Canada

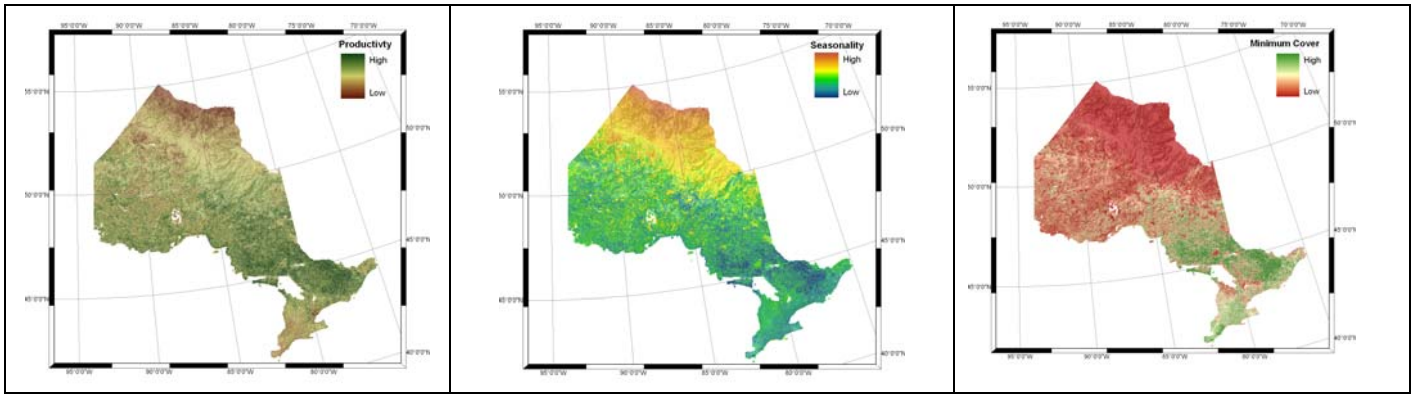
BIODIVERSITY MONITORING FROM SPACE

Forestry

B I O S P A C E

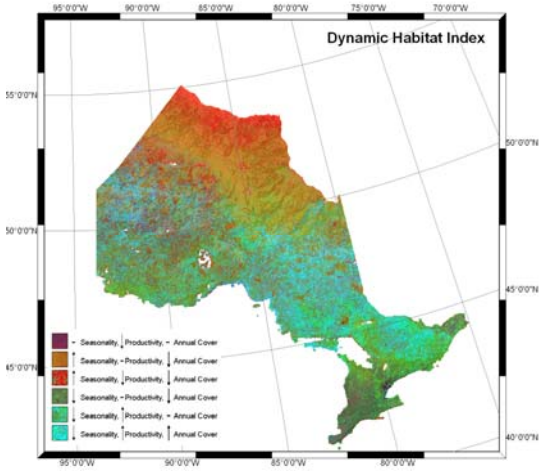
Understanding factors driving patterns of species diversity across broad areas is important to predict how species will respond to increased human influence and changing climate. The distribution and richness of breeding birds provides an excellent example of the importance for understanding the factors which influence species diversity. The Ontario Breeding Bird Atlas (OBBA), a volunteer-based project, collects data on the breeding distribution of all the bird species breeding in Ontario. The 10 x 10 km gridded dataset provides trends in the occurrence and distribution of over 300 bird species in Ontario.

As part of the BIOSPACE methodology we assess the relative predictive power of a number of remote sensing-derived indicators to predict bird diversity patterns of Ontario, Canada. Our four key indicators are productivity, land cover, topography, and disturbance; all readily available from satellite data.



As expected, the three components that comprised the dynamic habitat index (DHI) vary across Ontario as shown above, left productivity, centre seasonality and right, minimum cover.

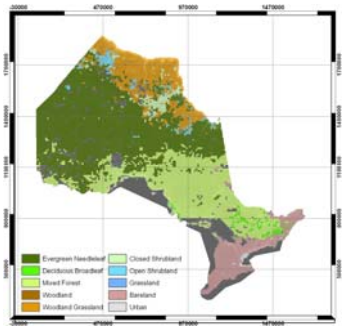
The highest annual seasonality is found in the northern portion of the province, an area of low relief with many lakes. This region experiences cold winters with extensive snow cover resulting in low productivity and low apparent minimum cover. The central region is more topographically variable with moderate vegetation productivity, principally containing mixed Boreal forest species resulting in the seasonality component being less variable, with increased productivity and lower minimum cover components. The southern reaches of the Boreal are a mosaic with forest and agriculture interspersed: further south, the region becomes more suitable for agriculture, and the natural forest is reduced to small isolated woodlots, resulting in low seasonality and high levels of minimum cover.

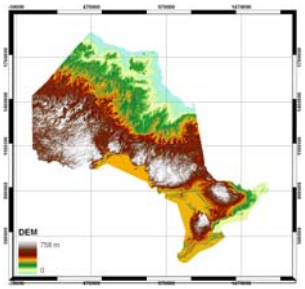


Visualizing the three components of the index jointly, highlights locations where components are correlated or otherwise. In this portrayal, increasing intensities of seasonality are red, increasing productivity green, and increasing levels of minimum cover blue. The extensive light blue areas represent the most productive land with moderate levels of minimum cover combined with little seasonality; whereas, the darker green areas, particularly in the south, have high productivity, reduced seasonality, and high levels minimum cover. Bright red areas in the north represent areas where seasonality is high and the remaining two components were near minimum indicating winter snow cover and low productivity. The remaining colors represented transition zones between the above described conditions.

A V I A N S P E C I E S R I C H N E S S

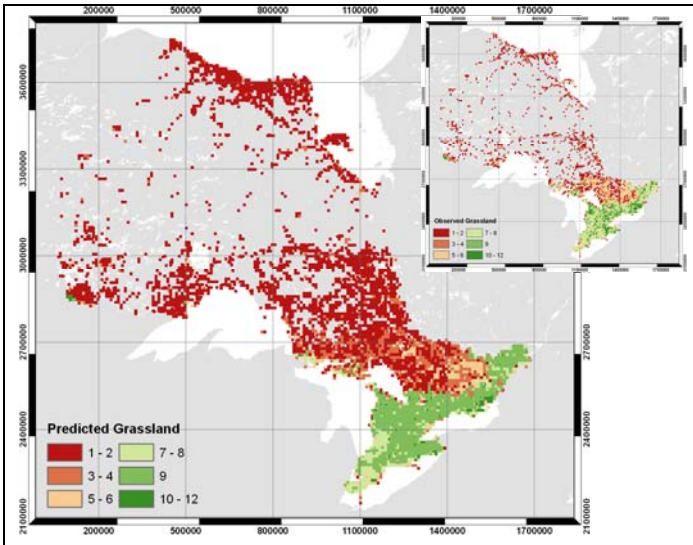
Information on current land cover is available using the University of Maryland (UMD) land cover classification derived from satellite imagery. The classification defines 14 classes, including evergreen needle leaf, evergreen broadleaf, deciduous needle leaf and deciduous broadleaf forest, and a fifth mixed forest class. The remaining classes include shrub and woodland complexes grassland, cropland, bare ground, urban, and water. Within each 10 km window, the dominant land cover class, the diversity (calculated as the proportion of the area covered by the dominant land cover class), and the richness (calculated as the total number of land cover classes within the 1km cell) were calculated.

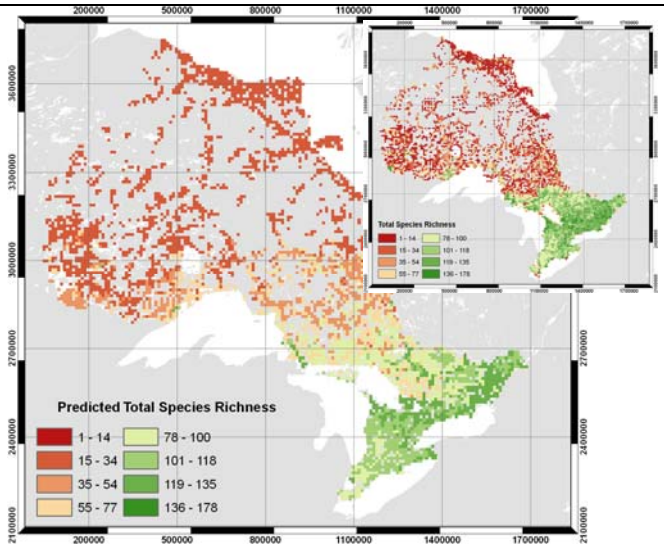




Terrain information is available from the Shuttle Radar Topography Mission (SRTM) and provides consistent elevation data over the land at 90 m spatial resolution, world-wide. We obtained SRTM data for the province and, in order to incorporate small scale variations in topography at the OBBS scale, we computed the topographic coefficient of variation (COV) calculated as the mean of the elevation within a 10 km window divided by its standard deviation.

In order to assess to what extent the remotely sensed derived indicators can explain the variance observed in the total bird species richness data as well as stratified species richness we utilized a non-parametric data-mining approach using regression trees.





The richness of the grassland species (left) is well described by the model which explains 75% of the variation observed in species numbers. The most significant variable in explaining grassland richness was dominant land cover with the second most explanatory variable apparent minimum cover which provided 15% of the total explanatory power. The model for total bird species richness (right), explained 61% of the observed variance with dominant land cover again being an important indicator and minimum cover and DHI seasonality also playing major roles in prediction. All models correctly predicted the broad trends with higher species number observed in areas of higher habitat diversity, such as sites dominant by bare ground and urban land cover classes with woodland mosaics, and reduced species richness in north in the Hudson Bay lowland and the Boreal forest areas.

The DHI components and the dominant land cover class both figured highly in the models confirming that these factors all convey different, and potentially complementary, information in relation to species richness.

This research has been described in: Coops, N.C., Wulder, M.A., Iwanicka, D. (2008) Assessing the relative importance of seasonal variation in production and land cover for satellite derived predictions of breeding bird distributions over Ontario, Canada. OIKOS. (In Review).

BIOSPACE is a collaboration between the Canadian Forest Service (CFS) of Natural Resources Canada (NRCan), 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 GRIP Program 2006 – 2008. Project Manager: Dr Mike Wulder (CFS).

We are grateful to the official sponsors of the Ontario Breeding Bird Atlas (Bird Studies Canada, Canadian Wildlife Service, Federation of Ontario Naturalists, Ontario Field Ornithologists, and Ontario Ministry of Natural Resources) for supplying Atlas data, and to the thousands of volunteer participants who gathered data for the project.

IRSS INTEGRATED REMOTE SENSING STUDIO

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