An approach to assessing comparative ecological condition of National Capital Region parks

May 2005
Human impacts at different scales

- Human impacts occur over a wide range of spatial and temporal scales
- Point sources (small:small)
- Impervious surface (medium:medium)
- Global warming (large:large)
Vital signs require monitoring at different spatial and temporal scales.
Challenges...

- Different scales of stressors (atmospheric inputs vs deer populations)
- Different features (WOTR vs CATO)
- Different park sizes (CHOH vs ROCR)
- Parks spatially divided (e.g., NACE)
- Balance of terrestrial and aquatic habitats
- Different physiographic regions (PRWI vs CATO)
Solution 1: Park classification for consistent assessment between parks

- **Natural Resource Parks**
  - Parks: PRWI, CATO, ROCR
  - Vital signs: air, geology, water, biological integrity, ecosystem process

- **Battlefield**
  - Parks: MONO, ANTI, MANA, HAFE
  - Vital signs: air, geology, water, biological integrity, ecosystem process

- **Monument**
  - Parks: CHOH, GWMP, NACE, WOTR
  - Vital signs: air, water

- Recognizing that all parks have some natural resources
Proof of concept: comparison of four parks in National Capital Region

- ANTI
- ROCR
- PRWI
- CATO

Ecosystem Health Index: Including measures of...

- Ecosystem Processes
- Water Quality
- Air Quality
Antietam National Battlefield (ANTI)

Park area:
13,161 ha

Watershed area (outside):
17,633 ha
716,178 ha (Anti Creek)

Physiographic region:
Ridge and Valley

Visitors 2004:
236,840
Rock Creek National Park (ROCR)

Park area: 7,116 ha

Watershed area (outside): 181,328 ha

Physiographic region: Coastal plain, Piedmont

Visitors 2004: 2,148,970
Prince William Forest Park (PRWI)

Park area: 50,549 ha

Watershed area (outside): 59,345 ha

Physiographic region: Coastal plain, Piedmont

Visitors 2004: 216,039
Catoctin Mountain Park
(CATO)

Park area:
22,772 ha

Watershed area
(outside):
22,387 ha

Physiographic region:
Blue Ridge,
Ridge and Valley

Visitors 2004:
734,189
Example of impervious surface

- CATO 0.87%
- ROCR 23.45%
- PRWI 2.5%
- ANTI 2.41%

Impervious surface

Scale bar approx 1 mile

Health threshold: < 10% impervious
Ecological link to vital sign measurement (justification for 10% impervious cover threshold)

- increased floods and flood peaks, leading to stream straightening and streambed erosion;
- increased erosion, leading to loss of trees and vegetation along the banks (at 8% - 10% impervious surface cov, streams double in the size of the bed due to the increased vol);
- increased pollutant loads;
- increased shellfish diseases and beach closures;
- increase in stream temperature which messes up lots of biological processes;
- increased bacteria, often as a direct of a high density of household pets;
- decreased high weather flow;
- decreased pooling;
- decreased woody debris, a crucial habitat element for aquatic insects;
- decrease in substrate quality;
- decreased fish passage during dry weather flow periods due to the enlarged stream bed; and
- decrease in insect fish and fish diversity. At 12% imperviousness, trout and other sensitive species can no longer survive in the stream.
## Impervious cover - relative to threshold

<table>
<thead>
<tr>
<th>Park</th>
<th>Impervious cover watershed (%)</th>
<th>Attainment of threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTI</td>
<td>2.41</td>
<td>1</td>
</tr>
<tr>
<td>ROCR</td>
<td>23.45</td>
<td>0</td>
</tr>
<tr>
<td>PRWI</td>
<td>2.50</td>
<td>1</td>
</tr>
<tr>
<td>CATO</td>
<td>0.87</td>
<td>1</td>
</tr>
</tbody>
</table>
## Summary of vital signs between parks

<table>
<thead>
<tr>
<th>Park</th>
<th>Impervious cover watershed (%)</th>
<th>Modelled Ozone (ppb)</th>
<th>Deer density # km²</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTI</td>
<td>2.41</td>
<td>76-85</td>
<td>35.1</td>
</tr>
<tr>
<td>ROCR</td>
<td>23.45</td>
<td>92-97</td>
<td>23.9</td>
</tr>
<tr>
<td>PRWI</td>
<td>2.50</td>
<td>86-91</td>
<td>15.5</td>
</tr>
<tr>
<td>CATO</td>
<td>0.87</td>
<td>86-91</td>
<td>71.3</td>
</tr>
</tbody>
</table>

Threshold:
- <10% for Impervious cover watershed
- <80 (8 hr mean 4th highest over 3 yr) for Modelled Ozone
- <10 forest <30 battlefield for Deer density
## Calculation of health on known values/four park comparison

<table>
<thead>
<tr>
<th>Park</th>
<th>Impervious cover watershed (%)</th>
<th>Modelled Ozone (ppb)</th>
<th>Deer density # km²</th>
<th>Summary health</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANTI</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.66</td>
</tr>
<tr>
<td>ROCR</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>PRWI</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0.33</td>
</tr>
<tr>
<td>CATO</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0.33</td>
</tr>
</tbody>
</table>

**Threshold**
- <10% Impervious cover watershed
- <80 (8 hr mean 4th highest over 3 yr)
- <10 forest
- <30 battlefield

**Where**
- Ecosystem health of 1 indicates attainment of all measured vital signs
- Ecosystem health of 0 indicates attainment of no measured vital signs

**Note**
- this ‘health’ is obviously biased by example indicators – 10-15 broad indicator measurements would be ideal
Effective management also requires knowledge of within park variations - ANTI

<table>
<thead>
<tr>
<th>Site</th>
<th>pH</th>
<th>DO (mg/L)</th>
<th>NO₃⁻ (mg/L)</th>
<th>PO₄³⁻ (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haines Farm</td>
<td>7.12</td>
<td>5.50</td>
<td>5.60</td>
<td>0.20</td>
</tr>
<tr>
<td>Miller Farm</td>
<td>7.17</td>
<td>8.48</td>
<td>8.70</td>
<td>0.21</td>
</tr>
<tr>
<td>Newcomer Farm</td>
<td>7.91</td>
<td>8.86</td>
<td>2.90</td>
<td>0.14</td>
</tr>
<tr>
<td>Above Pond</td>
<td>7.96</td>
<td>8.16</td>
<td>5.60</td>
<td>0.23</td>
</tr>
<tr>
<td>Mumma pasture</td>
<td>7.87</td>
<td>8.92</td>
<td>5.40</td>
<td>0.26</td>
</tr>
<tr>
<td>Mumma house</td>
<td>7.11</td>
<td>5.10</td>
<td>7.70</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Threshold: 6.5-9.0 >5.5 <10 <0.1

Values are annual medians for 2003
Thresholds from Runde, EPA nutrient standards summary
## Water quality health comparison within ANTI

<table>
<thead>
<tr>
<th>Site</th>
<th>pH</th>
<th>DO (mg/L)</th>
<th>NO$_3^-$ (mg/L)</th>
<th>PO$_4^{3-}$ (mg/L)</th>
<th>Summary Water quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Haines Farm</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>Miller Farm</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>Newcomer Farm</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>Above Pond</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>Mumma pasture</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0.75</td>
</tr>
<tr>
<td>Mumma house</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Threshold</strong></td>
<td></td>
<td><strong>&gt;5.5</strong></td>
<td><strong>&lt;10</strong></td>
<td><strong>&lt;0.1</strong></td>
<td></td>
</tr>
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**Water quality health comparison within ANTI**

<table>
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<tr>
<td>Above Pond</td>
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<tr>
<td>Mumma pasture</td>
<td>0.75</td>
</tr>
<tr>
<td>Mumma house</td>
<td>0.5</td>
</tr>
</tbody>
</table>

- 0.00 attained no water quality criteria
- 0.25
- 0.50
- 0.75
- 1.00 attained all water quality criteria
Recommendations

• Require a subset of parameters linked to key vital signs that can be **Modeled, Measured, Mapped** and **Thresholds establishment**

• Parks should be classified into broad categories to distinguish the largest differences present in structure and ecological function – eg Natural resource, Battlefield and Monument Parks

• Measurements should be taken at consistent temporal scales to allow direct comparison between parks – scales must be appropriate to parameters

• Within parks, assessment should be made to identify local management priorities
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