Additional Technical Details: The Interior Cedar-Hemlock Forest of North America, US portion.

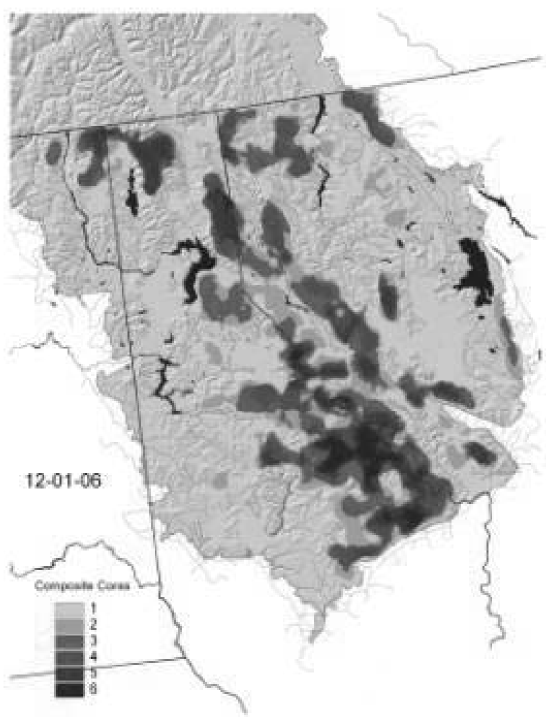
Methods

Terrestrial Focal Species and Habitats.

Methods follow the Interior Cedar-Hemlock forest of BC approach; details can be found at this link:

Additional Technical Details: The Interior Cedar-Hemlock Forest of North America, BC portion)

We chose a suite of focal species that we felt met most of the criteria desired and for which there were adequate data and scientific understanding to develop habitat suitability models. (Roberge and Angelstam 2004, Carroll et. al. 2001,2003, Lambeck 1997). We develop habitat suitability models for these focal species (grizzly bear, wolf, wolverine, lynx, cougar, woodland caribou). Comparable landscape characteristics are evaluated for the interior cedar-hemlock forest region in terms of Land Cover Class, Human Population Density, Road Density, Slope and Elevation. Relative permeabilities are assigned to each of the six focal species for each of the classifications within the five landscape characteristic categories. Results identify habitat concentration areas (cores) for each of the six focal species that are then merged into composites of these areas that could satisfy needs for several species. A preliminary composite core map indicates areas of key conservation importance (below):



Core Composite

We then use the least-cost-path connectivity methodology of Singleton and Lemkuhl et. al. (1999, 2000) and Singleton et. al. (2002, 2003) to identify probable movement corridors between core areas. We modify Singleton�s �cost surface� approach to reflect local habitat preferences.

Our composite focal species core and corridor results are being rigorously analyzed using two approaches. 1) An optimization of the final composite core area choices done by Dr. Justin Williams: a linear programming model will be used to minimize the total cost of simultaneously setting aside a required threshold area for each focal species. 2) a statistical evaluation of corridors and bottlenecks done by Dr. John DiBari: potential discontinuities or �bottlenecks� within corridors will be identified using spatially constrained clustering, fuzzy classification, and wombling (see Fortin 1994, Fagan et al. 2003) using BoundarySeer� (Kaufmann et al. 2001). Statistical significance will be determined via overlap analysis, sub-boundary analysis, or Monte Carlo randomization. Data for all analyses will include land cover and roads. Other conservation plan and recovery plan results that encompass or share our study area will be reviewed and relevant segments incorporated with our results to produce a final CAD encompassing both BC and US regions.

As various products are produced (maps, analyses, reports), CERI staff will communicate with stakeholders in the region and convene meetings when necessary. Important habitat core areas, corridors, and highway crossing sites will be visited on the ground and surveyed by fixed-wing aircraft. Results will be presented at scientific meetings and submitted for publication by peer-reviewed journals. Additional communications materials will be prepared for conservation NGOs and media in the project area as the project proceeds.

In addition to terrestrial focal species, we plan to incorporate data on aquatic focal species and habitats, avian focal species and habitats, and results of representation analysis following the methodology used for the BC portion of the CAD.

Aquatic Focal Species and Habitats. There are few data sets that are consistent across the US � Canada border. However, there are similar types of analyses that should be comparable.In BC we used salmon distribution and escapement data, along with distribution data on red- and blue-listed fish species, to identify priority streams. In the US the salmon have been extirpated: this alone is an important data set for determining relative conservation value. The primary data set that we plan to use for the US side is the Aquatic Integrity Areas model developed by Dr. Chris Frissel of the Pacific Rivers Council in collaboration with American Wildlands. The Aquatic Integrity Areas (AIA) model is a Geographic Information Systems (GIS)-based, coarse scale analysis of the current condition of native aquatic integrity across entire catchment basins. The AIA modeling project is the first phase in a multi-basin project that, with the Upper Missouri, will include the Upper Columbia, Upper Yellowstone, and Upper Green River Basins. Results from the modeling phase will help identify important subwatersheds for an aquatic conservation area design (CAD) on the regional scale. We will use the results from the Upper Columbia as one method to assess aquatic focal species for the Interior Cedar-Hemlock Forest CAD. Additional information on the AIA model can be found at http://www.wildlands.org/gis_aia.html#columbia.

The AIA data are not exactly comparable to the BC data. To make closer comparisons we will also incorporate data on streams supporting threatened and endangered fish species including bull trout, sturgeon and others from US Fish and Wildlife Service databases.

Avian Focal Species and Habitats. Avian Focal Species were not directly addressed in the BC portion of the CAD so far. There are some new datasets just becoming available that we will incorporate into both the BC and US portions of the CAD to prioritize avian habitat for conservation. One dataset is the Y2Y bird biodiversity hotspots analysis (Mapping Avian Diversity across the Yellowstone to Yukon Region) being completed by Andrew Hansen and Kingsford Jones at MSU, based upon methodology by the same authors (Mapping Bird Abundance and Community Diversity from Satellite Imagery: Validation of AVHRR and MODIS

Models:)) with information at http://www.y2y.net/science/grants/avian1.asp. Maps and datasets should be available before the completion of our CAD project. Another is a dataset on predicted probabilility of occurrence (habitat suitability) of 20 species of birds modeled by Dr. Judy Muir at University of Alberta in Edmonton (Powerpoint and Readme files attached). We currently have this dataset at our CERI offices and it covers the entire CAD area.

Representation Analysis. To include representation analysis in the Interior Cedar-Hemlock Forest (ICHF) CAD, and indirectly to address avian habitats, we incorporated the Tier 1 and Tier 2 results from The Nature Conservancy/Nature Conservancy Canada Canadian Rocky Mountain Ecoregional Assessment in the BC portion of the CAD. We will include these results for the entire CAD area.

Synthesis. Once the US portion of the terrestrial focal species analysis of the CAD is completed, we will combine the two datasets so that we have a seamless transboundary map. Since the landcover classifications differ slightly across the boundary we are using the derived cost surface layers which are derived from the assigned habitat values and are thus equivalent between datasets. We will redefine the core areas for the BC portion since we�ve refined the methodology somewhat while working on the US portion. The result will be maps of core areas and corridors for each species that are equivalent across the entire ICHF region, a map of composite core areas and connecting corridors (Baden Cross), optimized solutions for focal species core areas and corridors (Dr. Justin Williams), and alternate approaches to mapping and assessing corridors (Dr. John DiBari). The final CAD will combine these terrestrial focal species data with the aquatic, avian, and representation data discussed above.

Management Implications and Outreach. The CAD will be critiqued, modified, and refined throughout the process through interactions with knowledgeable local stakeholders We have made several site visits to the BC portion of the CAD and met with NGOs, Academics, Agency biologists, and First Nations. We have made one site visit in the US to Sandpoint and the Cabinet-Yaak area. In the summer of 2006 we will conduct similar site visits in the US portion and additional visits to BC. In the US we will arrange meetings with Idaho Fish and Game personnel in Lewiston (Clay Hickey and Jay Crenshaw) and in Sandpoint. We will meet with Forest Service District Rangers and other officers in Couer d�Alene (Randy Swick) and Sandpoint (Dick Kramer) and FWS service biologists Bob Hallock and Brian DeBolt. We will meet with conservation activists from the Rock Creek Alliance, the Montana Wilderness Association, the Idaho Conservation League, the Kootenai Valley Resource Council, and others.

These meetings are invaluable in identifying inaccuracies in the base data and model parameters. The entire process takes several years and each iteration produces a more accurate result. We are currently trying to arrange a fixed-wing aircraft with EcoFlight to conduct aerial surveys of key core and corridor areas in the US and BC during the summer of 2006.

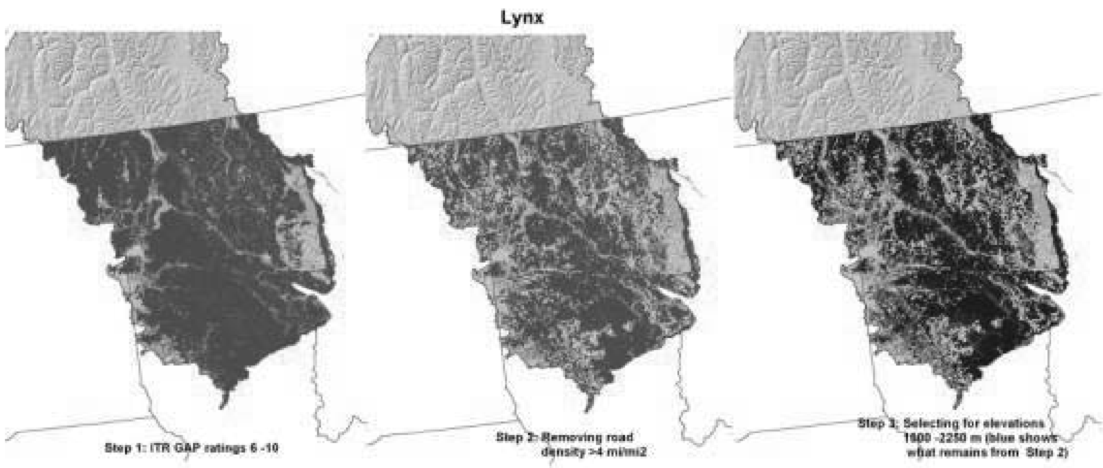
Results

Delineation of core areas of secure habitat for each of the six focal species was completed in 2005. Overlay of core areas to produce composite cores and analysis of corridors between cores began in early 2006. As various products are completed they will be displayed in this space.

Lynx Habitat Suitability model progression:
This series illustrates the basic process used to complete the habitat suitability models. This

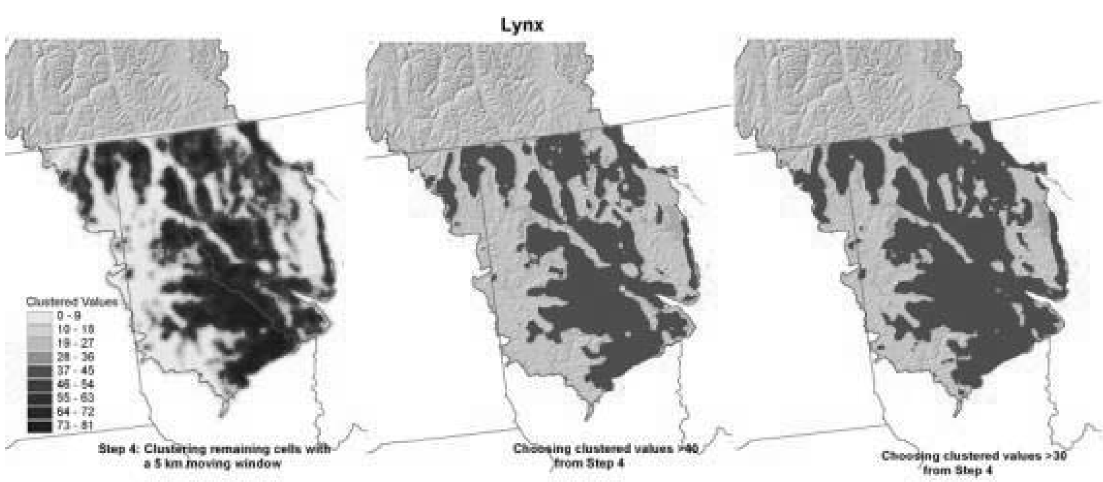
process was used to complete the first iteration of core habitat for both the U.S. and B.C. portions of the Inland Rainforest Conservation Area Design (CAD).

As we were developing the CAD we also developed a more precise method of identifying core areas in the Greater Yellowstone Ecosystem using grizzly bear habitat suitability . We then applied this method to all of the Yellowstone to Yukon area in the U.S. (see bottom of page) and used it as a training data set for grizzly cores for this CAD. In 2006 we hope to apply these more precise methods (using ArcGIS modelbuilder) to refine our definitions of core habitat for the Inland Rainforest.



1)

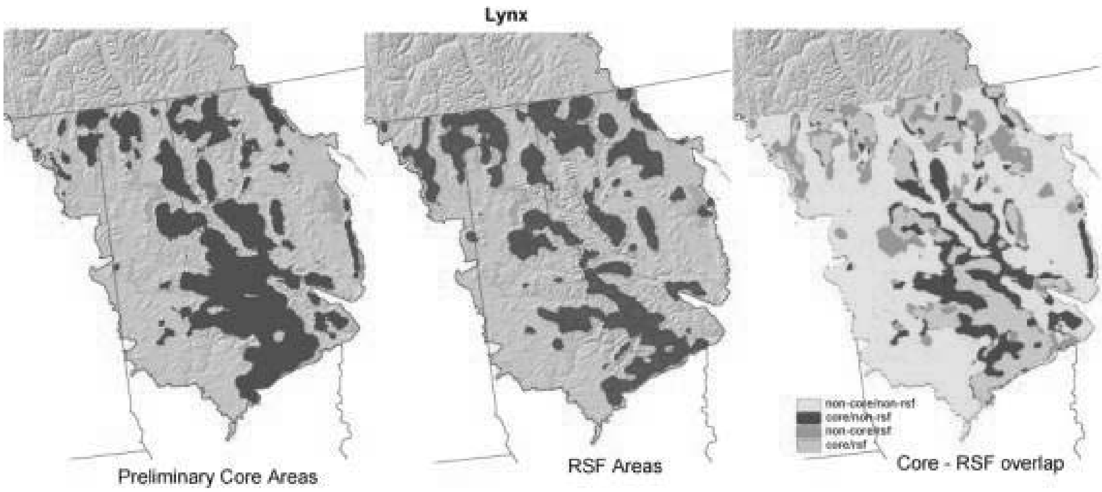
GIS analysis was done by Baden Cross (Applied Conservation GIS). GAP vegetation types were assigned values by expert opinion and cells with values over a threshold were selected.
Areas of high road density (actual value varied with species) were then removed.
Unsuitable elevations were then removed.



2)

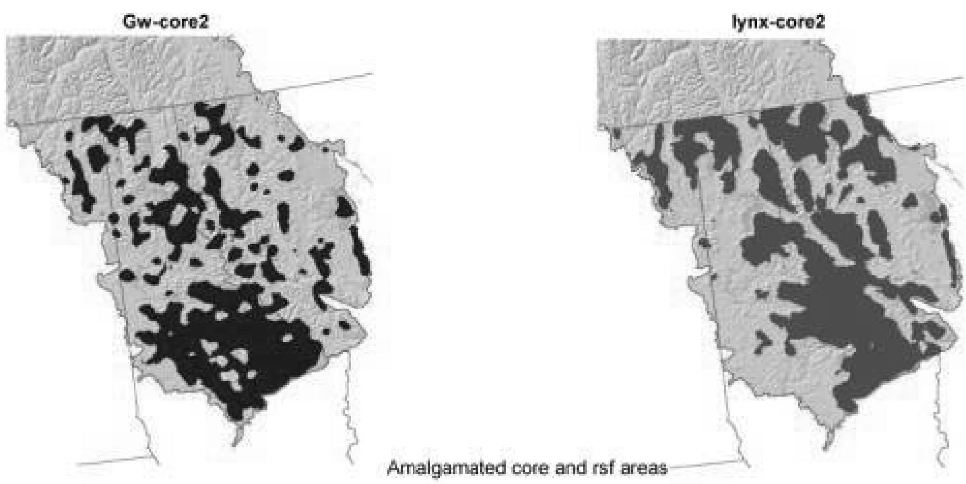
Next, suitable habitat cells were then clustered with a 5km moving window and various thresholds were evaluated by biologists to choose a level that corresponded with known areas of habitat on the ground.

Preliminary core areas were selected and compared with any empirical data available.



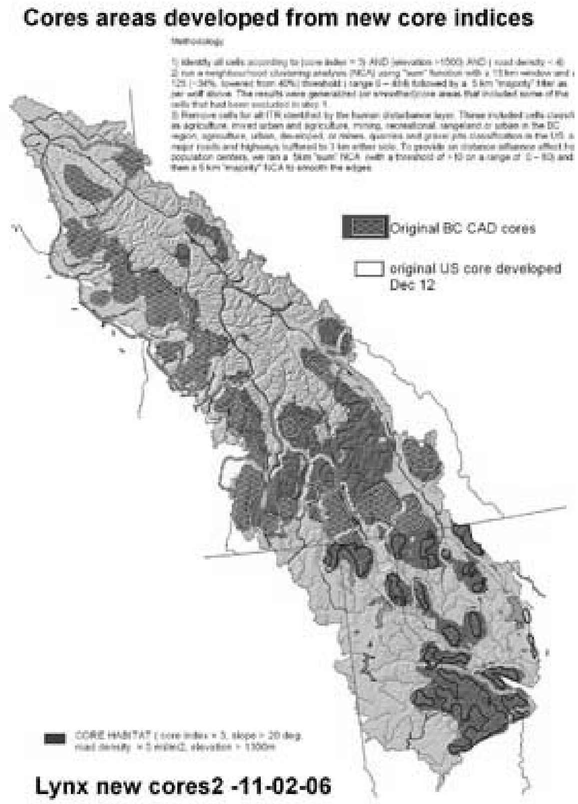
3)

In the case of lynx we compared the expert opinion cores with cores derived using RSF (resource selction function) values that were evaluated by Dr. Carlos Carroll using radiotelemetry locations from lynx studies in Canada and the U.S.



4)

Areas of overlap between the two model approaches were identified. For some species the overlap areas were chosen as the best approximation of known habitat; in other species the core areas from both approaches were combined to define the suitable habitat. The maps above show combined results for Gray Wolf (left) and Lynx (right).



Final Lynx This "final" map was then developed by removing areas of high road density again since many of those areas had been clustered with core habitat by the moving window and the RSF amalgamation techniques.

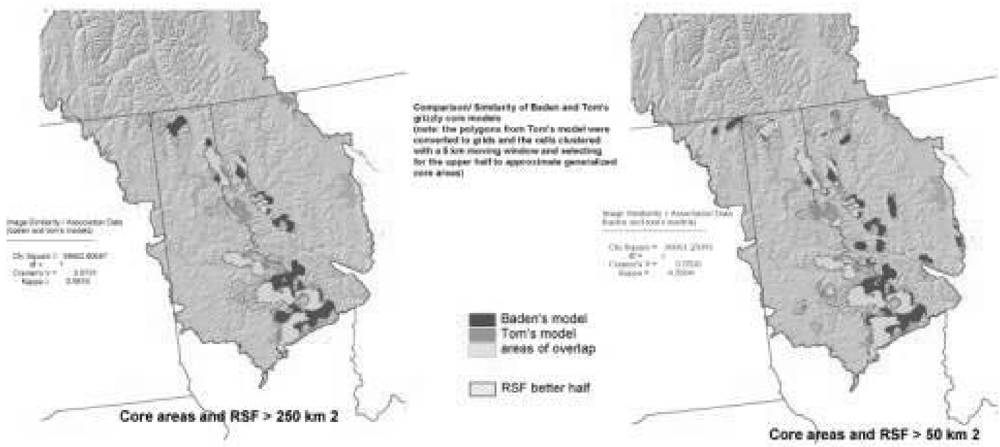
This map will now be taken into the field by CERI biologists and will be critiqued by other biologists and knowledgeable stakeholders in both the US and BC in order to make it more accurate and to further refine the model parameters.

These maps provide a valuable starting point to begin implementing conservation activities on the ground.

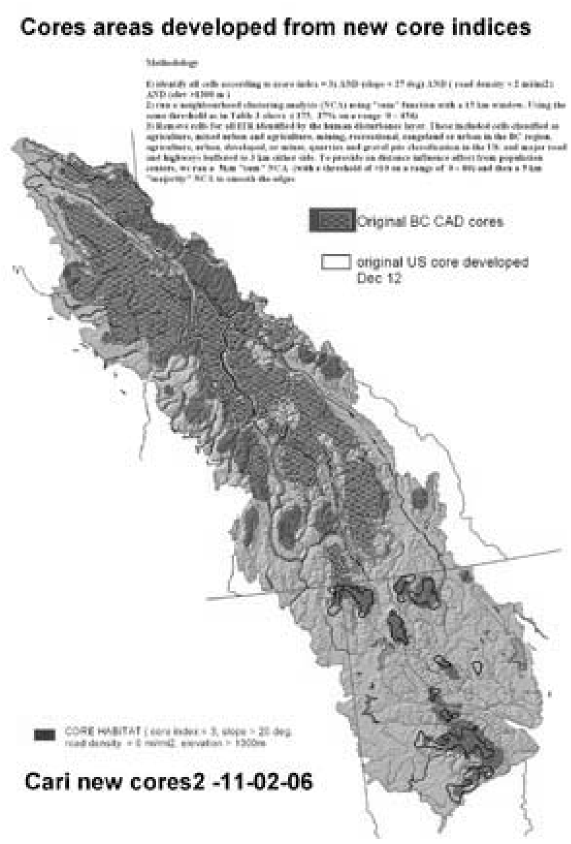
Mountain Caribou habitat models:

This series illustrates the last steps of the process used to complete the caribou habitat suitability model in the US.

Two models (Baden's and Tom's) were compared with an RSF model. The RSF model was derived from radiolocation data of mountain caribou in British Columbia.



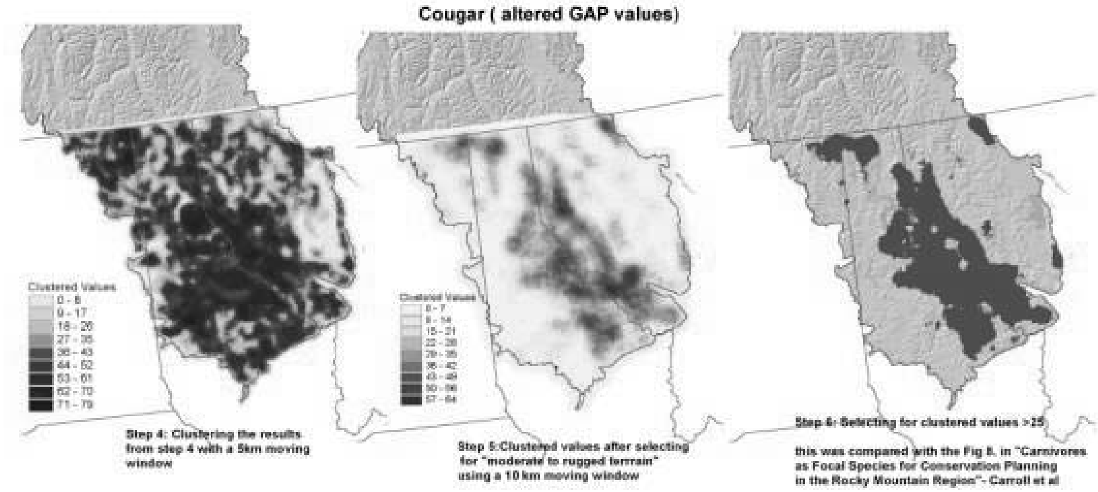
Caribou



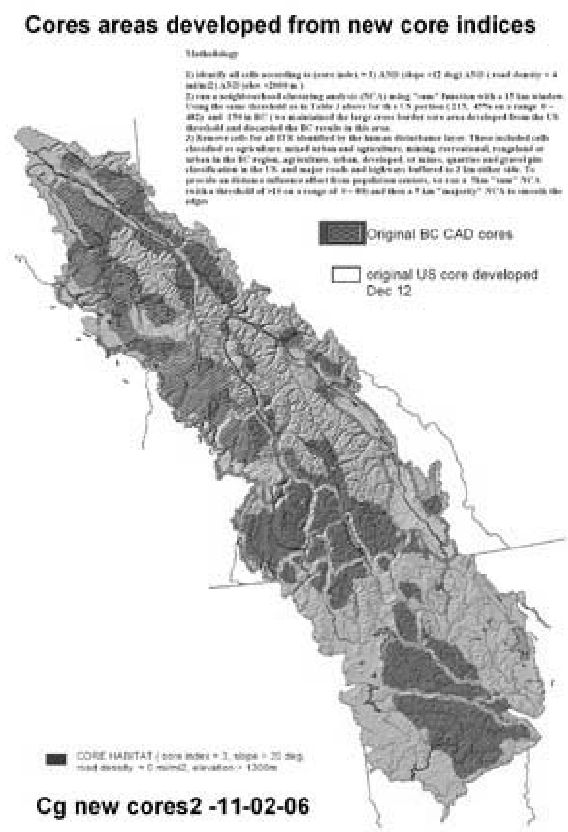
Final Caribou

Cougar Habitat models:

This series illustrates the clustering process used to complete the cougar habitat suitability model in the US. A topographical metric based upon slope and changes in elevation was used to delineate key cougar habitat among suitable landcover types.



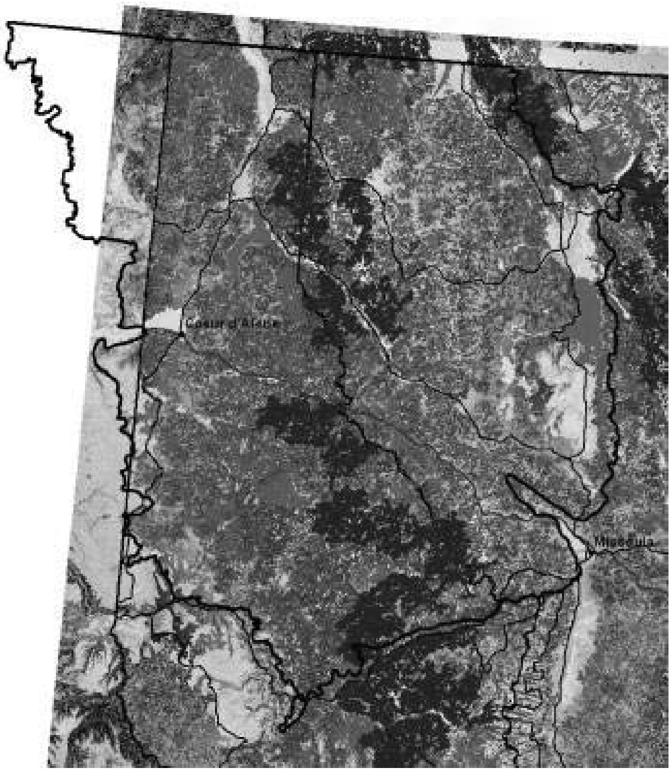
Cougar



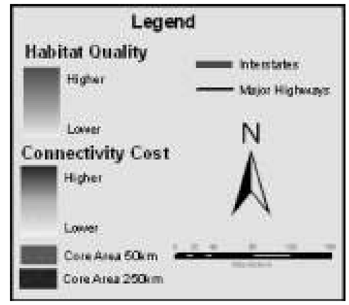
Final Cougar

Grizzly Bear cores and connectivity habitat.

This series illustrates part of the process used to complete the grizzly bear habitat suitability model in the US.



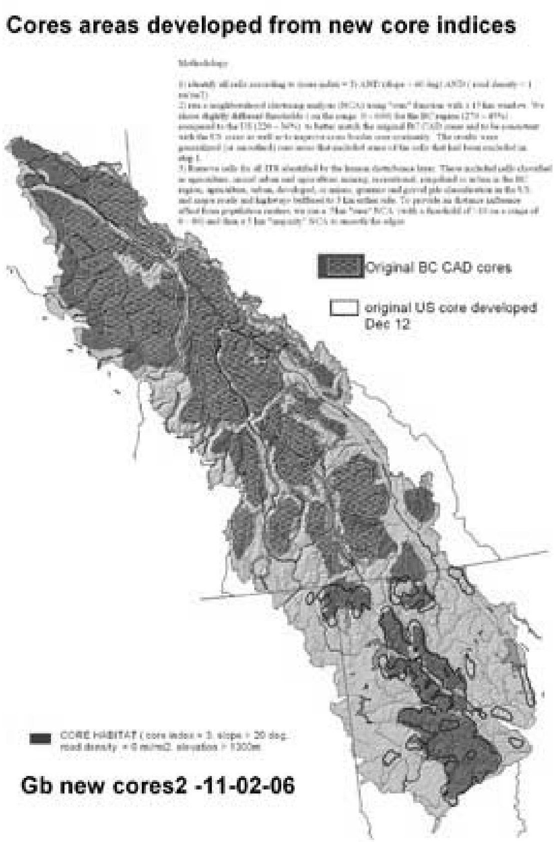
Grizzly Bear Composite



Grizzly Bear Composite

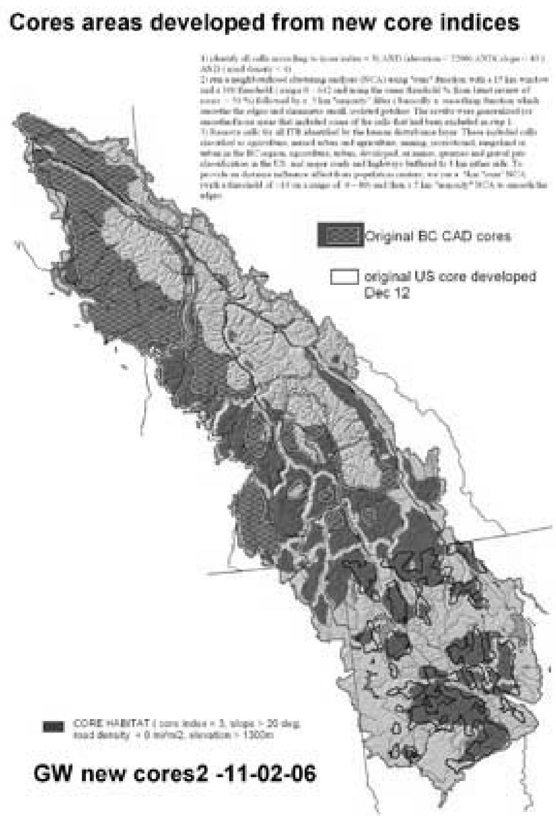
This map of grizzly bear habitat suitability (left: Grizzly Bear Composite) was developed by Tom Olenicki at CERI using a slightly different methodology and more advanced GIS software. It was used to threshold the grizzly bear model we used for the Inland Rainforest. The resultant transboundary map is shown below.

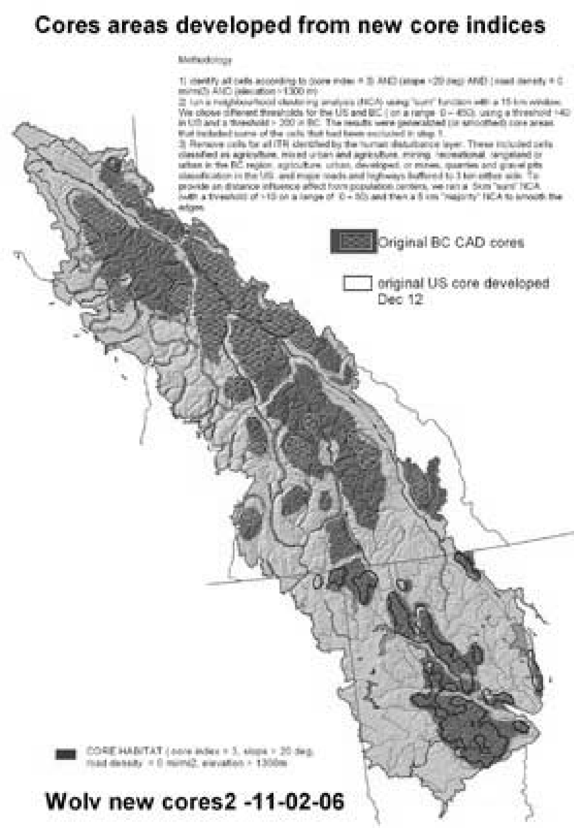
We plan to apply this methodology (using ArcGIS modelbuilder) to all the focal species in the Inland Rainforest in 2006.



Final Grizzly Bear

Using similar progressions we also developed models for Wolverine and Wolf.





Final Gray Wolf

Final Wolverine