming ….

- Models created using Marxan
- 2 km^2 Planning Units
- Cost or Resistance Layer:
  - Global Human Modification (Theobald et al. 2020)
- Salmonids Data sources:
  - MT Natural Heritage Program

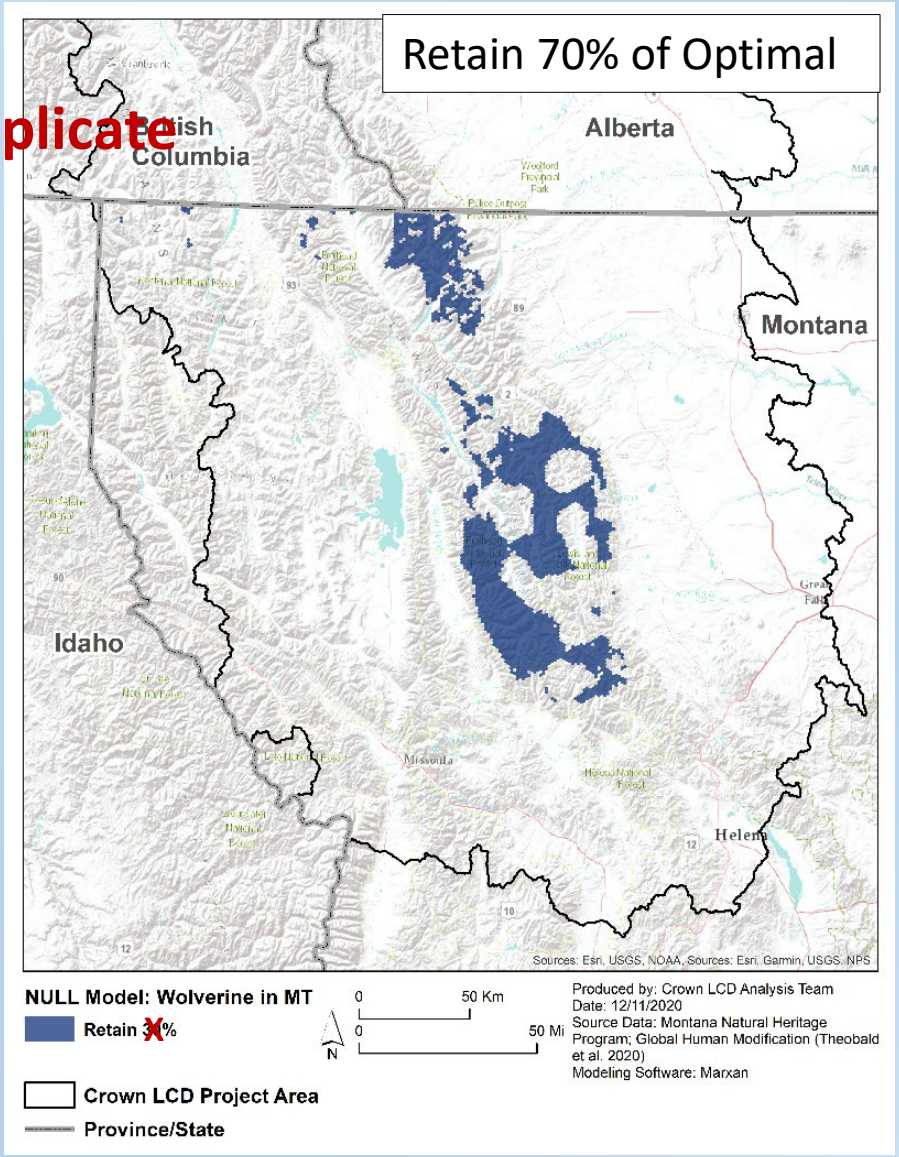
…. Soon!

NULL Model: Whitebark Pine in Montana

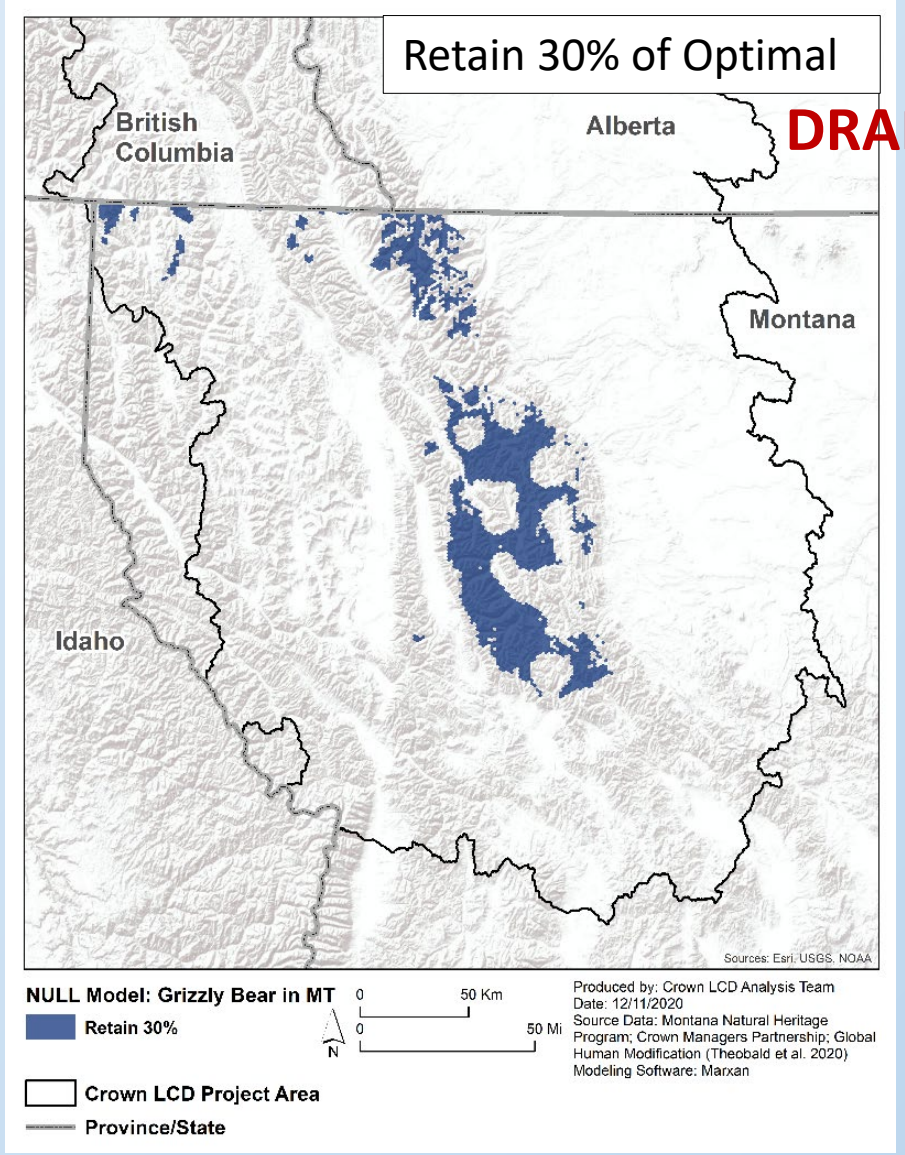


DRAFT Materials – Do Not Replicate

- Models created using Marxan
- 2 km^2 Planning Units
- Cost or Resistance Layer:
  - Global Human Modification (Theobald et al. 2020)
- Whitebark Pine Data sources:
  - Hi5 Partnership

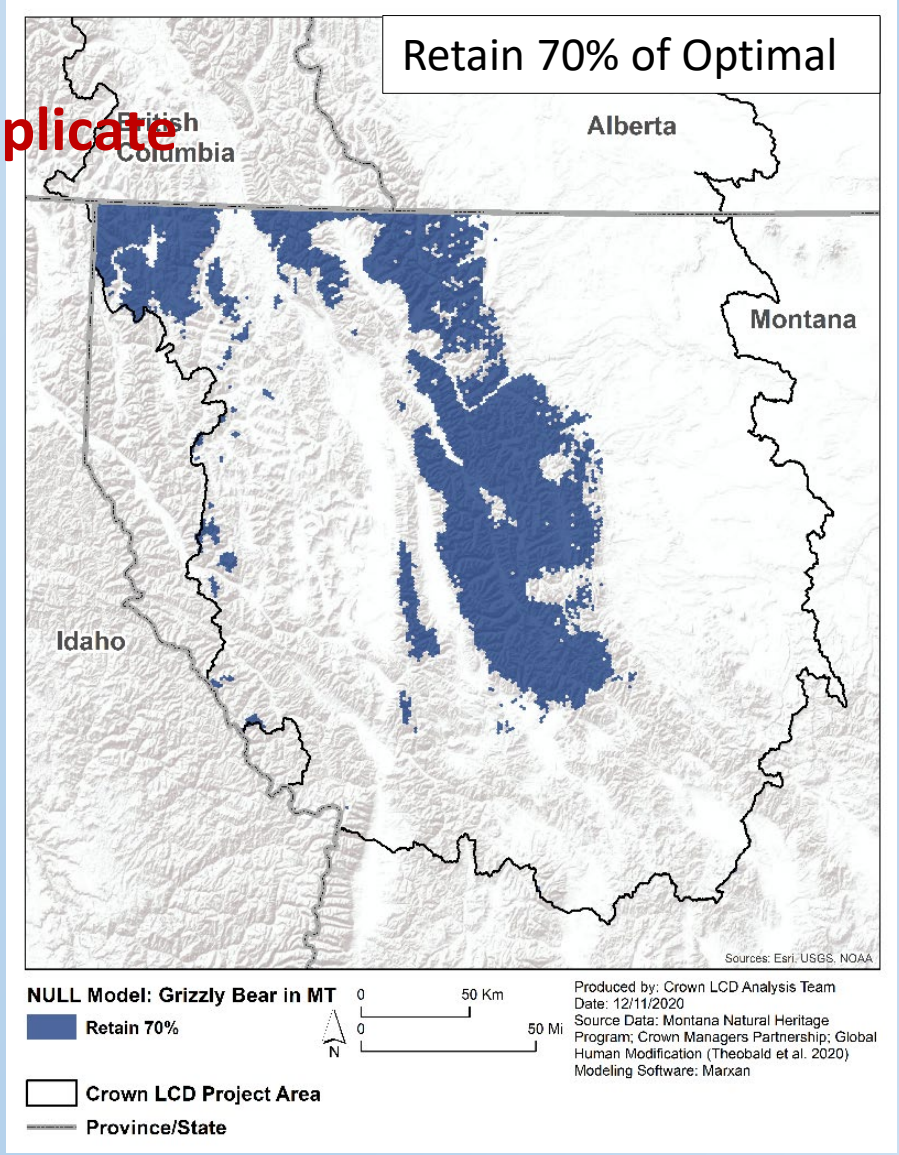


NULL Model: Grizzly Bear in Montana

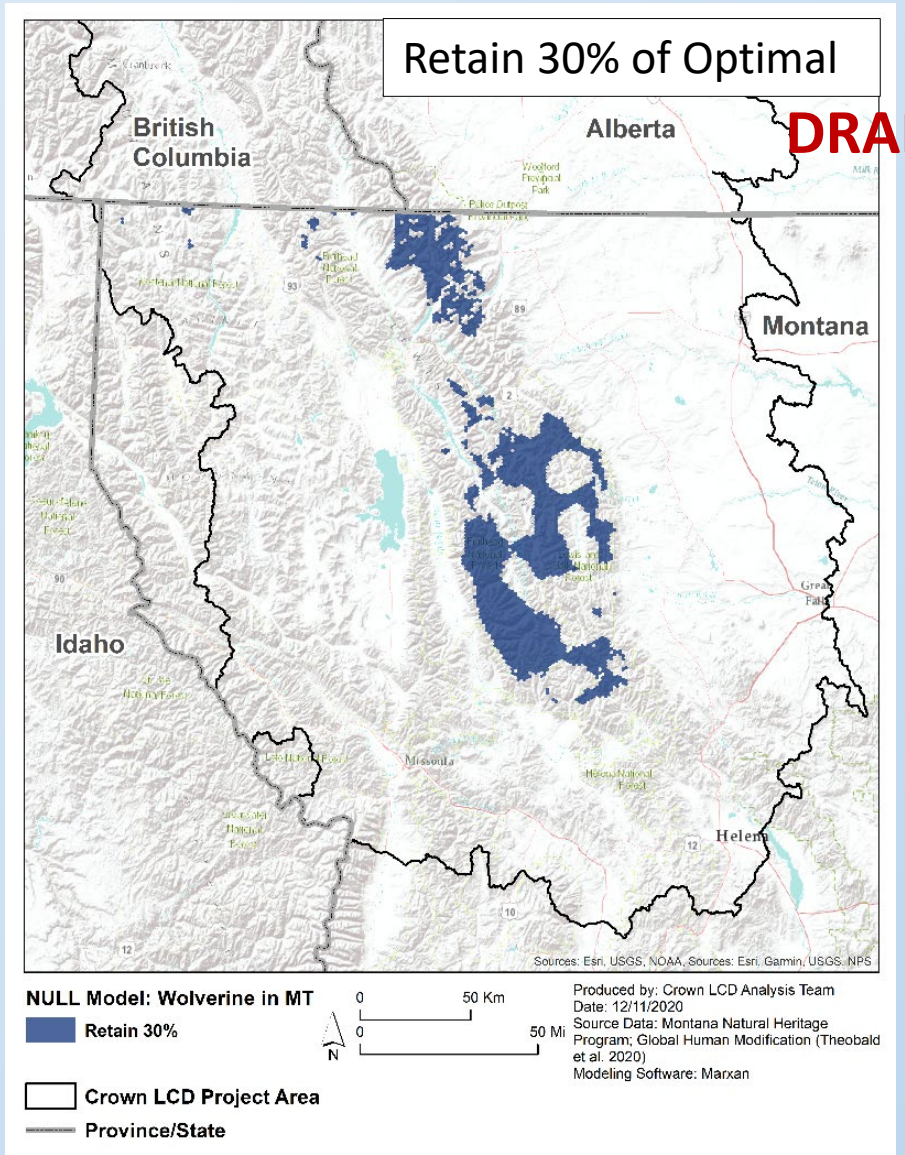


DRAFT Materials – Do Not Replicate

- Models created using Marxan
- 2 km^2 Planning Units
- Cost or Resistance Layer:
  - Global Human Modification (Theobald et al. 2020)
- Grizzly Bear Data sources:
  - MT Natural Heritage Program
  - Crown Managers Partnership

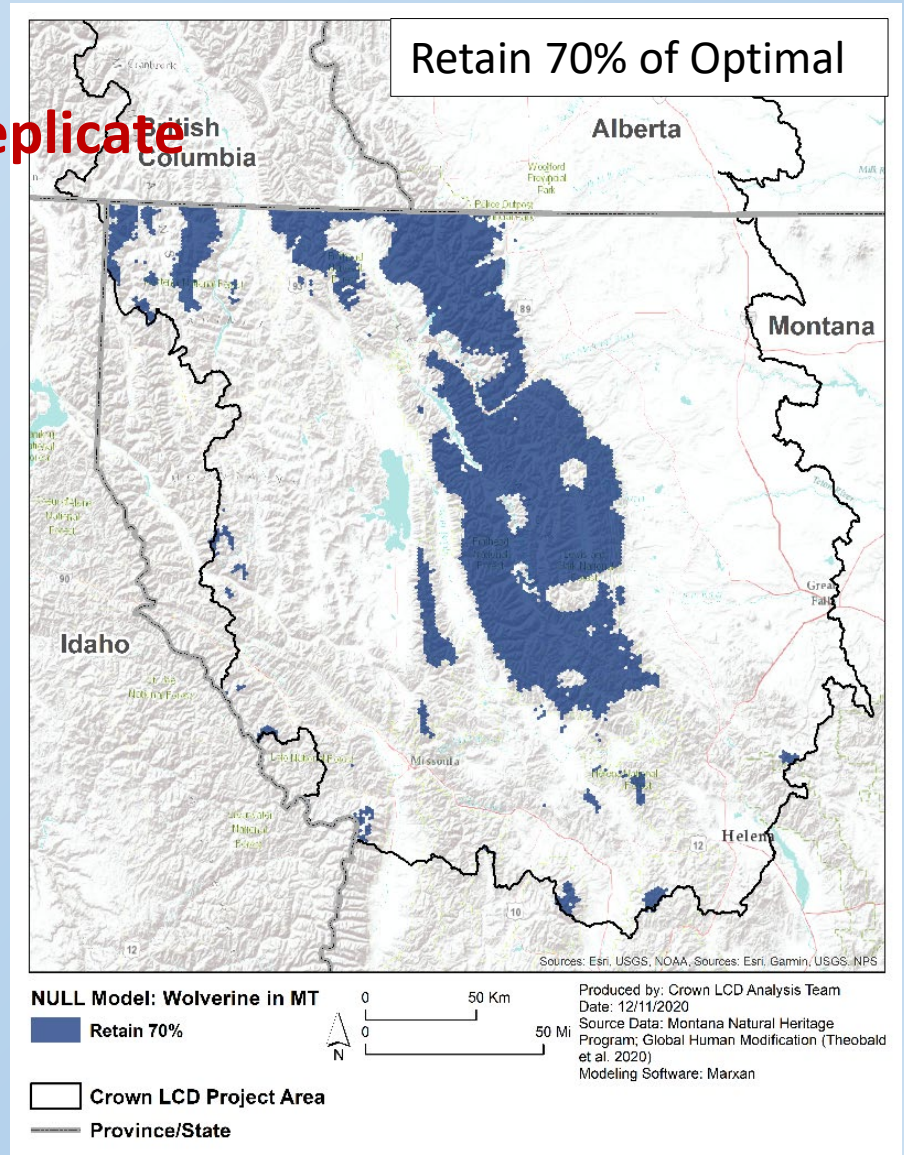


NULL Model: Wolverine in Montana

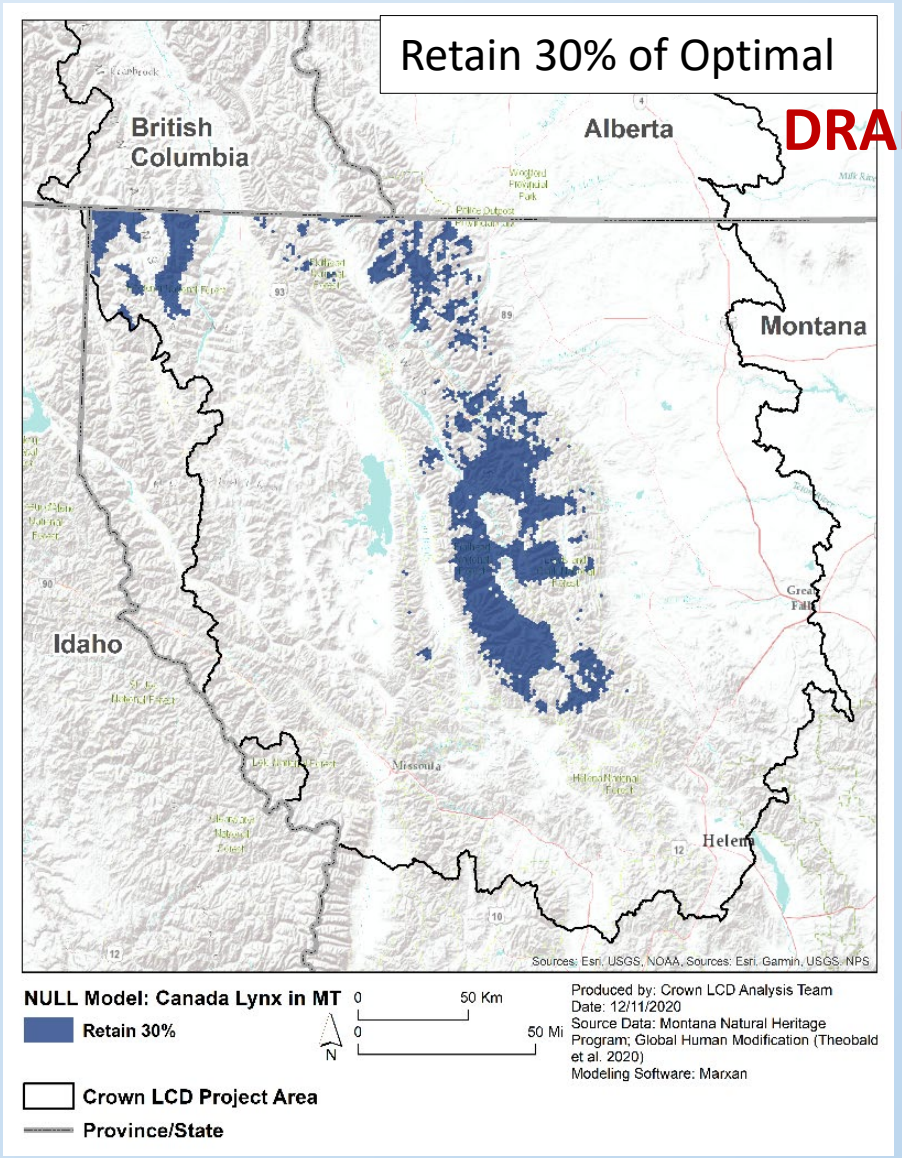


DRAFT Materials – Do Not Replicate

- Models created using Marxan
- 2 km^2 Planning Units
- Cost or Resistance Layer:
  - Global Human Modification (Theobald et al. 2020)
- Mesocarnivore Data sources:
  - MT Natural Heritage Program
  - US Fish and Wildlife Service

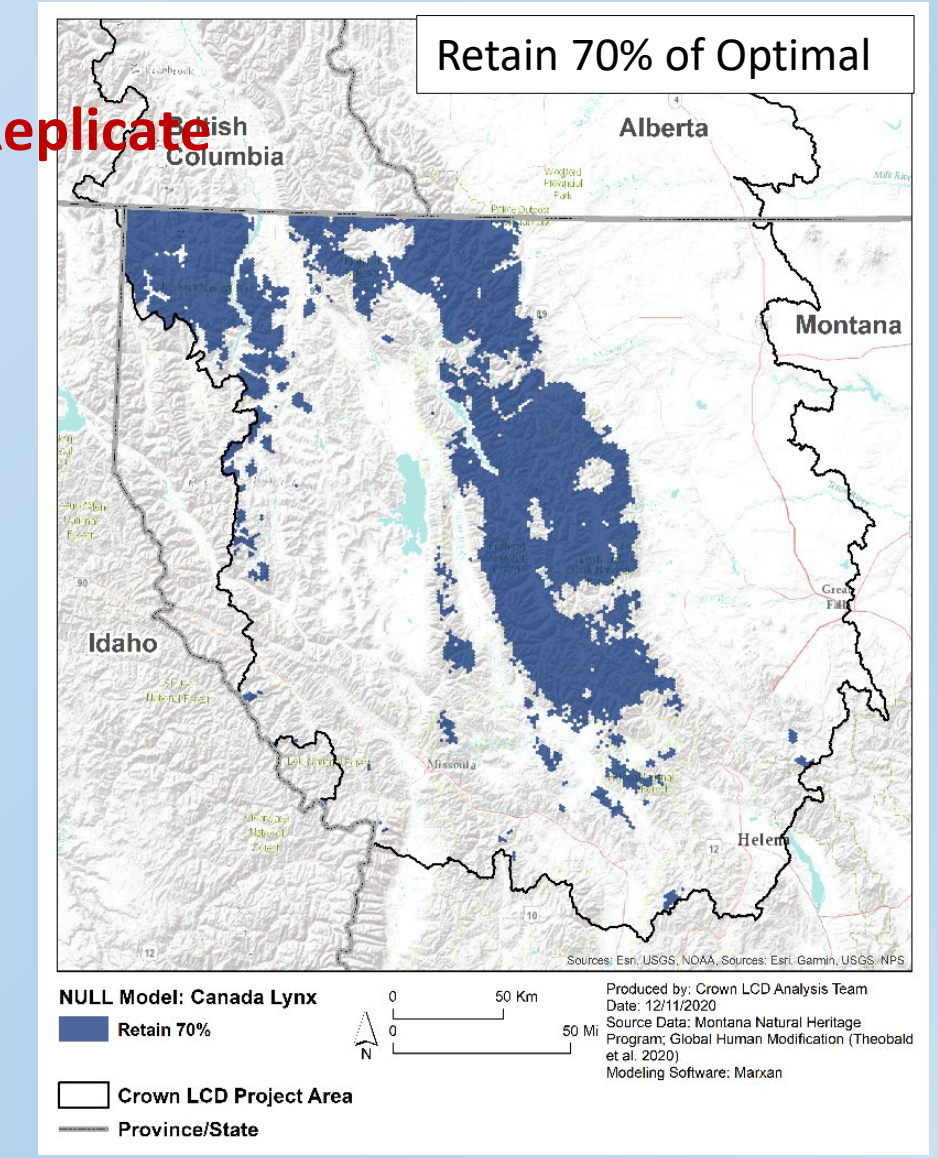


NULL Model: Canada Lynx in Montana



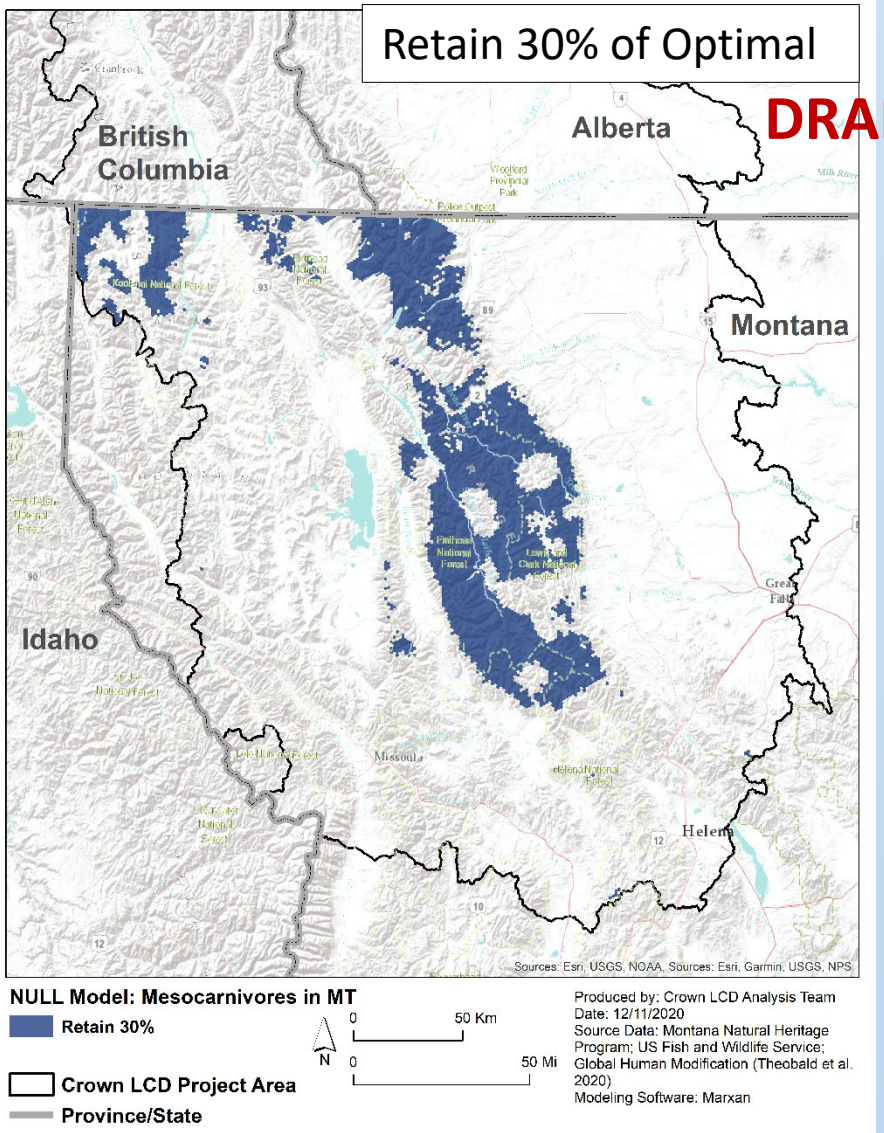
DRAFT Materials – Do Not Replicate

- Models created using Marxan
- 2 km^2 Planning Units
- Cost or Resistance Layer:
  - Global Human Modification (Theobald et al. 2020)
- Mesocarnivore Data sources:
  - MT Natural Heritage Program
  - US Fish and Wildlife Service



NULL Model: Mesocarnivore Guild in Montana

Wolverine and Canada Lynx



DRAFT Materials – Do Not Replicate

- Models created using Marxan
- 2 km^2 Planning Units
- Cost or Resistance Layer:
  - Global Human Modification (Theobald et al. 2020)
- Mesocarnivore Data sources:
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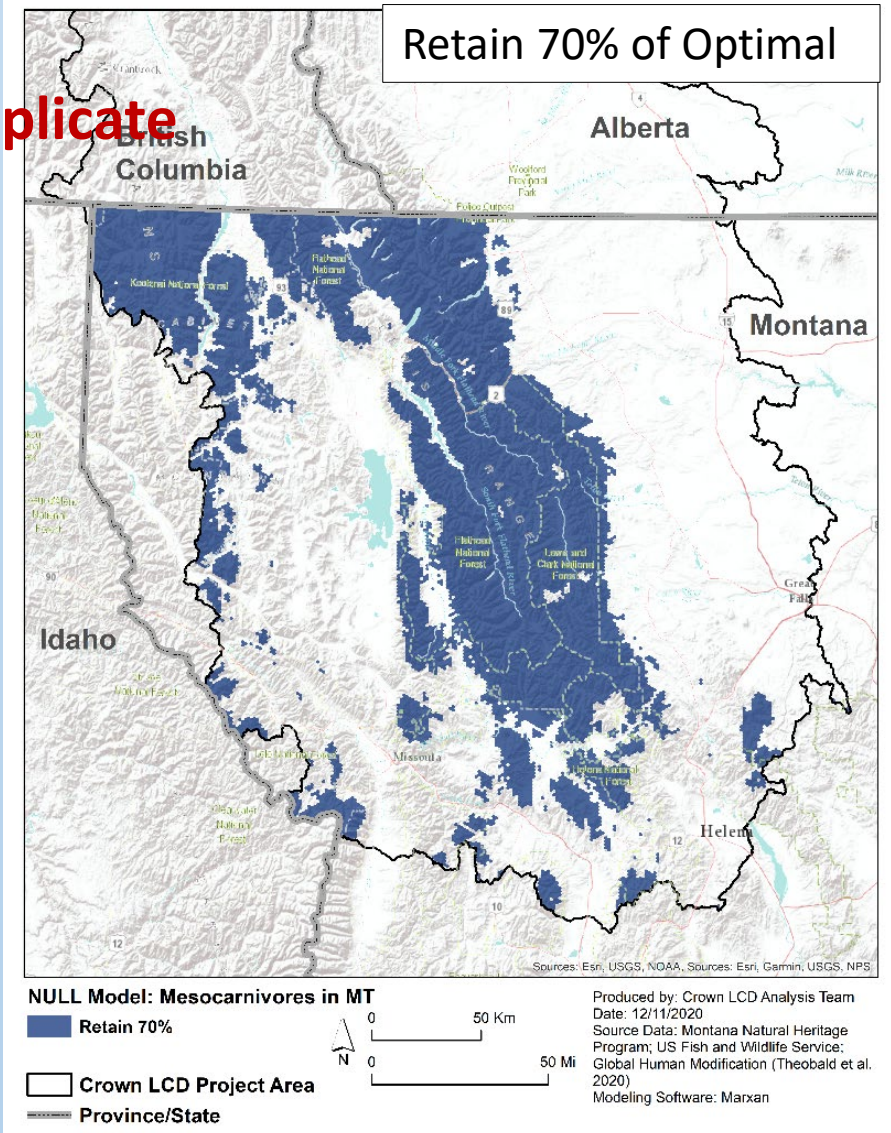
  - US Fish and Wildlife Service



What have we learned?

- Data in hand (at least for Montana) is largely sufficient to generate useful maps
- A single, uniform cost layer (Global Human Modification) is not particularly useful
- Three legs of our LCD chair: the Leadership Team, Technical Team and Analysis Team are functioning well
- The fourth leg – subject matter expert teams – are critical to for a reliable design

- **We still have A LOT of Work to do!!**

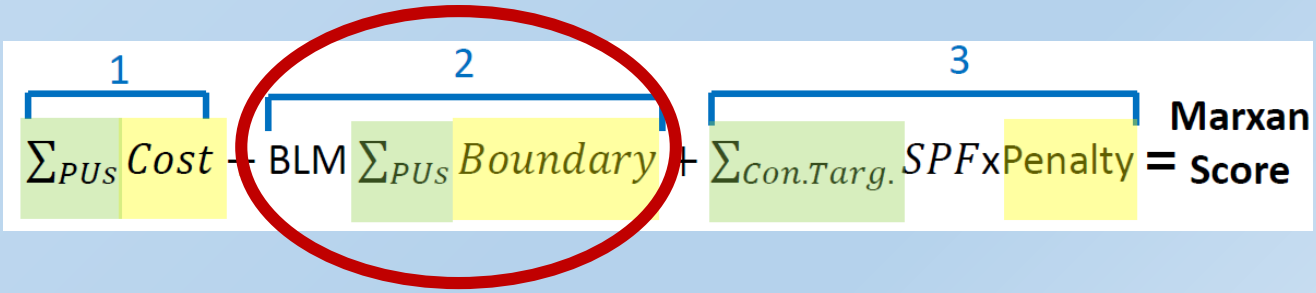
Model Parameterization …

- Optimization “Targets” for each feature
  - Model inputs identify “a target amount for each feature to be included in solution”
  - May be guided by:
    - Legislation
    - Resource Planning
    - Published Literature
    - Expert Knowledge

- “Boundary Limits Modifier”
  - Governs the amount of clumping in solution

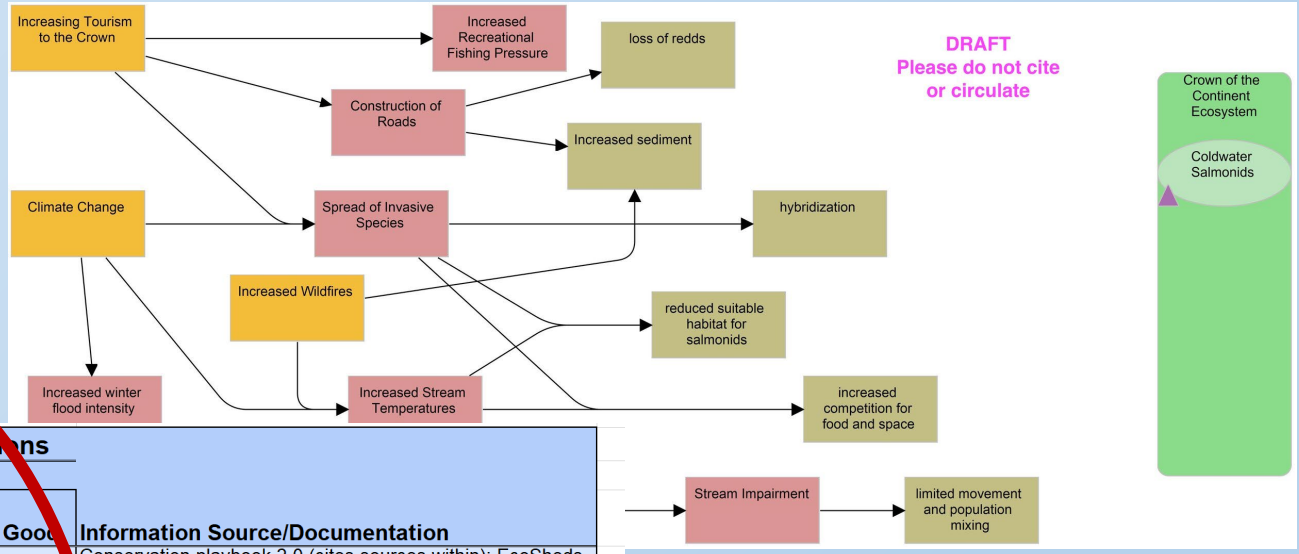
“spec.dat”

id	prop	target	targetocc	spf	name
1	0.65	0.0	0	1.0	C_Lynx
2	0.65	0.0	0	1.0	Wolverine
3	0.65	0.0	0	1.0	G_Bear



Model Parameterization …

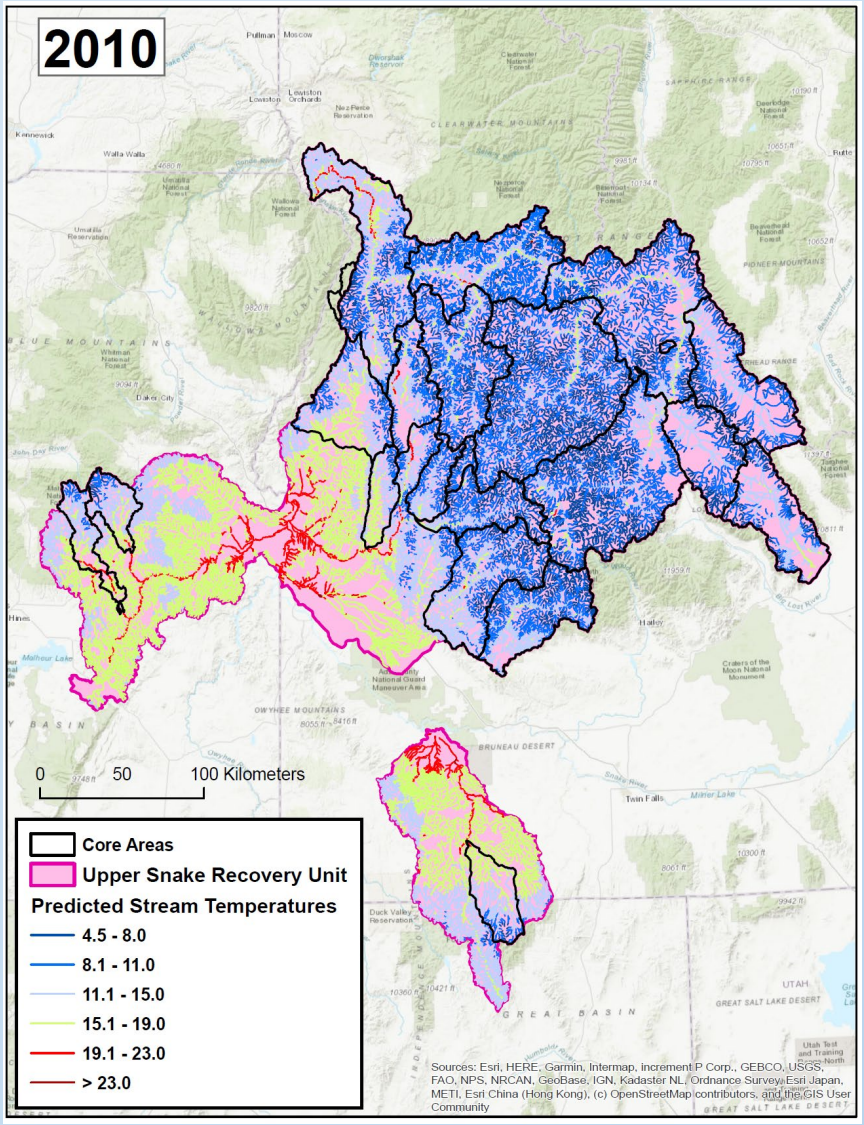
- **Feature-specific Cost estimation**
- Data, identification, acquisition and finesse

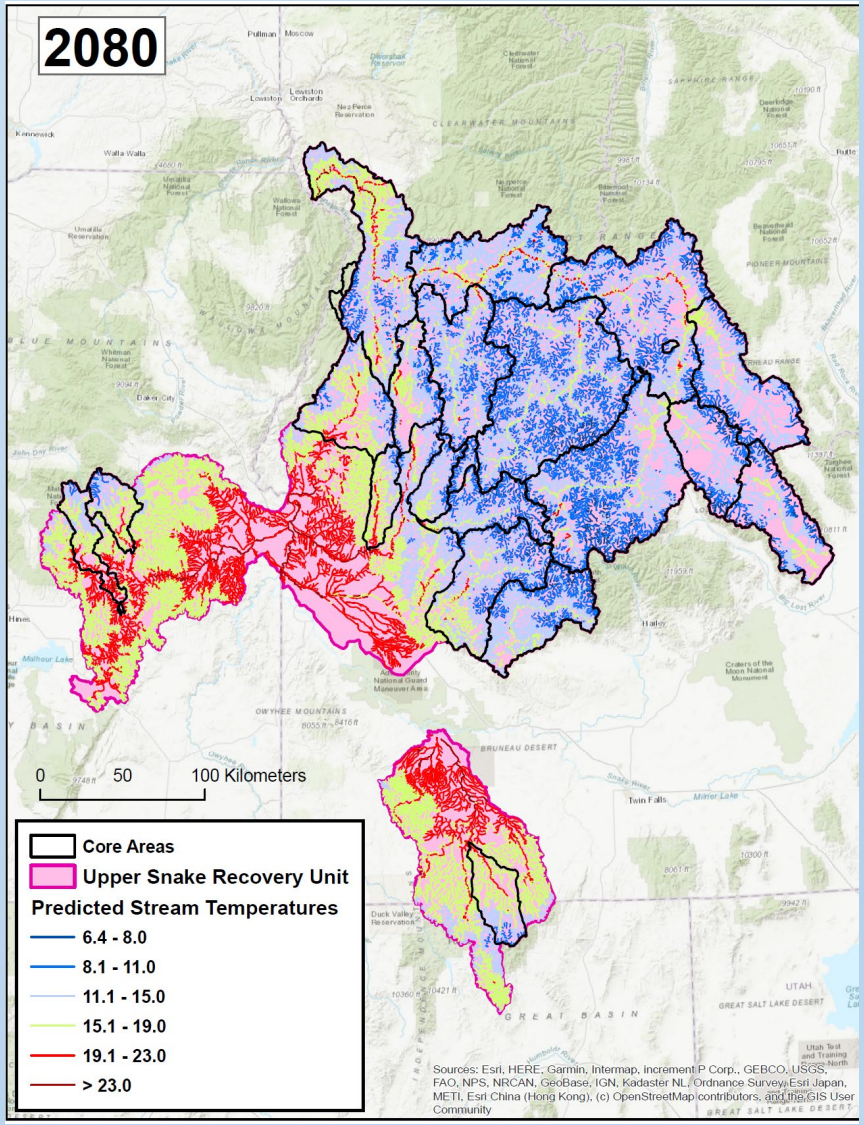


	West Slope Cutthroat Trout		Desired Conditions				
			RELATIVE CONDITION				
	KEY ECOLOGICAL ATTRIBUTE	INDICATOR (METRIC)	Poor	Fair	Good	Very Good	Information Source/Documentation
Climate Risk	Stream Temperature	Mean Aug. Stream Temp (degC)	20+	15-20	13-15	<13	Conservation playbook 2.0 (cites sources within); EcoSheds (Muhlfeld et al.)
		Max Aug. Stream Tem (degC)	23+	17-22	15-17	<15	coSheds (Muhlfeld et al.)
Demographic Risk	Demographic Connectivity	Number of other populations connect d (#)	<10	11-43	44-69	>70	EcoSheds (Muhlfeld et al.)
Genetic Risk	Hybridization Threat	Weighted (by fluvial distance) summatio of admixture among a interconnected populations (Index)					Ec Sheds (Muhlfeld et al.); brook trout and rainbow trout - CM "leading threat for salmonids"
	Rainbow Trout Admixture	Rainbow trout obse ved (0 to 100)					
Habitat Risk	Patch Size	Patch Area (km2)					le gth
	Stream Length	Total stream length (km)					
	Landscape Context	Patch area in valley bottom (%)					
	Flow	Stream length w winter flooding (%)					major driver / hybridization; Percentage length of streams with winter flooding decreases probability of presence
	Local human influence	(km/km^2)					Dunham et al. 2014
		presence					Dunham et al. 2014
	Wildfire	Percent of patch severely burned within the past 20 years					Dunham et al. 2014
					Desired Conditions		

Projecting Future Conditions

Of a number of costs including future climates





New Years Resolutions

- Get more exercise
- Thorough review of complete set of Leadership Team input
- Draft comprehensive conceptual models for all conservation features
- Identify, recruit and engage Subject Matter Expert Teams
  - Refine our estimates of feature-specific costs – current and future
- Process, scrub and prepare data for Alberta and BC
  - Continue very studious data documentation
- Get started on social, cultural and economic features
- Finish Feature Selection Report and update other project documentation
- Switch to Zoom for Leadership Team calls starting in January (26th at 11am Mountain Time)

Thoughts, Feedback Discussion …