Use of Remote Sensing to Assess Spatial and Temporal Patterns of Primary Production for Canadian Caribou Migration

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Introduction:

Monitoring caribou habitat via remote sensing can offer a better understanding of the dynamics of migrating caribou in Canada. It has been documented that broader scales play a role in Caribou habitat conservation and survival. However, traditional approaches to measure, monitor, and quantify caribou habitat provide useful, but spatially constrained information.

The use of remote sensing offers the opportunity for large area characterization of caribou habitat in a systematic, repeatable, and thorough manner.

In designing this approach we considered:

- ✓ Mapping the temporal and spatial changes in primary production and migration that is,
- ✓ Capable of both assessing and monitoring caribou habitat across their range and
- ✓ Utilize freely available remotely sensed datasets.

Review:

In a review of the potential remote sensing indicators useful for biodiversity assessment, we proposed 4 categories which capture research trends.

1. **Elevation** is a static variable compared to other biophysical parameters such as climate, its function as a key biodiversity gradient has been well documented.
2. Finer scale spatial patterns of **Land Use / Cover** are increasingly being used as predictors of vegetation composition and condition that drive species richness and abundance.
3. Correlation between vegetation **Productivity** and species richness and abundance is greater in areas of high production as more resources are available to support species.
4. Incorporating annual and seasonal time series of Land Surface Temperature and Vegetation data allows computation of the **Disturbance** Index (DI) (Mildrexler et al. 2007) which is sensitive to both continuous and discontinuous change allowing a greater understanding of changes in the terrestrial biosphere as well as informing managers about disturbance.

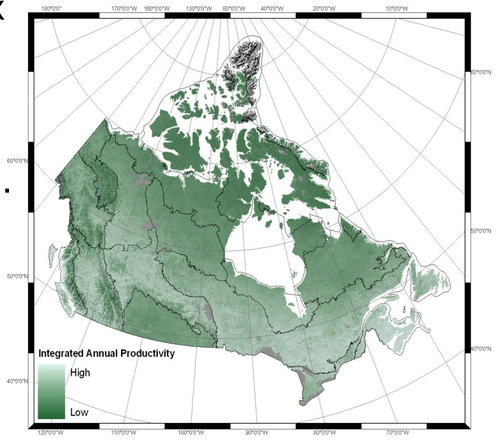
	Topography	Production	Land Cover and fragmentation	Disturbance
Spatial res. / Grain	90 m < 60° N; 1km > 60°N	1000 m	25 m	1000m
Image extent	Canada Wide	All vegetated areas	All forested areas	Canada Wide
Type of data	RADAR	fPAR	Enhanced Thematic Mapper	MODIS EVI / LST
Platform	Shuttle	Terra / Aqua / MERIS	Landsat	Terra / Aqua
Temporal Capacity	Single	Monthly / Annual	Once	8-day
Cost	Free	Free	Free	Free
Processing	Elevation Residuals	Dynamic Habitat Index (DHI)	Image classification	Disturbance Index (DI)

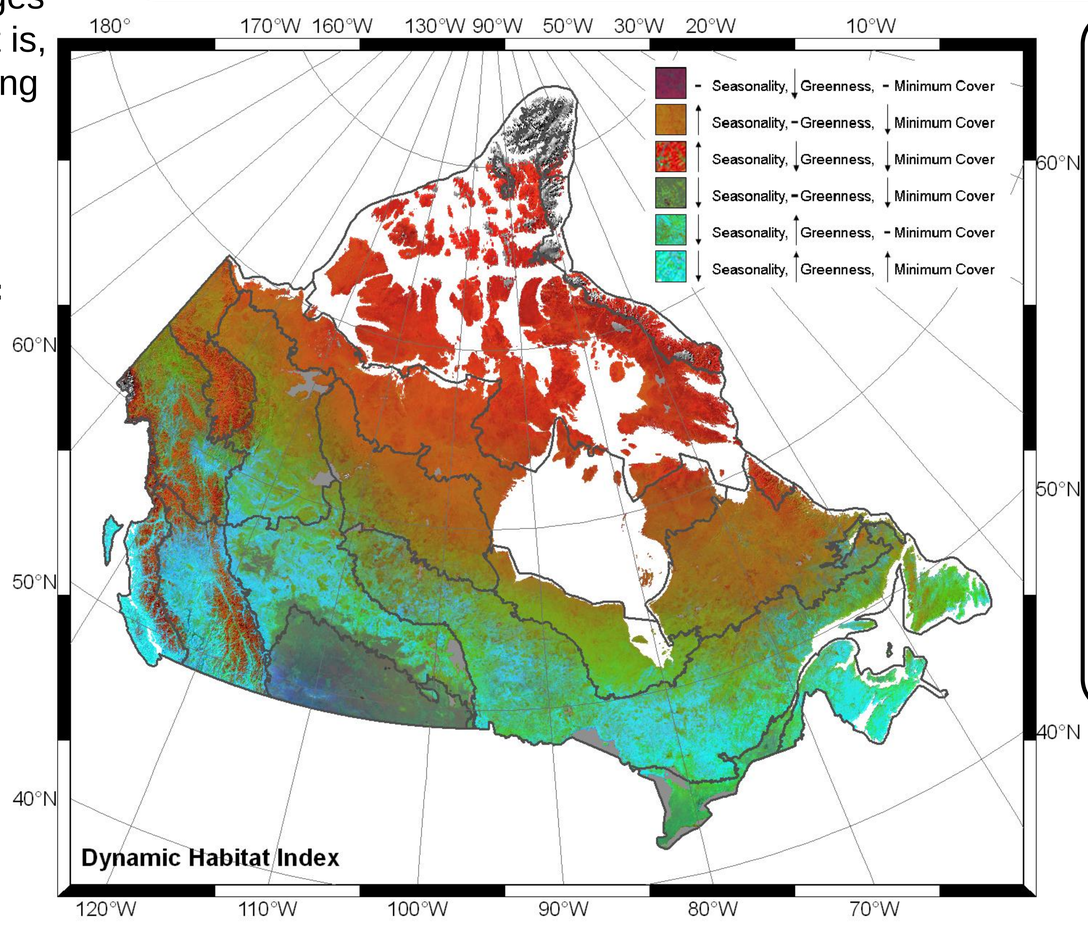
Dynamic Habitat Index (DHI):

Strong linkages have been demonstrated between canopy light absorbance (fPAR) and species home ranges and abundance. One approach developed within this project is the DHI.

Annual Overall Greenness

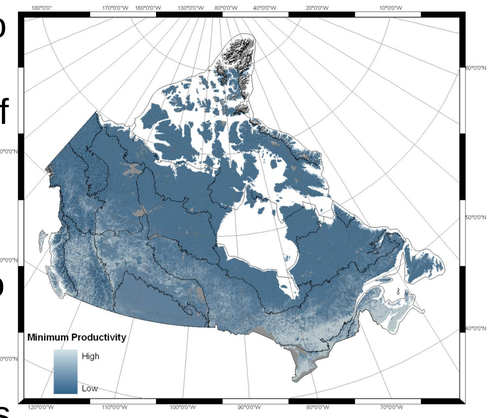
We sum the monthly MODIS fPAR to produce an annual greenness index which is added to provide a long term cumulative greenness component. fPAR, the fraction of photosynthetically active radiation, measures the photosysnthetic activity of the vegetation in the 0.4-0.7 µm wavelengths and is a more biophysical expression of vegetation functioning than NDVI. For instance, higher fPAR values during the growing season indicate denser vegetation cover and higher productivity due to absorbing more PAR. Lower values of fPAR can indicate areas of low vegetation productivity. An advantage of fPAR over NDVI is its ability to reflect variations in primary productivity by setting limits on the rates of carbon absorption.





Annual Minimum Cover

In addition to the overall greenness of a site, the capacity of the landscape to support adequate annual levels of green vegetation is important for food access and habitat. Without significant snow fall sites will maintain green biomass providing continual food and habitat.



Seasonal Variation in Landscape Greenness

The seasonal pattern of vegetation development depends on the climate and geography, with tundra having a shorter growing season than forests in more temperate regions. We capture this seasonality as the coefficient of variation. Areas with high seasonality have large variations in greenness over the annual cycle compared to their mean value. Whereas, low seasonality is indicative of areas that have consistent vegetation production through a year.

Caribou:

We intend to apply these four indirect biodiversity drivers to assess changes in the spatial and temporal patterns for selected herds of caribou. By using values of above ground net primary production derived from fPAR it will show the interannual variability for winter, summer, and calving caribou grounds. Caribou movements in their winter, summer, and calving grounds may illustrate changes in primary productivity throughout their migration routes. Locating areas high in productivity that caribou use during vital times in their life cycle may help identify important regions for conservation and allow researchers to asses the impact caribou have on their habitat.

Acknowledgements: We acknowledge the Biospace Team: Dennis Duro, Donald Iwanicka, Joanne White, and Meg Andrew.
BIOSPACE is a collaboration between the Canadian Forest Service (CFS), Canadian Space Agency (CSA) and the University of British Columbia (UBC) with a number of co-operators across-governmental and non-governmental agencies. Funding provided by the CSA.

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