Using Indicator Species to Assess Biodiversity

Jessica Grealey
2010 A.D. Latornell Conservation Symposium
Overview

• Introduction
• Selecting indicator species
• Case study
• Conclusions
Introduction

What is an ‘indicator species?’

• plants or animals that, by their presence, abundance, or lack of abundance, demonstrate some distinctive aspect of the character or quality of an environment (Freedman 2010).

• Indicators are used in ecology, environmental toxicology, pollution control, forestry, and wildlife management.

• Typically multiple species belonging to one or more taxa are studied
The selection of which indicator taxa is appropriate for a given study depends on the research question being explored, the resources available, and the geographic location of study.
A suite of characteristics are required for a taxonomic group to be effective as a biological indicator*:

✓ Sufficiently sensitive
✓ Widely distributed
✓ Capable of providing a continuous assessment over a wide range of stresses
✓ Efficient and cost effective to measure
✓ Responds to key gradients across ecological systems
✓ Provides the ability to distinguish between natural cycles or trends and those induced by anthropogenic stress

*Noss 1990; Karr 1991; Stork et al. 1997; Lorenz et al. 1999; Dale and Beyler 2001
Case Study

Butterfly Abundance & Diversity Along an Urban Gradient Region of Waterloo, Ontario
Butterflies as Indicators

Butterflies are suitable indicators because they are:

- extremely sensitive
- distributed over a wide geographical area.
- capable of providing a continuous assessment of changes in the environment over a wide range of stresses—specialists vs. generalists
- Capable of providing coverage of the key gradients across ecological systems (e.g. soils, vegetation types, temperature, etc.)
- cost effective to measure.
- A taxonomic group that has a well studied life history
Study Methods

- 15 sites were selected along a gradient of urbanization representing 5 different land uses
  - ESPAs, golf courses, residential areas, urban parks and industrial areas

- A 500m transect was established at each site

- Each transect was walked 1x per week and all butterflies observed were recorded

- Information on canopy cover, plant richness, nectar sources, herbaceous vegetation cover, habitat types, and weather were also recorded
Methods

A review of existing literature on biological indicators and their effectiveness was undertaken to determine if the results obtained through this urban gradient study could be applied to overall biodiversity in the region.
Results

Natural

- ESPA
- Urban Park
- Golf Course
- Residential Area
- Industrial Area

Urban
Results

Relative Abundance of Natural and Created Habitat by Land Use

- **Number of Transect Sections**
- **Land Use Type**: ESPA, Urban Park, Golf Course, Residential Area, Industrial Area
- **Legend**:
  - Natural Habitat
  - Created Habitat
Results

Note: Different letters represent significant differences in Shannon scores ordered highest to lowest using a Kruskal Wallis Test.
Results

Overall Butterfly Abundance by Land Use in 2009 and 2010

- 2009
- 2010
- Mean non native species

Land Use:
- ESPA
- Urban Park
- Golf Course
- Industrial Area
- Residential Area

Butterfly Abundance

- ESPA: 150
- Urban Park: 200
- Golf Course: 100
- Industrial Area: 350
- Residential Area: 100
Results

• A correlation between overall butterfly species richness and plant diversity, habitat diversity, canopy cover and the availability of nectar sources was observed.
• Butterfly abundance was observed to be heavily influenced by two non native species.
• ESPA designations appear to be effective at protecting butterfly communities and support the most ‘rare’ and ‘uncommon species’
• Urban parks support a high species richness compared to other land uses examined
• Golf courses, industrial areas, and residential areas support the least diverse communities despite the growing popularity of naturalized lawns and gardens
Comparison of studies that examine the effectiveness of indicators is complicated by differences in sampling effort, geographical location, site size, target species, and the way in which data has been analyzed.

Literature was found that supports the use of indicators for developing conservation strategies as well as literature that did not
Key considerations for using indicators:

• Characteristics that make a particular taxa suitable
• Geographical location
• Scale of study
• Gradient transitions
Conclusions

• Butterflies are effective indicators of plant diversity, bird diversity and potentially other terrestrial taxa.

• The use of indicators is appropriate in temperate regions over small scales using species which meet the criteria outlined.
THANK YOU!

Jessica Grealey
Natural Resource Solutions Inc.
(519)725-2227
jgrealey@nrsi.on.ca