INDICATOR:Terrestrial landscape fragmentation

Startegic Direction: Reduce Threats

Target: N/A

Theme: Pressures on Ontario's Biodiversity — Habitat Loss

Previous version: http://sobr.ca/_biosite/wp-content/uploads/Indicator-Terrestrial-Landscape-Fragmentation_May-19-2015.pdf

Background Information

Landscape fragmentation is the process by which habitat loss results in the division of large, continuous habitats into smaller, more isolated remnants. Scientific evidence shows that landscape fragmentation has negative effects on biodiversity (Fahrig 2003), largely resulting from the loss of the original habitat, reduction in habitat patch size and increasing isolation of habitat patches (Andrén 1994). More specifically, landscape fragmentation causes a reduction in habitat area, with associated declines in population density and species richness, and significant alterations to community composition, species interactions and ecosystem functioning (Fahrig 2003). Species occupying fragmented landscapes are also less able to shift their distributions to compensate for altered habitat quality resulting from changing climatic conditions. Thus, there is an important synergy between climate change and landscape fragmentation that may lead to increased loss of biodiversity (Varrin et al. 2008).

Landscape fragmentation not only deprives plants and animals of habitat, but also has indirect impacts, generating noise, light and air pollution or changing microclimates. Some species avoid human structures, which reduces their potential habitats even more. As a result, areas in which animals feel undisturbed become ever more scarce due to landscape fragmentation (Jaeger 2000). Further, landscape fragmentation results in an abundance of edge habitat, where edge-sensitive species or those that require large, undisturbed habitat are excluded (Fahrig 2003).

Landscape fragmentation is most evident in intensively used regions, where the habitat is divided by urbanization, agriculture, roads or other human developments (Fahrig 2003). Fragmentation has been rapidly increasing in Ontario, particularly in the south where human development is greatest (OBC 2010). This trend is likely to continue as Ontario's population is projected to grow by 31.5%, or almost 4.6 million, over the next 27 years; from an estimated 14.6 million in 2019 to almost 19.2 million by 2046, resulting in greater fragmentation of the remaining ecological network (Ontario Ministry of Finance 2020).

This indicator assesses terrestrial landscape fragmentation in Ontario using effective mesh size, an unbiased measure of the sizes of habitat patches within regions.

Data Analysis

Terrestrial landscape fragmentation in southern Ontario was assessed based on natural and anthropogenic land cover types in 2015 aggregated from the Southern Ontario Land Resource and Information System (SOLRIS v 3.0; OMNRF 2015). Landscape fragmentation was measured using effective mesh size (Jaeger 2000). Effective mesh size (m_{eff}) is a method to quantify fragmentation based on the probability that two points chosen at random in a region will be connected (i.e., found in the same habitat patch; Jaeger 2000). It is measured in units of area (i.e., ha or km^2). The greater the value, the more likely that any two points placed at random in an area will fall within the same connected natural area.

Effective mesh size was assessed for each ecodistrict in the Mixedwood Plains Ecozone in Ontario, with the exception of Manitoulin Island as it does not fall within the SOLRIS boundary (Figure 1). Roads and other infrastructure, urban areas, agricultural lands and extraction areas were considered barriers. It is important to note that as a measuring unit, effective mesh size assigns equal weight to all barriers. In reality, it may make a big difference whether an animal is confronted with a small country road or a highway. While it is possible that for some species, all barriers might constitute insurmountable obstacles, for most species, it will be the nature of the barrier placed in their path (volume of traffic, width, animal-tight fences, etc.) that carries the most weight (Jaeger 2000).

Patch-based landscape metrics can be biased by the boundaries and the extent of a reporting unit if the reporting unit boundaries fragment patches. To overcome this limitation the cross-boundary connections procedure was used, where provincial and/or ecozone borders were considered to be barriers and regional boundaries were not (Moser and Jaeger 2007). As such, m_{eff} was calculated using the following formula:

$$\mathbf{M}_{\text{eff}} = \frac{1}{A_{\text{total}}} \sum_{i=1}^{n} A_i \cdot A_i^{\text{cmpl}}$$

Where n= the number of patches, A_i = size of patch *i* inside the boundaries of the reporting unit (i = 1, 2, 3, …, n). A_i^{compl} = the area of the complete patch that A_i is a part of, and A_{total} = the total area of the reporting unit. A high effective mesh size value indicates low fragmentation of the landscape.

Download m_{eff} data

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Results

Trend: Baseline	**Data Confidence:** Medium	**Geographic Extent:** Mixedwood Plains

2011 2015

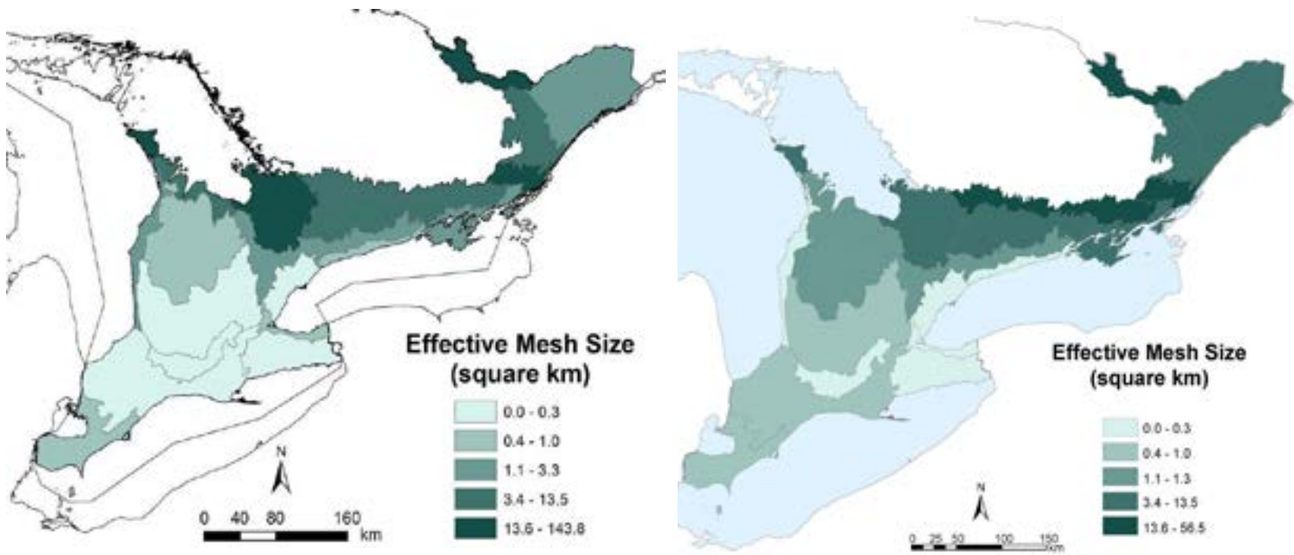

Figure 1. Effective Mesh Size for ecodistricts in southern Ontario 2011 and 2015. (*please note changes to effective mesh size can be attributed to real increase/decreases and improved data methodology)

Status

- In 2015, the effective mesh size in southern Ontario's Mixedwood Plain ecozone, ranged from a low of 0.03 km^2 in the Toronto Ecodistrict, to a high of 56 km^2 in the Charleston Lake Ecodistrict. This is similar to the 2011 results.
- The average size of the effective mesh size for the Mixedwood Plains area in 2015 was 7.4 km^2.
- The effective mesh size for all seven ecodistricts in the southwestern portion of the ecozone (Kincardine, Toronto, London, Grimsby, Niagara, St. Thomas, and Essex) was less than the median value of all areas assessed, showing southwestern Ontario is more fragmented than the rest of southern Ontario.
- To report on this indicator, we rely on analysis of spatial data and examination of changes between time periods. Currently, this analysis doesn't allow us to directly determine the cause of changes; however, observed increases or decreases in effective mesh size can likely be attributed to both real changes in anthropogenic cover, along with improved data methodology. Because of this challenge, direct comparisons between 2011 and 2015 were not made.

Links

Related Targets: N/A

Related Themes: N/A

Web Links:

Ontario GeoHub - Southern Ontario Land Resource Information System (SOLRIS) 3.0 – https://geohub.lio.gov.on.ca/documents/lio::southern-ontario-land-resource-information-system-solris-3-0/about

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