Hello west coasters, I'm coming to you from the western Great Lakes. My name is Christopher Morgan and I'm speaking to you today from the rural Hatley Public Library in Wisconsin on the traditional territory of the Menominee, Ho-Chunk, and Ojibwe Nations. I now work for the Wisconsin Department of Natural Resources, but spent the past couple years at the University of Northern British Columbia in Prince George, BC. I'll be presenting today on my master's thesis titled, "Systematic Conservation Planning in Tsay Keh Dene Territory: Incorporating Climate Change and Interweaving Traditional Ecological Knowledge", focusing on the connectivity aspect of the project.
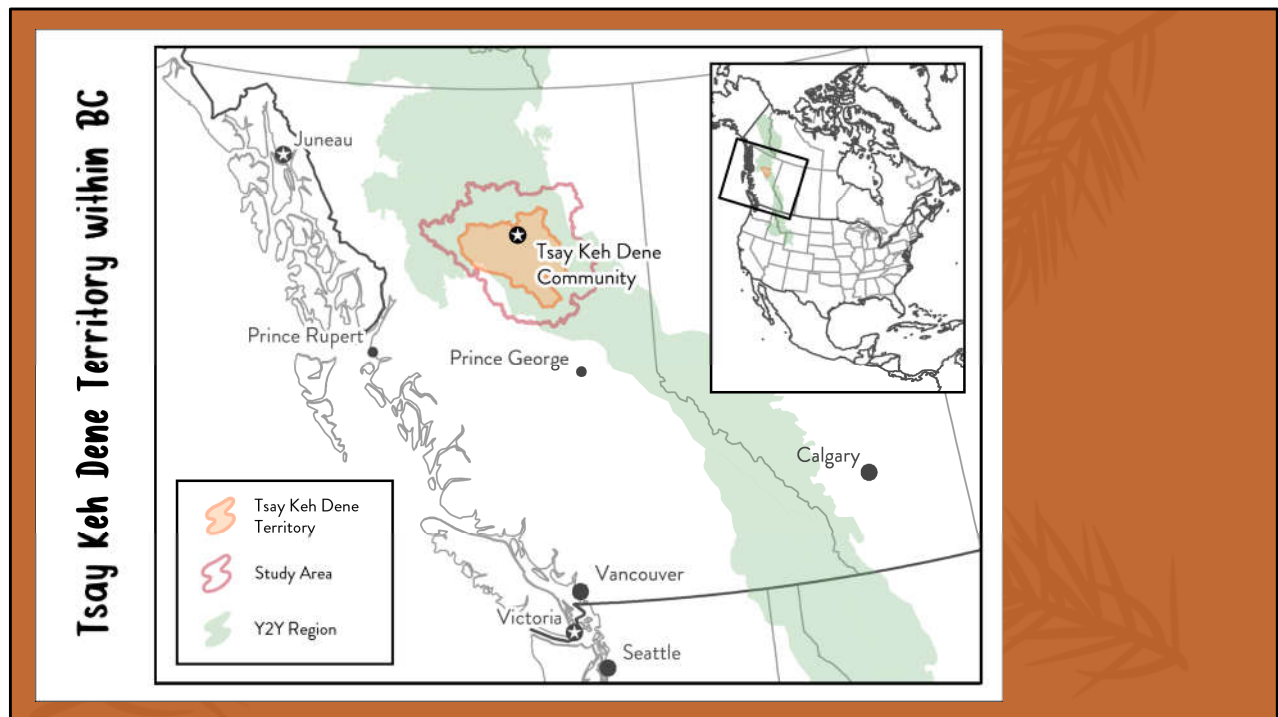
Give you an idea of where we were working – northcentral portion of British Columbia within the Yellowstone to Yukon corridor.

You can see Tsay Keh Dene Territory in orange, and will notice that our study area is a bit larger, acting as a buffer to better understand ecological processes across the landscape. Furthermore, the Territory boundary, while somewhat ecologically-informed, is still a political boundary. After discussions with the community, we decided on an ecologically-focused study area built with caribou herds and watershed groups. Connectivity was one of the main considerations here, as we wanted to understand movement in *and* around the Territory.

A brief history
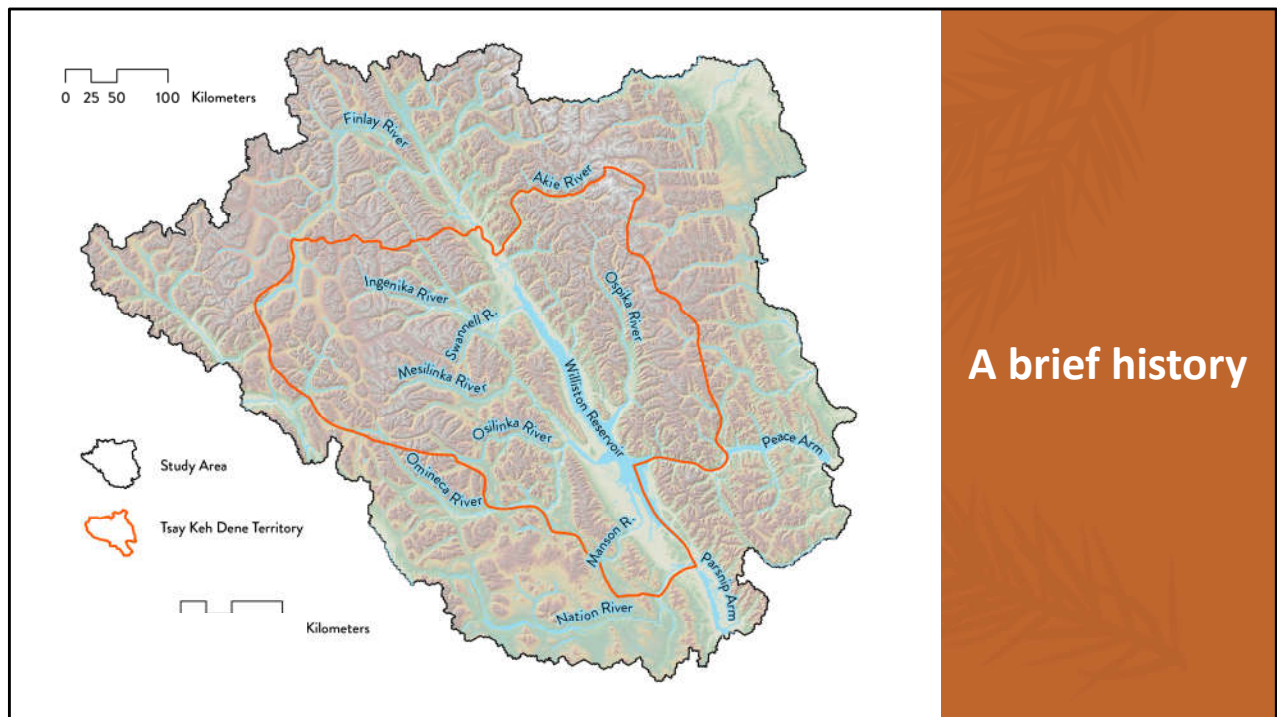
I'll use this topographical map to provide a bit of history. The Tsay Keh Dene are a Sekani people, residing in the northern Rocky Mountain Trench since time immemorial. They had limited interaction with Euro-Canadians until the fur trade, then subsequent gold rushes brought miners and missionaries. Forestry eventually creeped northward, and the construction of the Hart Highway in 1952 represented the first substantial connection to the region. Suddenly, that transportation impediment to the territory was gone. In the 1960s the province, led by Premier W.A.C. Bennett, created a crown corporation that many of you are quite familiar with – BC Hydro. To grow this fledgling enterprise, the province constructed a dam near Hudson's Hope, flooding the Peace, Parsnip, and Finlay Rivers to create the reservoir. The flooding of the Rocky Mountain Trench not only severed habitat for wildlife (such as a caribou migration route), but caught many Tsay Keh Dene off guard and displaced them from camps and village sites in the river valley. The Tsay Keh Dene ultimately created a new community site at the northern tip of the reservoir, where about half of their members still live today.

Research purpose and questions

→ **Explore which areas in Tsay Keh Dene Territory have high conservation value (both ecologically and culturally), exhibit landscape connectivity, and are resilient to climate change**

1. Which areas have the highest conservation value today?
2. Which areas retain conservation value when climate change is considered?
3. How can landscape connectivity be explicitly included in the SCP process?
4. Which stages of the SCP process provide an opportunity for the interweaving of Traditional Ecological Knowledge to produce a more inclusive conservation plan?

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I think it's really important to note that Tsay Keh Dene Nation initiated this project, reaching out to my supervisor, Dr. Pam Wright, about performing conservation planning work in their Territory after learning of similar work by some of Dr. Wright's previous students. I happened to be applying to grad school around this time and was thus very fortunate to be paired with this project.

My research purpose was to…

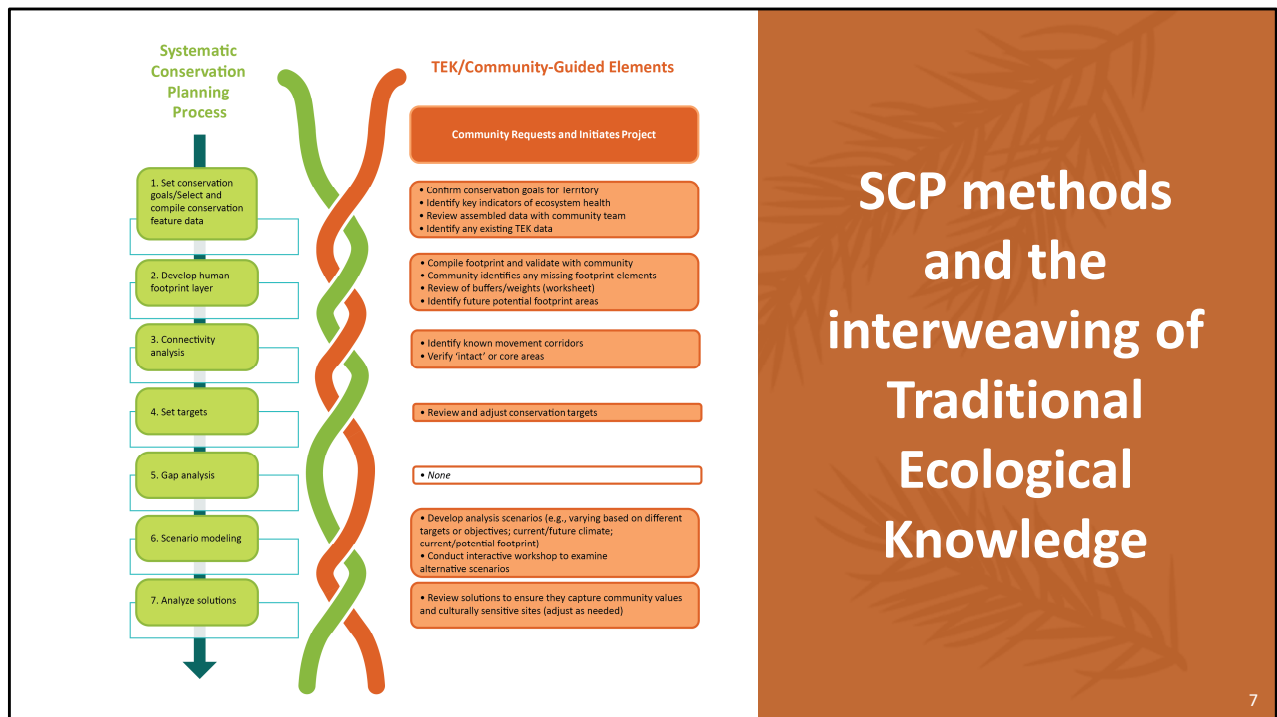The questions I sought to answer were…

Research purpose and questions

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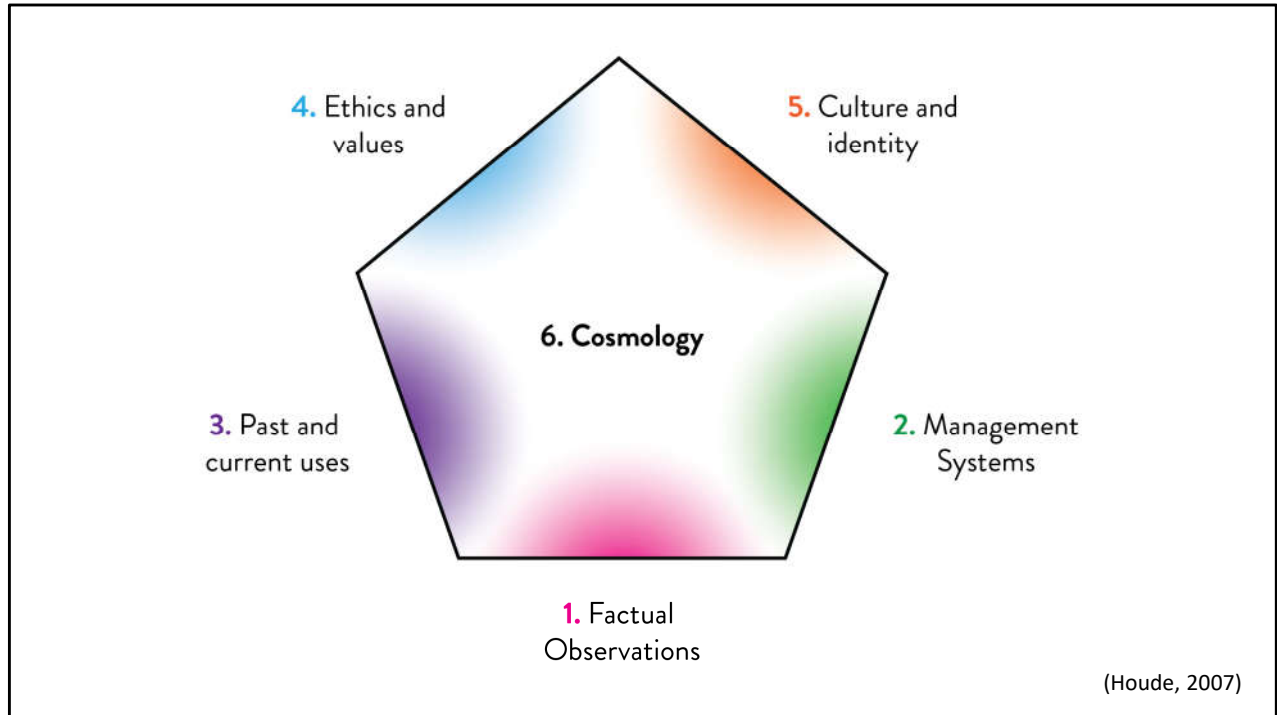
: bushelandberry.com

To help explain this concept, I like to use the analogy of finding the perfect berry patch. One patch might have the biggest blueberries, another patch might have blueberries, huckleberries, and cloudberries in close proximity, and another patch might have a nice breeze that keeps the mosquitoes and black flies away. What systematic conservation planning comes down to is identifying areas that have lots of these desirable characteristics in close proximity, or have a characteristic that is so rare that it isn't really found elsewhere in the study area.

Systematic Conservation Planning Process

TEK/Community-Guided Elements

Community Requests and Initiates Project

1. Set conservation goals/Select and compile conservation feature data
- Confirm conservation goals for Territory
- Identify key indicators of ecosystem health
- Review assembled data with community team
- Identify any existing TEK data

2. Develop human footprint layer
- Compile footprint and validate with community
- Community identifies any missing footprint elements
- Review of buffers/weights (worksheet)
- Identify future potential footprint areas

3. Connectivity analysis
- Identify known movement corridors
- Verify 'intact' or core areas

4. Set targets
- Review and adjust conservation targets

5. Gap analysis
- None

6. Scenario modeling
- Develop analysis scenarios (e.g., varying based on different targets or objectives; current/future climate; current/potential footprint)
- Conduct interactive workshop to examine alternative scenarios

7. Analyze solutions
- Review solutions to ensure they capture community values and culturally sensitive sites (adjust as needed)

SCP methods and the interweaving of Traditional Ecological Knowledge

While there is a well-established SCP process, blending it with TEK has only been attempted a handful of times. As the Nation was the foundation of this project, we sought to involve their knowledge and expertise whenever possible. This largely meant explaining the importance and implications of each stage of the SCP process and allowing Nation staff to guide the decision-making throughout. It also meant blending TEK data and values with Western science-based datasets for a number of conservation features.

4. Ethics and values
5. Culture and identity
6. Cosmology
3. Past and current uses
2. Management Systems
1. Factual Observations

(Houde, 2007)

Traditional Ecological Knowledge is often thought of in a material sense, but there are several dimensions, or faces of TEK, some more abstract than others. The "traditional" aspect is meant to convey the intergenerationality of this way of knowing. I also respect that some people take exception to the word "traditional" in this context, as it can erase the knowledge and ideas of those living today. Regardless, I would argue that applying Indigenous ethics and values in decision-making is an equally valid form of TEK.

Interweaving of Traditional Ecological Knowledge

: Tsay Keh Dene Nation

: Evan MacKinnon

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By interweaving Traditional Ecological Knowledge, I sought to use GIS technology to empower a community and share an accessible and defensible expression of their conservation goals – a form of counter-mapping. This meant using GIS technology to speak in the same language that governments and industry often operate in. By allowing Tsay Keh Dene values to shape this process, local voices, views, and understandings were etched into this work.

The main theme that emerged from this community-led approach to the SCP process was the importance of providing sufficient context and conveying the implications of each decision that had to be made. While I wanted to effectively convey the parameters of the project, I still wanted authentic ideas from the Nation and not answers that were overly pigeonholed by the conventional SCP framework.

Full list of focal conservation features

Coarse-Filter Features	
Abiotic	Land Facet Diversity
	Land Facet Rarity
Environmental	Elevational Diversity
	Ecotypic Diversity
	Heat Load Index Diversity
Biotic	(Disturbance)-(BEC Zone)-(Age/Burned) Ex 1: NDT1-ESSF-Burned Ex 2: NDT2-SBS-Mature/Old
	Rare BEC Zones

Fine-Filter Features	
Species	Grizzly Bear
	Bull Trout/Fish
	Fisher
	Caribou (by herd)
	Moose
	Stone Sheep
	Mountain Goat
	Wolverine
	Bank Swallow
	Barn Swallow
	Western Toad
	Horned Grebe
	Little Brown Myotis
	Northern Myotis
	Olive-Sided Flycatcher
	Rusty Blackbird
Special Features	Wetlands
	Lakes
	Karst Deposits

Climate Change Features	
Migration	Backward Velocity 2055
	Backward Velocity 2085
	Forward Velocity 2055
	Forward Velocity 2085
	Climate Corridors
Refugia	Cool Headwater Refugia
	Climatic Refugia
	Biotic Refugia
Misc.	Bird Richness
	Carbon Storage (above and below ground)

Cultural Features	
	Sites of Cultural Importance
	Cultural/Spiritual Areas
	Subsistence Areas

Connectivity Features	
	Linkage Mapper
	Omniscape

This is the full list of features that we set targets on. This is supposed to show what sort of features we looked at and convey that it was A LOT.

Of course, I'll focus on the connectivity features here, which were valuable subsets of the outputs of two different types of connectivity.

Conservation features

Cultural Features

Fine-Filter Features

Coarse-Filter Features

Climate Change Features

Connectivity Features
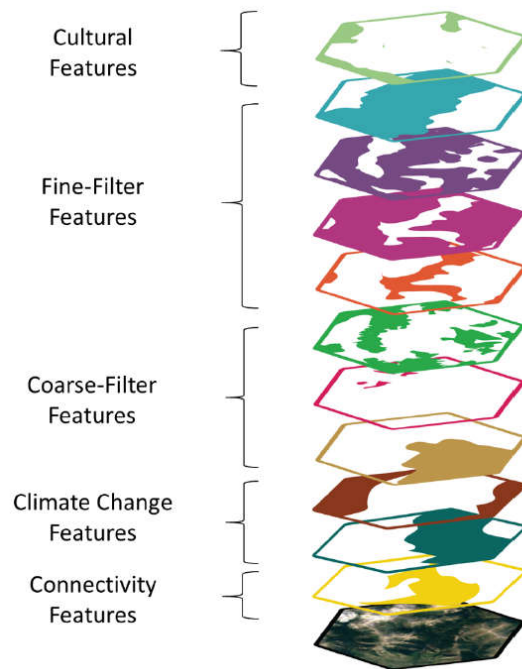
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Here's those categories that our conservation features fell into again, but in a graphic to help you visualize how they were essentially all stacked atop one another in the prioritization tool.

Human footprint

- Oil and gas
- Mining
- Forest harvesting
- Wind power

- Recreation
- Agriculture
- Urbanization
- Industrial Sites
- Roads

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Next comes the human footprint, or mapping areas of development and disturbance. I developed three different footprint layers based on levels of permanence, allowing users of the tool to select one based on their needs. Here are some of the features that went into the footprint layers.
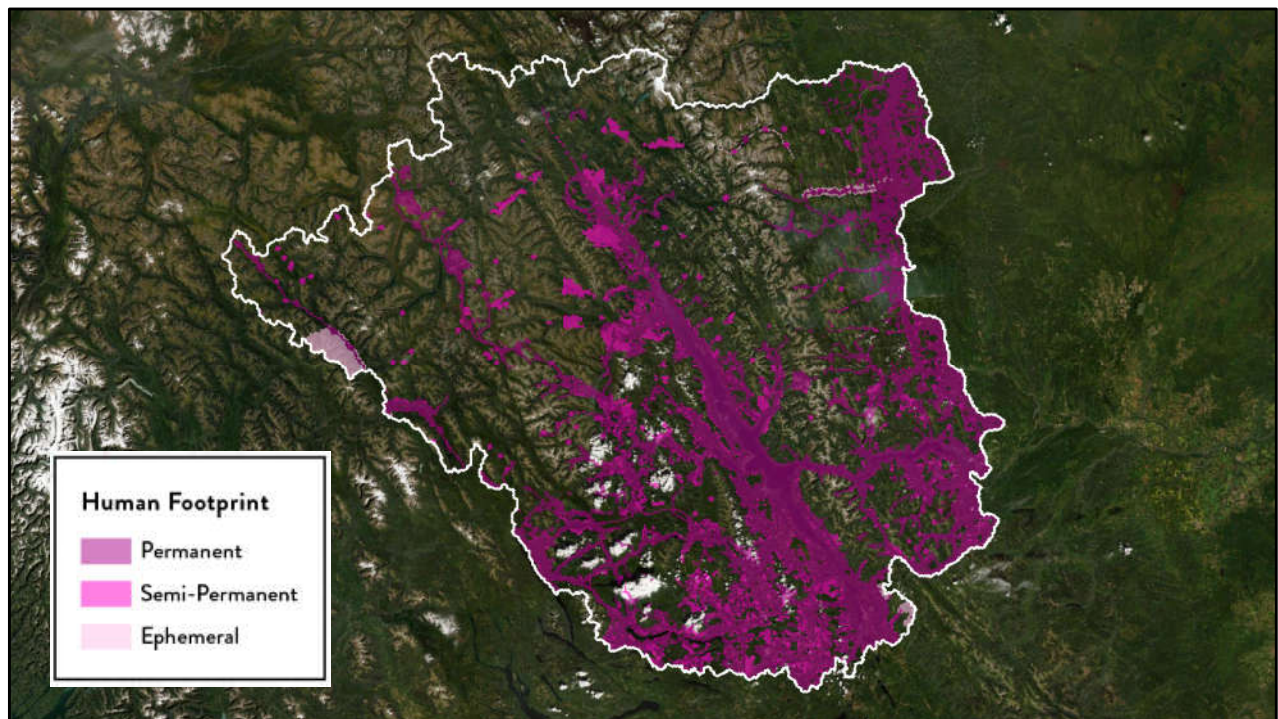
And here's what they look like. This was a workshop with Nation staff to show what I had compiled from provincial data sources, and then enhancing the data with local knowledge on the site of additional development, as well as nuance on relative impacts of development in a local context.

Connectivity-focused conservation

→ Use of connectivity tools
→ Solution characteristics

WILDLIFE CONNECTIVITY

· LEGEND ·

Sensitive Landscape Area
Valley Bottom
Movement Corridor
River
Roads
Train Tracks
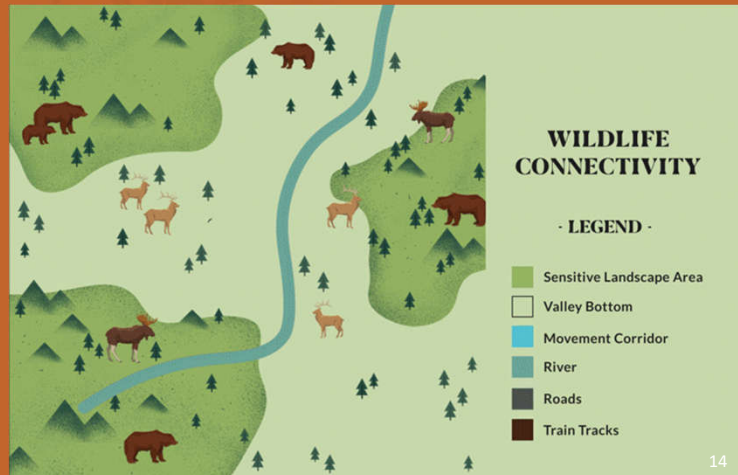
📷: Wildsight; Graphic by Bailey Repp

To explicitly include connectivity, I had to decide on which tools to use, how to use their outputs in the planning tool, and then assess their subsequent solutions. The graphic on the right illustrates the concept of wildlife using corridors between intact habitats, with human development severing those linkages.
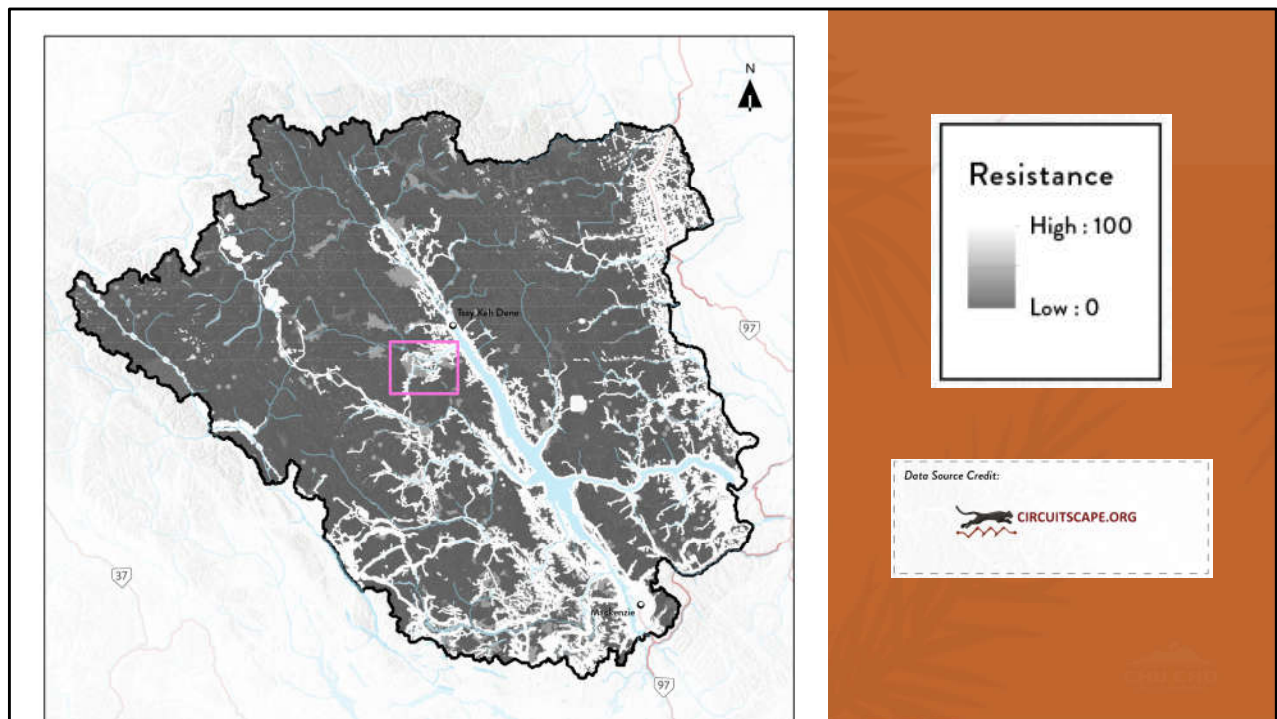
From there we can create our resistance layer. The human footprint is a major component, but it also takes land cover and slope into account. Consider how steep slopes and snow and glacier covered areas are more difficult to traverse.
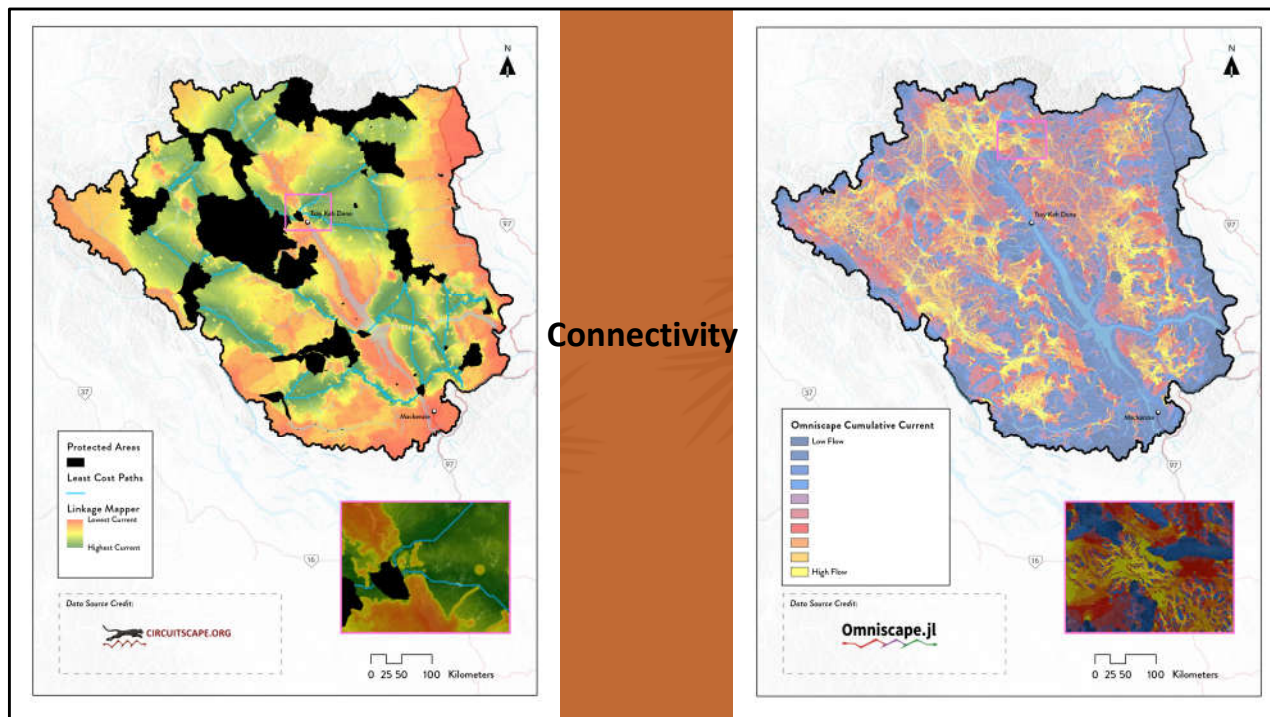
Connectivity

That resistance layer then becomes the basis of the two connectivity analyses I performed. The map on the left looked at connectivity between existing and proposed protected areas (known as LinkageMapper). This tool is generally more suitable in highly fragmented environments where the goal is to connect islands of natural areas. The map on the right looked at connectivity of the landscape overall (known as Omniscape). This tool is better suited for landscapes that are relatively intact. Both of these tools use electric circuit theory and the theoretical flow of electric current to quantify the connectedness of a landscape based on how much resistance is faced, whether that be from slope, land cover, or human development. I modeled what is known as structural connectivity, or how difficult it is for a *generalized* species to move across the landscape since we were interested in conservation more broadly. The tools also allow for the modeling of connectivity based on a specific species' behavior, as well as empirical movement data.

I ultimately used portions of these datasets to inform my planning tool.
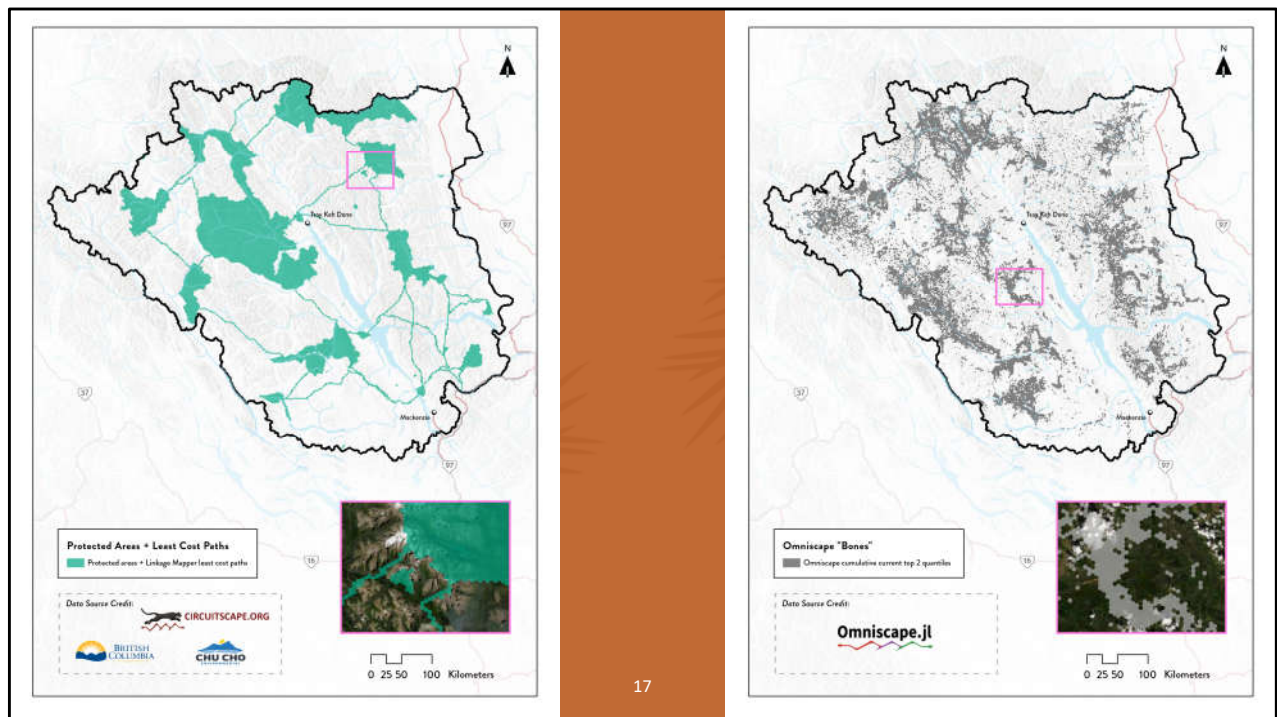
I used subsets of those outputs to create locked-in connectivity layers for use in my scenarios – ensuring they were included as part of the solution. On the left is protected areas and the least cost paths between them. The thinking here was that we wanted just the core pathways between protected areas, allowing our prioritization tool to build them out into thicker corridors with lands that had ecological merit. On the right is the top two quantiles of connectivity flow from the Omniscape output, or the 20% of lands that were deemed most connected.

Scenarios

→ Present

→ Futures (2050 & 2080)

→ Both

→ Connectivity
   o Between protected areas
   o Entire landscape

	Scenario A	Scenario B	Scenario C	Scenario D	Scenario E	Scenario F
Targets Set for:	Present	Future (2050s)	Future (2080s)	Present + Future (both)	Present	Futures (both)
Footprint:	Permanent + Semi-Permanent	Permanent	Permanent	Permanent + Semi-Permanent	Permanent + Semi-Permanent	Permanent
Locked-in Areas:	None	None	None	None	Protected Areas + Least-Cost Paths	Omniscape "Bones"

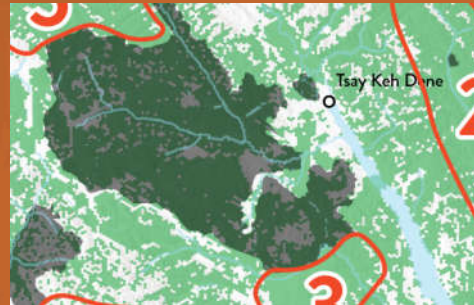UNBC UNIVERSITY OF NORTHERN BRITISH COLUMBIA

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I ran six planning scenarios in the tool that centered on present conditions, predicted future conditions under climate change for the 2050s and 2080s, and connectivity. However, the Nation can run whatever scenarios they want with the tool moving forward.
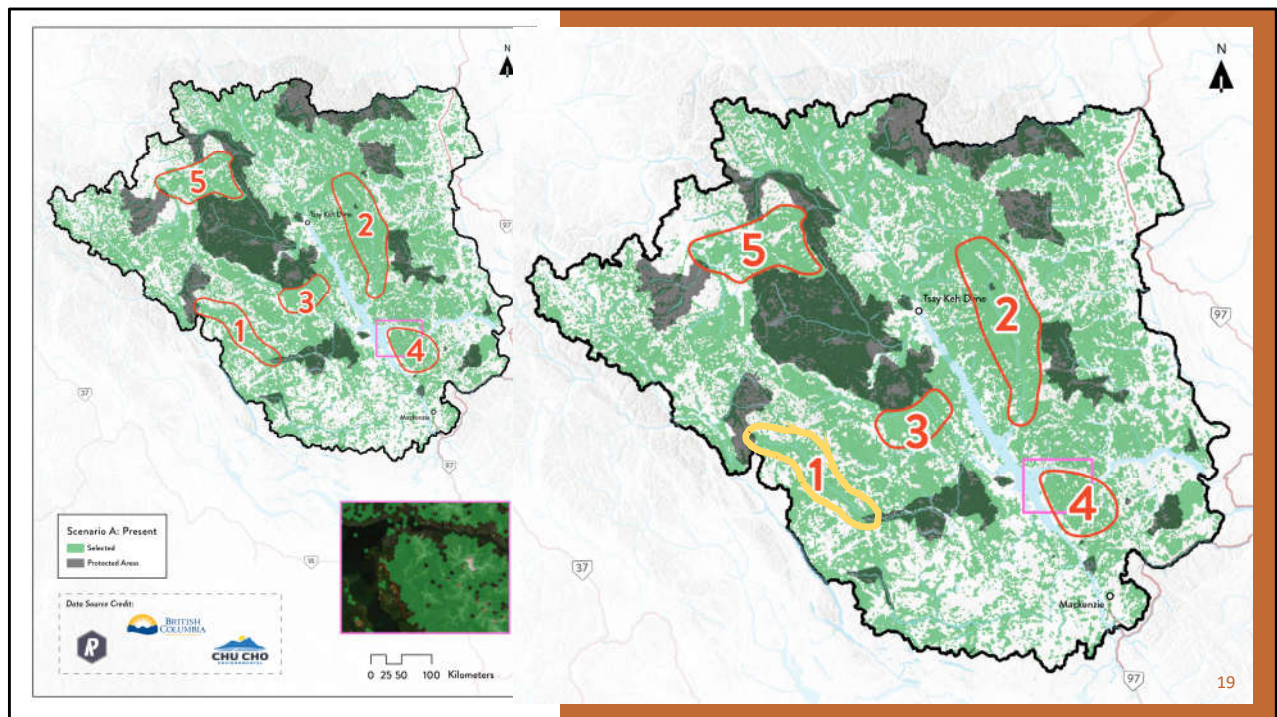
To give you an idea of what the outputs of this tool look like, here's the present-day solution in green. To highlight Focal Area 1, this portion of the Omineca River valley would provide a crucial connection for wildlife between Sustut and Omineca Provincial Parks. It was likely selected for its bull trout habitat and low to moderate elevation caribou habitat.

Example applications

→ Informing grizzly camera trap study

→ Refining of Ingenika Conservation & Management Area

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When I was in PG last week working in the Chu Cho office, I learned that they're combining the LinkageMapper output, Omniscape output, and TEK on known grizzly areas to strategically place camera traps for a long-term grizzly bear study.

Another practical outcome that stands out is how the Nation has used the Omniscape output to help refine some of the boundaries of the proposed Ingenika Conservation & Management Area. This is an ongoing effort by the Nation to create an Indigenous Protected and Conserved Area in the Ingenika River watershed, which is a culturally and spiritually important area to the Tsay Keh Dene.

It is also home to the Chase caribou herd. Not only are caribou (wedzih in the Sekani language) important to the people, but the Nation has been working specifically to rebound this herd by decommissioning old resource roads.

Practical implications

→ Day-to-day
  o An actionable strategy and plan for effective conservation as resource extraction referrals are processed

→ Long-term
  o A suite of potential conservation areas for consideration

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Practically, my analysis and this tool will provide an actionable strategy to systematically assess resource extraction referrals that the Nation receives from Industry. This should lead to better conservation outcomes in the short-term as these individual projects can be better assessed for how they fit into the larger landscape puzzle.

Longer-term, it also provides a means of selecting areas for official conservation designations or other management practices.

Conclusions

→ Effort of inclusion and reciprocity

→ Aid holistic decision-making

→ Convey an updateable tool accepted by all

→ Leverage multiple ways of knowing to sustain both people *and* the land

SCP Tool Application Icon

In closing, I sought an outcome of inclusion and reciprocity by attempting to interweave the knowledge and values of the Tsay Keh Dene throughout the process. The main goal of this work was to benefit the Nation and the land its people call home. At the same time, this effort benefitted immensely from the invaluable knowledge of these Indigenous land stewards and those working on their behalf.

The intent is that the Nation will be able to use the tool over the long term and continue to adapt, expand and apply it. This will allow the Nation to leverage multiple ways of knowing and help lay the foundation for informed and defensible land-use decisions that support both people and the land into the future.

Acknowledgements

I would first and foremost like to thank the Tsay Keh Dene Nation for allowing me to play a role in their conservation and land stewardship traditions.

I would also like to thank my supervisor, Dr. Pam Wright, and committee members Dr. Sina Abadzadesahraei and Dr. Richard Schuster.

Also Erica Bonderud and Evan MacKinnon, who were my main contacts at Chu Cho Environmental and the Nation's Lands, Resources and Treaty Operations office throughout the project.

Luke Gleeson, a TKDN member who wears many hats and provided invaluable knowledge on TK history and cultural background info

And finally, Mitacs and the Yellowstone to Yukon Conservation Initiative for their support, and AdaptWest, WCS Canada, Round River Conservation Studies, and John Hagen & Associates for sharing their rigorous climate and habitat data with me.

Eternally grateful for this project…
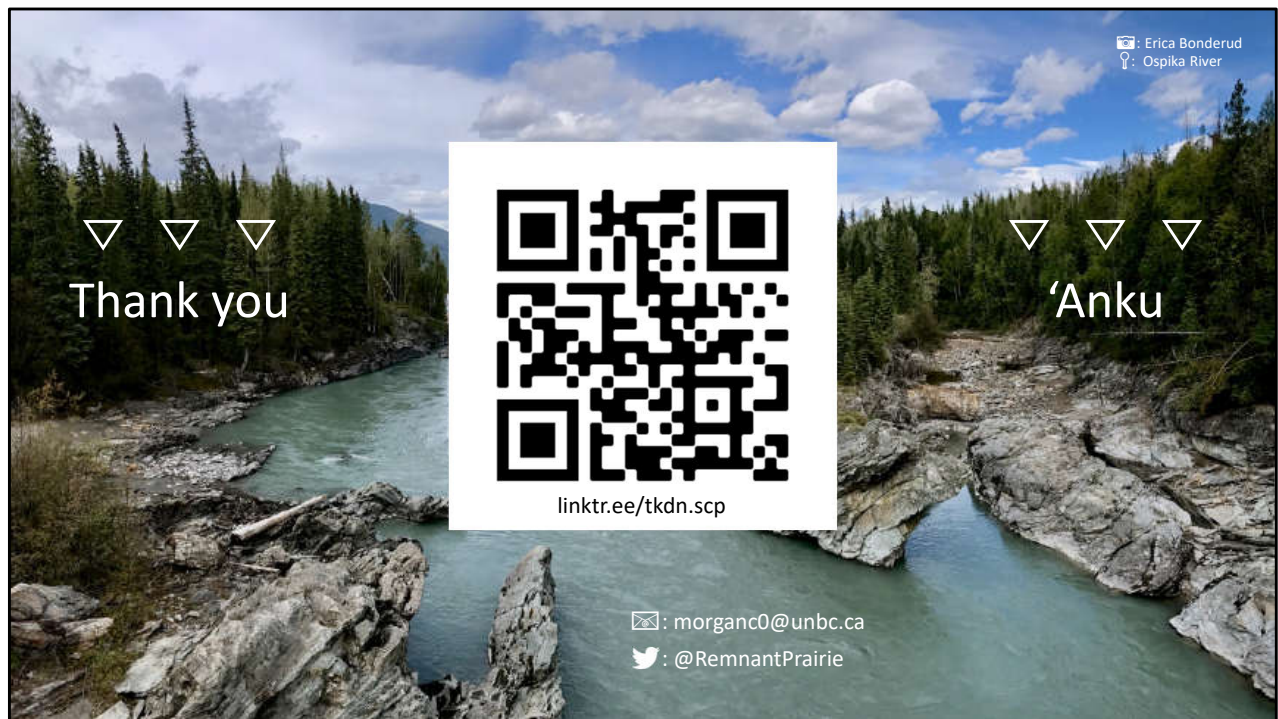
Thank you for listening. I'm looking forward to a hearty discussion. I've got my contact info up here if anyone wants it, as well as a QR code that takes you to a set of links about the project.

Limitations

→ Connectivity and TEK both considered in identifying high-value conservation areas, but TEK did not explicitly inform connectivity analyses

→ Beyond scope of project to collect data from community discussions to produce TEK-sourced movement data

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