Economic and ecological outcomes of flexible biodiversity offset systems

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Biodiversity Offsets

Compensate for environmental impacts of development through conservation activities elsewhere

1. Market force: Incentive to minimize impacts
2. Equity: Society is compensated for losses
   - Typical goal is no-net-loss (NNL)
   - “Equivalency” → amount and type

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Why No-Net-Loss?

_Equivalency: intuitive, orderly... and a red herring?_

**Issues**

- Conservation priorities may not be the target of “equivalent” offsets
- Restricted trading
- Spatially-variable costs
Case Study: Alberta’s Boreal Forest

Conservation Priorities

Industrial Development

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## Offset Currency: Defining Stewardship Units

### Biodiversity Losses

<table>
<thead>
<tr>
<th>Activity</th>
<th>Biodiversity Intactness Change (%)</th>
<th>Areal Extent (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-90%</td>
<td>13,000 ha</td>
</tr>
<tr>
<td></td>
<td>-25%</td>
<td>10,000 ha</td>
</tr>
<tr>
<td></td>
<td>-3%</td>
<td>20 ha</td>
</tr>
</tbody>
</table>

### Biodiversity Gains

<table>
<thead>
<tr>
<th>Activity</th>
<th>Biodiversity Intactness Change (%)</th>
<th>Areal Extent (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+3%</td>
<td>20 ha</td>
</tr>
<tr>
<td></td>
<td>+30%</td>
<td>15,000 ha</td>
</tr>
<tr>
<td></td>
<td>+10%</td>
<td>64 ha</td>
</tr>
</tbody>
</table>

### Calculation

\[
\text{Area impacted (km}^2\text{) } \times \text{ Change in Biodiversity Intactness (\%)}
\]

**Stewardship Units:** Change in “Intactness-Adjusted Area” (\(\Delta\text{IAA}\))
Biodiversity Losses: Oil Sands 2020 Forecast

Total Impact: -3302 IAA units

Divided by Vegetation Classes

- Coniferous - Dense
- Mixedwood - Dense
- Wetland - Shrub
- Broadleaf - Dense
- Wetland - Treed
- Water

- Herbaceous
- Wetland - Herbaceous
- Coniferous - Open
- Wetland - Mixed
- Shrub - Tall
- Mixedwood - Open
Offset Targets: Conservation Priorities vs. Equivalency

Combine each Offset Option...
A. Equivalent Vegetation IAA amounts
B. Total IAA

...with each Biodiversity Target
1. No spatial constraints
2. Caribou Range
3. Dry Mixedwood + Caribou

= 6 possible scenarios

Scenario A1 = “Equivalency”
Offset Activities & Costs

**Protection**
- Credits: Avoidance of future IAA loss (energy & forestry)
- Cost: Compensation to existing tenure holders

**Restoration**
- Credits: \( \Delta \)IAA from removing legacy roads & seismic lines
- Cost: Estimated from existing projects
Example Offset Networks

A) Equivalent Vegetation

B) Total IAA

1. No spatial constraints
2. Caribou Range
3. Dry Mixedwood + Caribou
Offset Scenarios: Cost Comparison

Habib et al. *Conservation Biology* 2013
Summary

• Biodiversity metric based on standardized provincial monitoring program
• Incorporates both area and intensity of impacts
• Allows for trading across ecosystems to prioritize chosen ecological targets
  – Cost differences are stark
  – Makes land-use trade-offs explicit