Invasive plant species represent a significant threat to ecosystem function and native vegetation and are of concern to conservation management. Understanding the interacting factors that influence their distribution is necessary to predict their spread and limit their impact. This study presents an analysis of the effect of landscape fragmentation on the distribution and diversity of invasive species in the Niagara Escarpment Plan Area (NEPA) using Geographic Information Systems (GIS) software.

**Project Objectives**

Describe the distribution of invasive plants in the Niagara Escarpment. Evaluate the effects of disturbance, landscape heterogeneity, and native species diversity. Map and quantify these effects using GIS. Identify which variables are most responsible for invasive species presence to inform management and policy decisions regarding land use planning.

**Methodology**

- **Sampling**
  - Point-Quarter sampling method (Cottam and Curtis 1956) conducted in 88 accessible stands to collect tree, sapling and understory data.
  - At every second point a quadrant was laid to collect percentage cover classes of understory vegetation.
  - Tree and vegetation data from Point-Quarter sampling was matched against a list of invasive species in southern Ontario.

- **GIS and Statistical Analysis**
  - Presence and average percent cover of invasive species were mapped using ArcMap 10.2.
  - Buffers of 250 m, 500 m, 1000 m and 2000 m radii were created around all sampling points.
  - Native species richness, road and trail length and density, developed area and forested area tested against invasive species presence and cover.

**Distribution of Vegetation**

Total of 259 plant species recorded

<table>
<thead>
<tr>
<th>Region</th>
<th>Invasive Species</th>
<th>Native Species</th>
<th>Developed Area</th>
<th>Forested Area</th>
<th>Road Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>250 m buffer</td>
<td>25</td>
<td>125</td>
<td>0.04</td>
<td>0.37</td>
<td>0.15</td>
</tr>
<tr>
<td>500 m buffer</td>
<td>35</td>
<td>140</td>
<td>0.05</td>
<td>0.33</td>
<td>0.17</td>
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<tr>
<td>1 km buffer</td>
<td>70</td>
<td>200</td>
<td>0.06</td>
<td>0.30</td>
<td>0.16</td>
</tr>
<tr>
<td>2 km buffer</td>
<td>110</td>
<td>250</td>
<td>0.07</td>
<td>0.27</td>
<td>0.15</td>
</tr>
</tbody>
</table>

**Invasive Species Captured**

- 11 species recorded in 62.5% of the 88 sampled stands.
- The average percent cover of all invasive species ranged from 0% to 36.2%, and averaged 6.6% across all stands.
- Garlic mustard (Alliaria petiolata) is the most prevalent species. It was captured in 70 plots, mostly in the Niagara Peninsula and Halton Sections.
- Other abundant species: Bittersweet nightshade, Mother-of-thyme, and European buckthorn.

Field sampling in 2011-12 was possible through the following partnership: The Niagara Escarpment Commission (NEC), The Niagara Escarpment Biosphere Fund, The Niagara Escarpment Foundation, Ontario Ministry of Natural Resources and Faculty of Forestry, University of Toronto.

**Main Findings**

The availability of spatial data makes GIS an effective tool for analyzing the influence of landscape fragmentation on vegetation across landscapes.

**Distribution of Invasive Species**

Invasive species richness was most strongly positively correlated with road length and density. Land use and fragmentation partially explain the distribution of invasive plant species in (Stepwise regression: 45% variability explained). A more complete understanding of invasion in the Niagara Escarpment requires the inclusion of extra biotic and abiotic variables (e.g., climate, soil characteristics, topography, past land use, current population, etc.).