Canada

BIODIVERSITY MONITORING FROM SPACE

Forestry

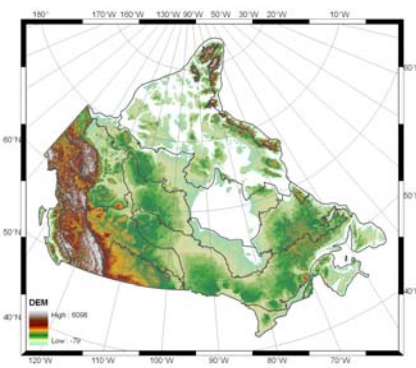
B I O S P A C E

Ecosystem centred approaches to biodiversity management are becoming increasingly adopted for sustainable management. Critical to their success is the underlying classification which identifies regions with similar characteristics. Once defined these provide an underlying basis for conservation and biodiversity management. With increased computing power, and availability of spatially explicit environmental layers, the potential to develop quantitative descriptions of ecoregions has increased, allowing them to be more easily developed. In a review of the potential of remote sensing technology to provide indicators useful biodiversity assessment, BIOSPACE proposed 4 broad categories which capture research trends.

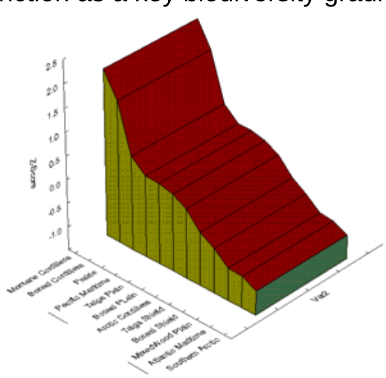
	Topography	Production	Land Cover	Disturbance
Spatial res.	90 m < 60° N; 1km > 60°N	1000 m	25 m or 1km	1000m
Type of data	RADAR	fPAR	ETM or MODIS / AVHRR	Greenness and Temperature
Platform	Shuttle	MERIS / SPOT VEGETATION	Landsat	Terra / Aqua / MERIS

As part of BIOSPACE, we have utilised ecoregions, as defined by the National Ecological Framework of Canada, and characterised them using the remotely sensed derived indicators of species richness.

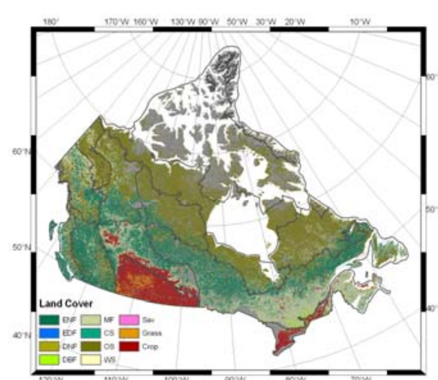
T O P O G R A P H Y



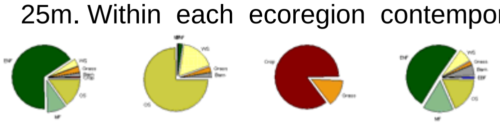
Temperature and moisture are two of those common variables used to assess biological diversity, usually in the form of annual precipitation and evaporation. While elevation is a relatively static variable compared to other biophysical parameters such as climate, its function as a key biodiversity gradient has been well documented. For example species diversity has shown a unimodal pattern, with the highest species diversity often occurring at mid-elevations. The Shuttle Radar Topography Mission (SRTM) provides consistent elevation data over the globe. A statistical analysis within and between ecoregions indicated that the z-score height of pixels within ecozones, was the topographic variable most able to differentiate ecosystems. The analysis indicated all ecosystems were statistically separable except for overlaps for Pacific Maritime with Taiga Plain and Mixedwood Plain and Atlantic Maritime.

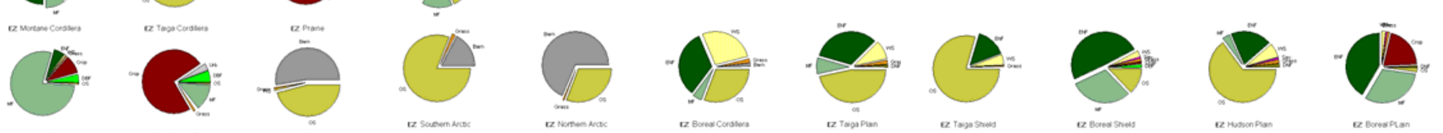


L A N D C O V E R



Finer scale spatial patterns such as land use / cover are increasingly being used as potential predictors of species diversity at regional and local scales. Land cover maps, in particular, depicting assemblages of cover type are critical to biodiversity assessments as they represent a “first-order” analysis of species occurrence. Information on current land cover, from remote sensing technology, is available at 1-km from the University of Maryland (UMD) land cover classification, and from the GRIP-funded CSA – CFS Earth Observation for Sustainable Development (EOSD) at 25m. Within each ecoregion contemporary land use information can be extracted and compared as well as information on the fragmentation of these landscapes.

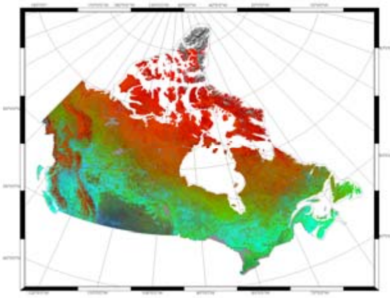


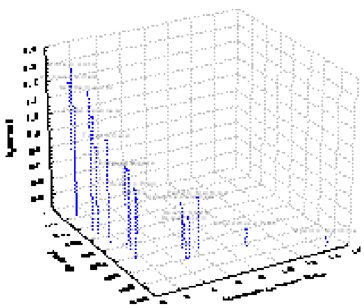


E C O Z O N E – B A S E D B I O D I V E R S I T Y

PRODUCTIVITY

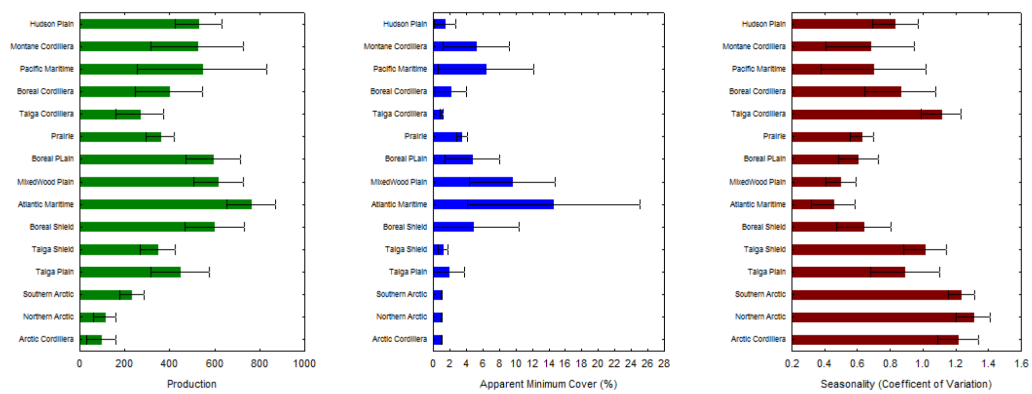
A direct correlation between productivity and species richness is expected as areas of high production have more resources to partition among competing species, thereby supporting greater numbers of species than areas with lower production. A key metric of vegetation production from satellite imagery is the fraction of photosynthetically active radiation (fPAR) intercepted by vegetation, which is analogous to greenness cover. We implement a Dynamic Habitat Index (DHI) which defines 3 indicators of vegetation dynamics; total annual production, minimum level of perennial cover, and degree of vegetation or seasonality. We utilized monthly MODIS fPAR from 2000 – 2006.





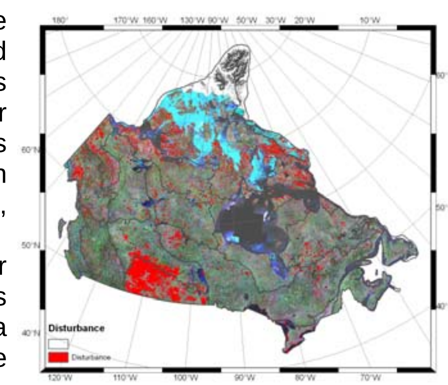
The Arctic Cordillera and Northern Arctic experience significant polar darkness and permanent snow cover resulting in very low annual cover and low overall greenness. Further south in the Southern Arctic, soil conditions improve and large flushes in cover occur result in increasing overall greenness and high seasonality. The Prairies, also have low annual cover; however, the cumulative greenness is high and seasonality comparatively less. In the west the Pacific Maritime contains high levels of greenness and low seasonality and the Montane Cordillera has high seasonality, and average levels of cover and greenness. The Taiga Plains & Taiga Shield have relatively high annual cover, and the seasonality is less compared to the northern ecozones.

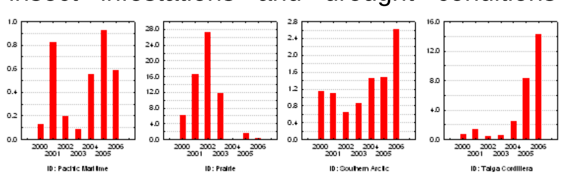
To the east the wetland dominated Hudson Plain ecozone shows a high annual production, high levels of annual cover, and moderate seasonality. The deciduous and evergreen Mixedwood Plains and Atlantic Maritime have high levels of greenness, reflecting the mix of agriculture and woodlands.

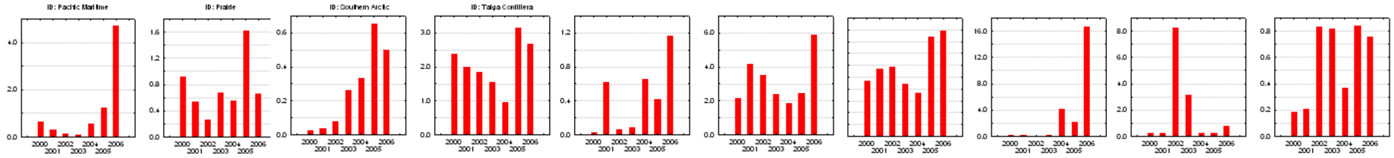


DISTURBANCE

Incorporating annual and seasonal time series of MODIS Land Surface Temperature (LST) and Enhanced Vegetation Index (EVI) data, the BIOSPACE implemented Disturbance Index (DI) is sensitive to both continuous and discontinuous change. This ability to capture vegetation dynamics over large areas is required to develop a greater understanding of changes in the terrestrial biosphere as well as informing managers about disturbance more typically captured through specific monitoring programs (such as insect, fire, or agricultural conditions). Significant disturbance events such as fire, insect infestations and drought conditions are all discernable from the index. These findings indicate that for monitoring a large area, such as Canada, the time series based DI is a useful additional tool to aid in change detection and monitoring activities.







This research has been described in detail in: Coops, N.C., Wulder, M.A., Iwanicka, D. (2008) Large area monitoring with a satellite-based disturbance index sensitive to annual and seasonal variations. Ecological Applications (07-2015) (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).

IRSS
INTEGRATED REMOTE SENSING STUDIO

CSA ASC

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Natural Resources Canada
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