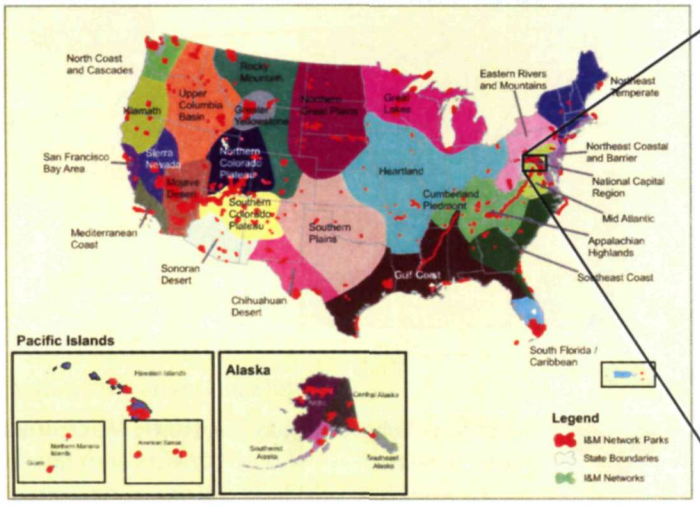
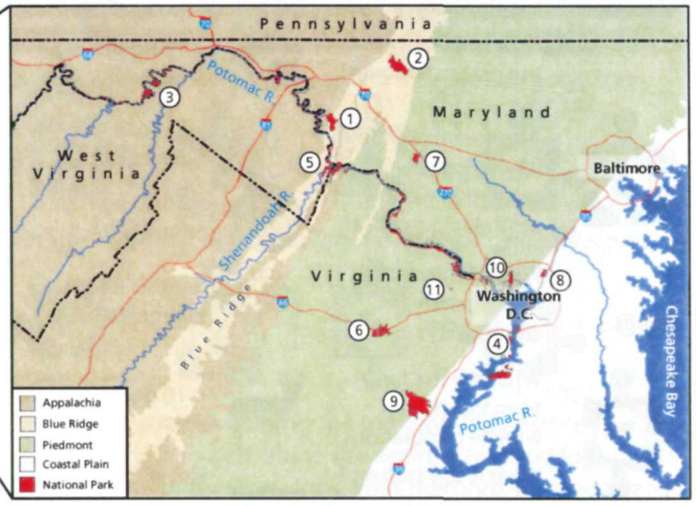
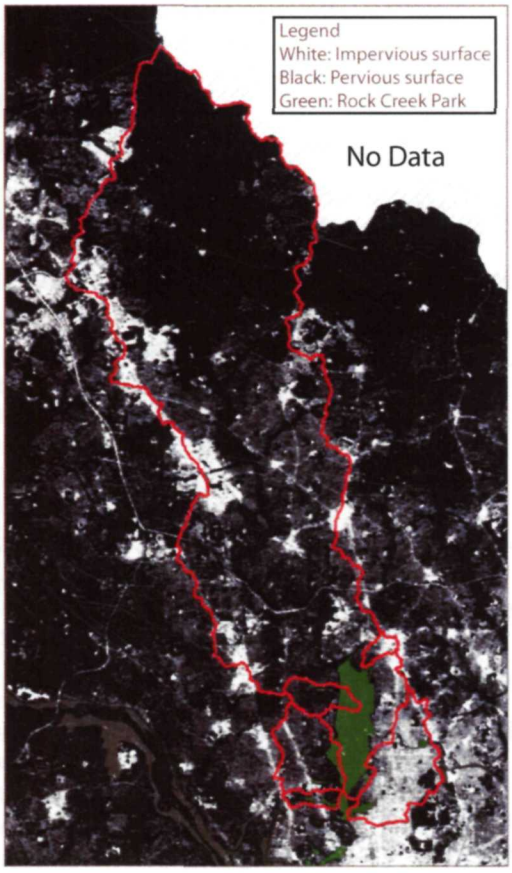
MEASURING THE HEALTH OF OUR NATIONAL PARKS: ROCK CREEK PARK



The Inventory and Monitoring (I&M) Program has subdivided the 270 National Park units with significant natural resources into 32 Networks. All of the parks within a Network share similar natural resource challenges. The purpose of these Networks is to conduct long-term resource monitoring.



The National Capital Region Netwok (NCRN) consists of 11 parks within Maryland, Virginia, West Virginia, and the District of Columbia. These parks were established for their cultural and recreational value; however, they provide important natural oases in an increasingly urban context.



Rock Creek Park was founded in 1890 as one of the first federal parks. At the time, it was located at the edge of the growing District of Columbia and was a favorite rural retreat for city residents. Today, Rock Creek Park is considered 'an island of forest in a sea of development'; as shown in the impervious surfaces image to the left.

The 3,000 acre park surrounds the lower watershed of Rock Creek and its tributaries. Urban development outside of the park boundary impacts the park's natural resources through heavy traffic, increased flooding and pollution of park streams, introduction of non-native and invasive species, high recreational demand, and boundary encroachments. The large tract of forest within the park helps to buffer some of the urban impacts and to improve water quality in the lower Rock Creek.

In Rock Creek Park, the National Capital Region Inventory and Monitoring Program is monitoring 20 chemical, physical, and biological elements and processes that represent overall park health and condition. These 'vital signs' will help to inform park management about the condition of the air, water, ecological and physical resources of Rock Creek Park. Managers can incorporate this information in their restoration and protection decisions for important natural resources. Long-term monitoring data can provide park managers with an indication of the effectiveness of their management actions.

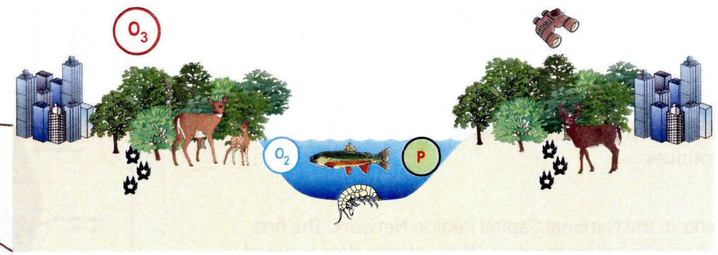
DEVELOPING AN ASSESSMENT METHODOLOGY FOR ROCK CREEK PARK

1. Linking management objectives to thresholds

Vital Sign Category	Management Objective	Vital Sign	Threshold
	When are visitors and vegetation exposed to unhealthy air?	O_3	< 8 ppm (8 h)$^{-1}$ Source: EPA
	How is visibility in the parks changing?		< 15 µg m^{-3} Source: EPA
	Are streams suitable for ecological, recreational and aesthetic purposes?	O_2	> 5 mg O_2 L^{-1} Source: EPA
		P	> 36.56 µg P L^{-1} Source: EPA
	What is the status of the benthic community?		Benthic IBI > 3 Source: MBSS
	What are the long-term trends in wildlife populations?		< 10 deer km^{-2} Source: NPS
	What is the status of the fish community?		Fish IBI > 3 Source: MBSS
	What are the long-term habitat changes in the region?		< 10% impervious surfaces Source: Lookingbill

The first step in this assessment is to determine thresholds or assessment points. These values are the directly linked to management objectives. Park managers need to know the status and trends of their resources. These resources are being monitored by I&M through a particular vital sign. Each vital sign is then assigned a threshold value. This value may be regulated (ozone), it may be a desired condition (deer), or it may be based on scientific literature (impervious surfaces).

· Conceptual diagram and symbol legend ·



Legend

- beech/oak/tulip poplar forests
- historical/cultural sites
- development and traffic

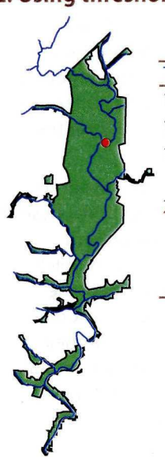
Vital signs used in integrated assessment

- **Aquatic Macroinvertebrates** consists of measurements of benthic IBI measured irregularly
- **Fishes** consists of measurements of fish IBI measured irregularly
- **Land Cover/Land Use** is measured by amount of habitat, connectivity, edge and impervious surfaces. All are measured on a 5 year basis.
- **Nutrient Dynamics** consists of measurements of nitrate, ammonia, and total phosphorus. All are measured monthly
- **Ozone** concentration is sampled hourly
- **Visibility and Particulate Matter** is measured using $PM_{2.5}$ and is sampled daily
- **Water Chemistry** consists of measurements of pH, dissolved oxygen, water temperature, acid neutralizing capacity, and salinity. All are measured monthly
- **White-tailed Deer** density is measured on an annual basis

Vital sign categories

- Air Quality and Climate
- Water Quality and Hydrology
- Biodiversity
- Ecosystem Pattern and Proess

2. Using thresholds to assess park resources: Water quality at Pinehurst Branch



	Dissolved O_2 mg L^{-1}	NO_3 mg L^{-1}	PO_4 mg L^{-1}	pH	Salinity
Threshold	> 5.00	< 2.00	< 0.037	6.00 - 8.50	< 0.25
10/4/2005	7.80	0.40	0.69	7.50	Not Reported
11/3/2005	6.56	1.20	1.23	7.58	Not Reported
12/8/2005	9.01	0.30	0.41	7.47	1.10
1/3/2006	5.58	2.50	0.44	7.67	0.20
2/14/2006	11.88	3.00	0.48	7.67	0.70
3/8/2006	7.64	3.10	0.15	8.30	0.30
4/4/2006	5.98	0.70	Absent	8.01	0.20
5/4/2006	3.94	2.80	0.61	7.75	0.20
	0.88	0.50	0.00	1.00	0.50

Excellent A ≤ 1.00
Good B ≤ 0.80
Poor C ≤ 0.60
Degraded D ≤ 0.40
Very Degraded F ≤ 0.20

The second step in the assessment is to compare the monitoring data collected by the I&M program to the thresholds developed in the previous step. In the table to the left, the data that do not meet the threshold are highlighted in red. In order to compare data with differing units or spatial and temporal scales, an index value is calculated. This value varies from zero to one and is the percentage of time the vital sign metric meets the threshold. For example, nitrate concentration receives a 0.50 score because half of the sampling points meet the threshold value. These index values are then compared to the legend (bottom) to give managers and the public a qualitative understanding of the condition of park resources.

3. Determining the optimal integrated assessment

Average all vital sign scores

$O_3 + \text{bug} + O_2 + P + \text{bug} + \text{deer} + \text{fish} + \text{paw} = 0.40$

Multiply transformed vital sign scores

$O_3 \times \text{bug} \times O_2 \times P \times \text{bug} \times \text{deer} \times \text{fish} \times \text{paw} = 0.07$

Average vital signs within categories; Average category scores

$\text{puzzle} + \text{puzzle} + \text{puzzle} + \text{puzzle} = 0.44$

Average vital signs within categories; Multiply category scores

$\text{puzzle} \times \text{puzzle} \times \text{puzzle} \times \text{puzzle} = 0.03$

The third step in developing the integrated assessment methodology is to determine the optimal method for integrating all of the vital signs. Four methods were analyzed for Rock Creek; two use vital sign scores, or averaged metric scores, and two use vital sign category scores, which are averaged vital sign scores. The multiplicative methods use transformed data to avoid multiplying by zero.

Of the four methods, the optimal method is to average vital signs within catgories and then average the category scores to obtain the final score. This method is the simplest method that also allows for comparison between multiple networks. Not all networks are monitoring the same vital signs, however they are all monitoring vital signs within the general categories. Using this method provides managers with the opportunity to compare categories across parks in multiple networks.

4. Finalizing the Rock Creek Park integrated assessment

The table to the right shows the final Rock Creek Park integrated assessment following the methodology described in this newsletter. This framework allows park managers not only to determine the overall condition of the park, but also to determine the condition of specific park natural resources.

For Rock Creek, Water Quality and Hydrology is the only resource category that is in good condition. By looking at the vital sign score, park managers can see that Water Chemisty is in good condition, but that the Aquatic Macroinvertebrates score is decreasing the category score. Therefore, park management can target effort in improving the macroinvertebrate habitat in order to improve park health.

For the Biodiversity category, Fishes are in excellent condition; however, the overabundance of White-tailed Deer is reducing the category score. Park managers can use this information to modify current management plans to include deer population control in order to improve park health.

Vital Sign Category	Vital Sign	Vital Sign Score	Category Score	Park Score
	O_3	0.28	0.28	0.44
	deer	0.33		
	O_2	0.67	0.63	
	P	0.49		
		0.00		
	deer	0.00	0.60	
	fish	1.00		
	paw	0.50	0.25	

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FURTHER ASSESSMENT STEPS

ROCK CREEK PARK ASSESSMENT

- Gather any missing data for the remaining vital signs. This includes information for a number of vital signs in the biodiversity category. Much of the missing data is still not currently available from the National Park Service.
- Update all information that has been gathered to date. I&M will continue to collect data on all vital signs; therefore, gathering the most up-to-date information will occur throughout the project.
- Develop thresholds for the remaining vital signs. Thresholds have been developed for 31 of the 58 vital sign metrics measured in Rock Creek Park. These 31 metrics are part of 16 vital signs in the integrated assessment. Thresholds will be developed for the remaining vital sign metrics as this project continues.

NATIONAL CAPITAL REGION NETWORK ASSESSMENT

- Expand the Rock Creek assessment methodology to all of the parks in the National Capital Region Network. The first step in expanding the methodology to all of the parks will be to begin to collect the data. Water quality data is already available for 10 of the 11 parks. A rough assessment has been conducted on this information and has shown some interesting trends that will be investigated further as the assessment is continued.
- Analyze the expanded data set statistically to determine any correlation between vital sign metrics. It is important to use independent metrics because any correlation within metrics results in hidden weighting to those metrics. Removing correlated metrics will make the assessment more informative to park management.
- Compare the National Capital Region Network parks other protected and unprotected areas to discover any regional patterns in ecosystem health. This comparison will not include all of the vital signs that are monitored in the National Capital Region Network as there may be limited data for the other areas. Develpment of this comparative assessment is still in the early stages and may be modified as the project progresses.

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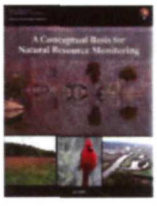

For further information information about the NCRN I&M Program, please visit www.ncrvitalsigns.net to download any of the above publications.

Many thanks to all of the National Park Service and Integration and Application Network staff who have assisted with this effort.

For further information, please visit
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