Effects of Adjacent Land Use on Ecological Integrity for Lakes and Wetlands

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Freshwater Wetland-Dependent Wildlife with Upland Requirements (MA)

<table>
<thead>
<tr>
<th>Wetland-Dependent Species</th>
<th>Species with Upland Requirements</th>
<th>% Wetland-Dependent with Upland Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibians</td>
<td>20</td>
<td>19</td>
</tr>
<tr>
<td>Reptiles</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Mammals</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>Birds</td>
<td>42</td>
<td>23</td>
</tr>
<tr>
<td>TOTAL</td>
<td>86</td>
<td>65</td>
</tr>
</tbody>
</table>

Species Richness vs. Forest Clearing

Findlay & Houlanhan, 1997
Species Richness vs. Road Density

- Plant species richness vs. paved road density (1000 m)
- Herp species richness vs. paved road density (1000 m)
- Bird species richness vs. paved road density (500 m)
- Mammal species richness vs. paved road density (500 m)

Findlay & Houlahan, 1997
Findlay and Houlahan, 1997
Findlay and Bourdages, 2000
Conservation Assessment & Prioritization System (CAPS)

Assessing ecological integrity and supporting decision-making for land conservation, habitat management, project review & permitting to protect biodiversity

Landscape Ecology Lab

http://www.umasscaps.org
Ecological Community Approach
Ecological Integrity

...the long-term capability of the ecological community to sustain its composition, structure and function and thus also its resiliency to stress
The CAPS Analysis

GIS data → Land cover map → Integrity metrics

Index of Ecological Integrity
Several landscape metrics are calculated based on the land cover map and other data.
CAPS Integrity Metrics: Road Traffic

Low traffic effects

High traffic effects
CAPS Integrity Metrics: Road Traffic

Low traffic effects

High traffic effects
Weighting metrics

Weight for each class

very bad

not so bad
Weighting metrics

weight \times distance

inflection point

weight for each class

weight by distance
Weighting metrics

weight for each class × weight by distance = final weights

weight

very bad
not so bad

A B C D E

weight

inflection point

distance

weight

distance

weight
CAPS Integrity Metrics:  
Watershed metrics

Full watershed above a point  
Metrics weighted by a time-of-flow model
Edge Predators

High

Low
## CAPS Integrity Metrics

<table>
<thead>
<tr>
<th>Stressor metrics</th>
<th>Watershed-based stressor metrics</th>
<th>Resiliency metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road Traffic</td>
<td>Road salt</td>
<td>Similarity</td>
</tr>
<tr>
<td>Habitat loss</td>
<td>Road sediment</td>
<td>Connectedness</td>
</tr>
<tr>
<td>Microclimatic alterations</td>
<td>Nutrient enrichment</td>
<td></td>
</tr>
<tr>
<td>Mowing &amp; plowing intensity</td>
<td>Dam intensity</td>
<td>Aquatic connectedness</td>
</tr>
<tr>
<td>Domestic predators</td>
<td>Watershed habitat loss</td>
<td></td>
</tr>
<tr>
<td>Edge predators</td>
<td>Imperviousness</td>
<td></td>
</tr>
<tr>
<td>Non-native invasive plants</td>
<td>Hydrological alterations</td>
<td></td>
</tr>
<tr>
<td>Non-native invasive earthworms</td>
<td>Impounded</td>
<td></td>
</tr>
<tr>
<td>Wetland buffer insults</td>
<td>Percent impounded</td>
<td></td>
</tr>
<tr>
<td>Tidal restrictions</td>
<td>Altered stream geomorphology</td>
<td></td>
</tr>
<tr>
<td>Salt marsh ditching</td>
<td>Stream temperature alteration</td>
<td></td>
</tr>
<tr>
<td>Coastal structures</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beach pedestrian traffic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beach ORVs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boat traffic intensity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emissions intensity</td>
<td></td>
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</tr>
</tbody>
</table>
Metrics are combined into an index of ecological integrity
Statewide Index of Ecological Integrity (IEI)
The Biological Condition Gradient

1. Natural structural, functional, and taxonomic integrity is preserved
2. Structure & function similar to natural community with some additional taxa & biomass; ecosystem level functions are fully maintained
3. Evident changes in structure due to loss of some rare native taxa; shifts in relative abundance; ecosystem level functions fully maintained
4. Moderate changes in structure due to replacement of sensitive ubiquitous taxa by more tolerant taxa; ecosystem functions largely maintained
5. Sensitive taxa markedly diminished; conspicuously unbalanced distribution of major taxonomic groups; ecosystem function shows reduced complexity & redundancy
6. Extreme changes in structure and ecosystem function; wholesale changes in taxonomic composition; extreme alterations from normal densities

Tiered Aquatic Life Use (TALU)

Level of Stressors

Low
Watershed, habitat, flow regime and water chemistry as naturally occurs

High
Chemistry, habitat, and/or flow regime severely altered from natural conditions
Level 3: Site Level Assessment Methods (SLAM)

- Forested Wetland
- Salt Marsh
The IBIs
Multiple taxonomic groups

Forested wetlands: IEI-IBI

<table>
<thead>
<tr>
<th></th>
<th>#taxa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vascular plants</td>
<td>13</td>
</tr>
<tr>
<td>Macroinvertebrates</td>
<td>9</td>
</tr>
<tr>
<td>Diatoms</td>
<td>14</td>
</tr>
<tr>
<td>Bryophytes</td>
<td>11</td>
</tr>
<tr>
<td>Epiphytic macrolichens</td>
<td>4</td>
</tr>
</tbody>
</table>

Verification Plot
Concordance = 0.79
Invasive Plants in Forested Wetlands

- Acer platanoides
- Berberis thunbergii
- Celastrus orbiculatus
- Euonymus alata
- Frangula alnus
- Iris pseudacorus
- Lonicera morrowii
- Myosotis scorpioides
- Phalaris arundinacea
- Ranunculus repens
- Rhamnus cathartica
- Rosa multiflora

$N=64$
Logistic Regression
$P=0.0011$   $\rho^2=0.12$