National Park Service
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Natural Resource Stewardship and Science

Harpers Ferry National Historical Park Natural Resource Condition Assessment—SUMMARY

National Capital Region

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The full 134-page report can be accessed via *https://irma.nps.gov/App/Reference/Profile/2205992* and *http://www.ian.umces.edu/press*.

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ON THE COVER

John Brown's Fort was the building built in 1848 that was originally constructed for use as a guard and fire engine house for the federal Harpers Ferry Armory.
Photo by Joy Schoenberger.

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BACKGROUND AND CONTEXT

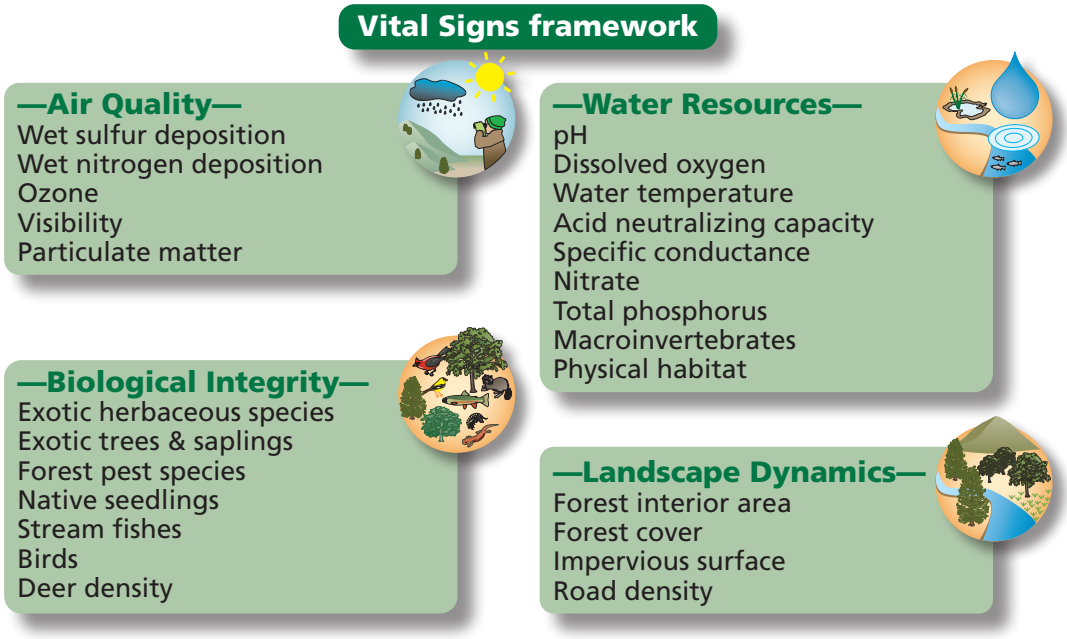
Harpers Ferry National Historical Park was established in 1944 to "be a public national memorial commemorating historical events at or near Harpers Ferry." At the confluence of the Shenandoah and Potomac Rivers, the park contains riparian habitats, floodplains, agricultural fields, geologic exposures, rare limestone glades, developed areas, and upland forests.

Harpers Ferry National Historical Park's natural resources are challenged by multiple regional and local stressors. Air pollution from power plants, industry, and vehicle emissions result in reduced air quality through large regions of the central eastern seaboard of North America. The park is therefore subjected to high ozone and atmospheric deposition, potentially impacting flora, fauna, and park visitors. Watershed-wide urbanization and development result in challenges to water quality. Increased nutrients, pollutants, and flashiness of river flow can result in impacts to wetland flora and fauna as well as streambank erosion. Other threats to the park include exotic species, deer overpopulation, and gypsy moths.

Old Town. Photo: Robert Baker/NPS.

APPROACH

The Vital Signs framework was used to assess natural resource condition within Cato-Harpers Ferry National Historical Park. Within each Vital Sign, indicators were identified that would inform the assessment and data was sourced for these indicators. Reference conditions were established for each indicator, and the percentage attainment of reference condition was calculated. Once attainment was calculated for each indicator, an unweighted mean was calculated to determine the condition for each Vital Sign category and then similarly to combine Vital Sign categories to calculate an overall park assessment. Based on these key findings, management recommendations and data gaps were developed.



Vital Signs framework used in this assessment.

FEATURES OF HARPERS FERRY NATIONAL HISTORICAL PARK

The majority of Harpers Ferry National Historical Park is located in the Blue Ridge physiographic province. The wide range of riparian and terrestrial environments found in the park creates a mosaic of habitats that support a diverse flora and fauna.

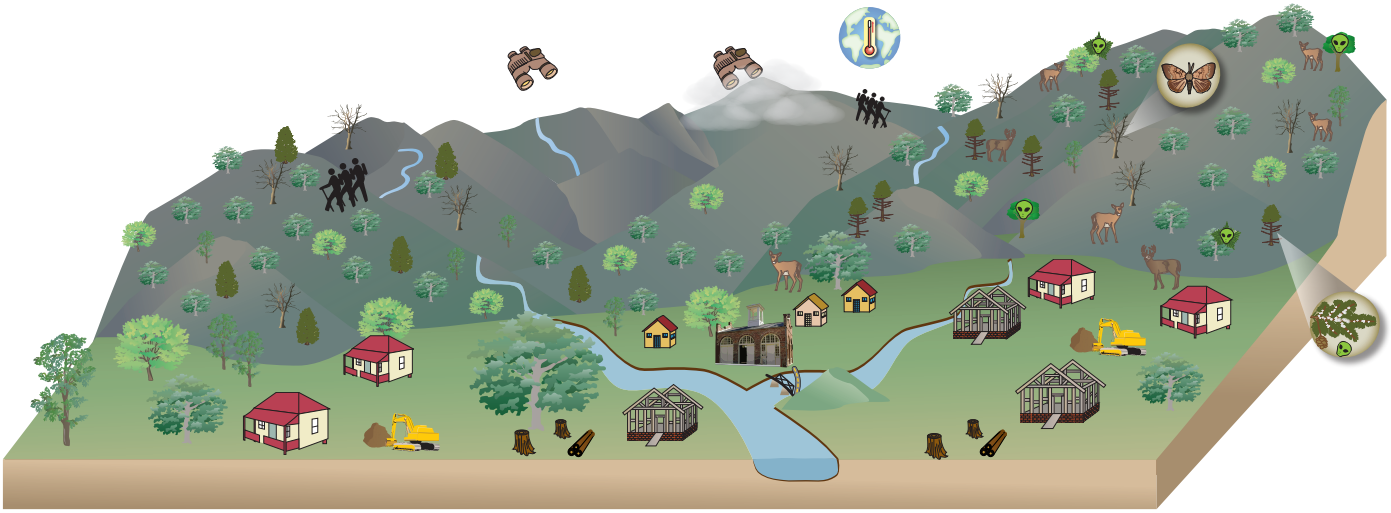
Cannon at the Murphy Farm. Photo: Marsha B. Wassel/NPS.

The Shenandoah and Potomac Rivers converge at Harpers Ferry. The rivers are not within the national historical park's authorized boundary but do constitute approximately 24 km (15 mi) of shoreline within the park. In addition to the two major rivers, there are three perennial streams and several canals within the national historical park boundaries. The streams are Elks Run and Flowing Springs in West Virginia and Piney Run in Virginia. The wetlands, floodplains, and forests of the park support many species of plants and animals. The park contains, or has habitat suitable for, a number of federally and state-listed species and species of concern, such as the Allegheny woodrat (*Neotoma magister*)and the American peregrine falcon (*Falco peregrinus*). Visitors also come to Harpers Ferry to seek a variety of experiences related to the natural soundscapes and lightscapes found in the park.

THREATS TO HARPERS FERRY NATIONAL HISTORICAL PARK

Exotic plants and diseases are prevalent within the park. AMore than 260 non-native species of plants have been documented within the park. Exotic and invasive plants compete with native species, while insect and other pests cause damage to forest trees. Several pests and diseases threaten forest resources, among them the gypsy moth (*Lymantria dispar*) and hemlock woolly adelgid (*Adelges tsugae*). Excessive numbers of white-tailed deer use the park as a refuge, resulting in overgrazing of native flora, particularly tree seedlings. Population and housing densities continue to increase in the areas adjacent to the park, which reduces the habitat available for native flora and fauna. On a regional scale, degraded air quality associated with vehicular traffic affects aquatic habitats and sensitive species.

Gypsy moth larva. Photo: Ferenc Lakatos.



Natural resources

- Scenic views (good air quality)
- Native plant communities
- Historic places and events
- Sustainable visitor use

Threats to park natural resources

- Obstructed scenic views (poor air quality)
- Invasive exotic species (including gypsy moth, hemlock woolly adelgid, and plant species)
- Deer overpopulation
- Exotic diseases and tree death
- Adjacent land use
- Global climate change

Features of and threats to the natural resources of Catoctin Mountain Park.

KEY FINDINGS, RECOMMENDATIONS, AND DATA GAPS

Overall, the natural resources of Harpers Ferry National Historical Park were in *degraded condition*.

The Vital Signs framework showed that air quality condition was generally very degraded, water resources condition was moderate, biological integrity condition was variable but degraded overall, and landscape dynamics condition was generally moderate.

Natural resource condition assessment of Harpers Ferry National Historical Park.

Vital Sign	Reference condition attainment	Current condition
Air Quality	6.6%	Very degraded
Water Resources	58%	Moderate
Biological Integrity	37%	Degraded
Landscape Dynamics	54%	Moderate
Harpers Ferry National Historical Park	**39%**	**Degraded**

Air quality was in a very degraded condition, with 7% attainment of the reference conditions. Degraded air quality is a problem throughout the eastern United States, the causes of which are out of the park's control. The specific implications to the habitats and species in the park are less well known. Gaining a better understanding of how reduced air quality is impacting sensitive habitats and species within the park would help prioritize management efforts. Air quality is measured and interpolated on regional and national scales. Implementation of park-scale air quality monitoring would give better insights into park-level air quality condition and possible effects on park habitats and species.

The close connection between climate and air quality is reflected in the impacts of climate change on air pollution levels. In particular, the U.S. EPA has concluded that climate change could increase ozone concentrations and change amounts of particle pollution.

Air Quality. Key findings, management implications, and recommended next steps for air quality in Harpers Ferry National Historical Park.

Key findings	Management implications	Recommended next steps
• Air quality is very degraded	• Habitats and species in the park may be affected	• Monitor for local effects
• Air quality is a regional problem	• Habitats and species in the park may be affected	• Support regional air quality initiatives

Air Quality. Data gaps, justification, and research needs for air quality in Harpers Ferry National Historical Park.

Data gaps	Justification	Research needs
• Ecological thresholds for mercury wet deposition	• Wet deposition is monitored but the only available reference condition is for fish tissue concentration	• Relate fish tissue concentrations to wet deposition
• Park-scale air quality data	• Need to implement park-specific management actions	• Use transport and deposition models • Calibrate with roadside data within the park
• Effects of poor air quality on park habitats and species	• Need to implement park-specific management actions	• Investigate effects of poor air quality on sensitive habitats and species within the park

Water resources were in a moderate condition overall, with 58% attainment of reference conditions. Nutrients (nitrogen and phosphorus), specific conductance, and the Benthic Index of Biotic Integrity (BIBI) were in poor to very degraded condition while pH, dissolved oxygen, water temperature and acid neutralizing capacity were in very good condition, similar to results found in parks throughout the region.

Water quality is only measured at one site within the park, so it is recommended to expand monitoring to include sites in Elk Run and Piney Run. These streams do not originate in the park and only run through the park for a short distance but it would be informative to monitor what is coming through the park from upstream. Data gaps and research recommendations revolve around maintaining good water quality by identification of nutrient sources and sensitive organisms.

Water temperature increase is one of the most immediate threats from climate change, and this would result in the loss of fish and other organisms that depend upon cooler water.

Water Resources. Key findings, management implications, and recommended next steps for water resources in Harpers Ferry National Historical Park.

Key findings	Management implications	Recommended next steps
• Very degraded condition for nitrogen and phosphorus	• Affects stream flora and fauna • Reduces quality of visitor experience	• Reduce non-point source nutrient inputs from watershed (in partnership with agencies) • Continue riparian buffer establishment • Maintain implementation of best management practices on leased agricultural lands
• Water quality parameters are measured at only one site	• Only have data for one stream within the park	• Establish regular water quality monitoring in other streams within the park
• Water quantity	• Affects stream flora and fauna • Reduces quality of visitor experience	• Monitor water quantity as well as quality
• Benthic Index of Biotic Integrity (BIBI) and Physical Habitat Index (PHI) data have not been updated since 2004	• Current status of BIBI and PHI are poorly known	• Update and regularly repeat BIBI and PHI monitoring (scheduled to be repeated in 2013)

Water Resources. Data gaps, justification, and research needs for water resources in Harpers Ferry National Historical Park.

Data gaps	Justification	Research needs
• Origins of nitrogen and phosphorus pollution are uncertain	• Affects stream flora and fauna • Reduces quality of visitor experience	• Identify sources of nutrients
• Karst features in and around the park are poorly understood	• Karst landscapes influence water flows into and through the park	• Locate, map, and monitor groundwater and springs • Monitor water quantity as well as quality

Biological integrity was in a degraded condition overall, with 37% attainment of reference conditions. Deer density and the seedling stocking index were both in very degraded condition. Studies show a relationship between high deer density and poor forest regeneration and as such, deer management should continue to be a top priority. Other monitoring recommendations include exotic species monitoring and education, and continuing to monitor pests and diseases. Data gaps and research needs include developing a bird index for non-forest species and modeling the effects of climate change and other stressors on the region's forests.

How climate change may affect the park's resources and habitats should be an ongoing research focus, in particular how it might affect the introduction and spread of exotic species and forest pests and diseases.

Biological Integrity. Key findings, management implications, and recommended next steps for biological integrity in Harpers Ferry National Historical Park.

Key findings	Management implications	Recommended next steps
• Deer overpopulation may be impacting forest regeneration and agriculture	• Increased herbivory reducing desired plant and bird species, and lowering yields in agricultural areas • More road collisions • Potential for spread of chronic wasting disease	• Develop a deer management plan • Implement deer population control measures • Use exclosure studies to quantify effect of deer on forest regeneration
• Presence of exotic plants	• Displacement of native species, reducing biodiversity	• Prioritize species and locations/habitats for implementing control measures • Restore and maintain native species and communities
• Amphibians are not monitored	• Amphibians are an important ecosystem component	• Identify and map wetland and stream sites where monitoring could take place • Design and implement an amphibian monitoring program
• Small mammals are not monitored	• Small mammals, and bats in particular, are an important ecosystem component	• Design and implement an mammalian monitoring program, including monitoring bats in caves • Map cave systems and karst features
• Fish Index of Biotic Index (FIBI) is in poor condition	• Fish are an important ecosystem component	• Identify sensitive locations and unpack the Index to identify which measurements are showing degraded condition
• Emerald ash borer has been detected in the park	• Has the potential to spread throughout the park	• Continue to monitor for emerald ash borer in the park and implement management actions • Plan for the future forest with the absence of hemlock and ash trees • Establish a seed bank of hemlock and ash seeds

Biological Integrity. Data gaps, justification, and research needs for biological integrity in Harpers Ferry National Historical Park.

Data gaps	Justification	Research needs
• Bird data is limited to forest species only	• Knowledge about usage of other habitats by birds is needed	• Development of indices related to bird use of other habitats (e.g., grasslands)
• Limited knowledge on how the return of larger predators (coyotes, black bears) to the region may impact ecosystems	• The return of these predators will impact populations of prey animals which in turn may impact deer tick populations and occurrence of Lyme disease	• Research and modeling into the effects of these predators on the ecosystem • Monitor occurrence and behavior of predators
• Limited knowledge on how forests might change in light of new and future stressors (climate change, pests, and diseases)	• These stressors are already present or will be present in the near future	• Research and modeling into the effects of these stressors on the region's forests

Landscape dynamics were in a moderate condition overall, with 54% attainment of reference conditions. Impervious surface at both spatial scales was in very good condition, as was forest cover within the park. Forest interior area within the park was in good condition, and was in moderate condition at the 5x park area scale. Road density was in very degraded condition at both spatial scales. The amount of forest cover and interior area within the park are influenced by the leased agricultural lands and developed areas within the park boundary. At the larger spatial scale, the proximity of the towns of Harpers Ferry and Bolivar, as well as developments to the south-west of the park, affects all of the landscape dynamics metrics.

Research needs for the park mostly relate to its function as a habitat corridor in the region. How climate change may affect the park's resources and habitats should be an ongoing research focus.

Landscape Dynamics. Key findings, management implications, and recommended next steps for landscape dynamics in Harpers Ferry National Historical Park.

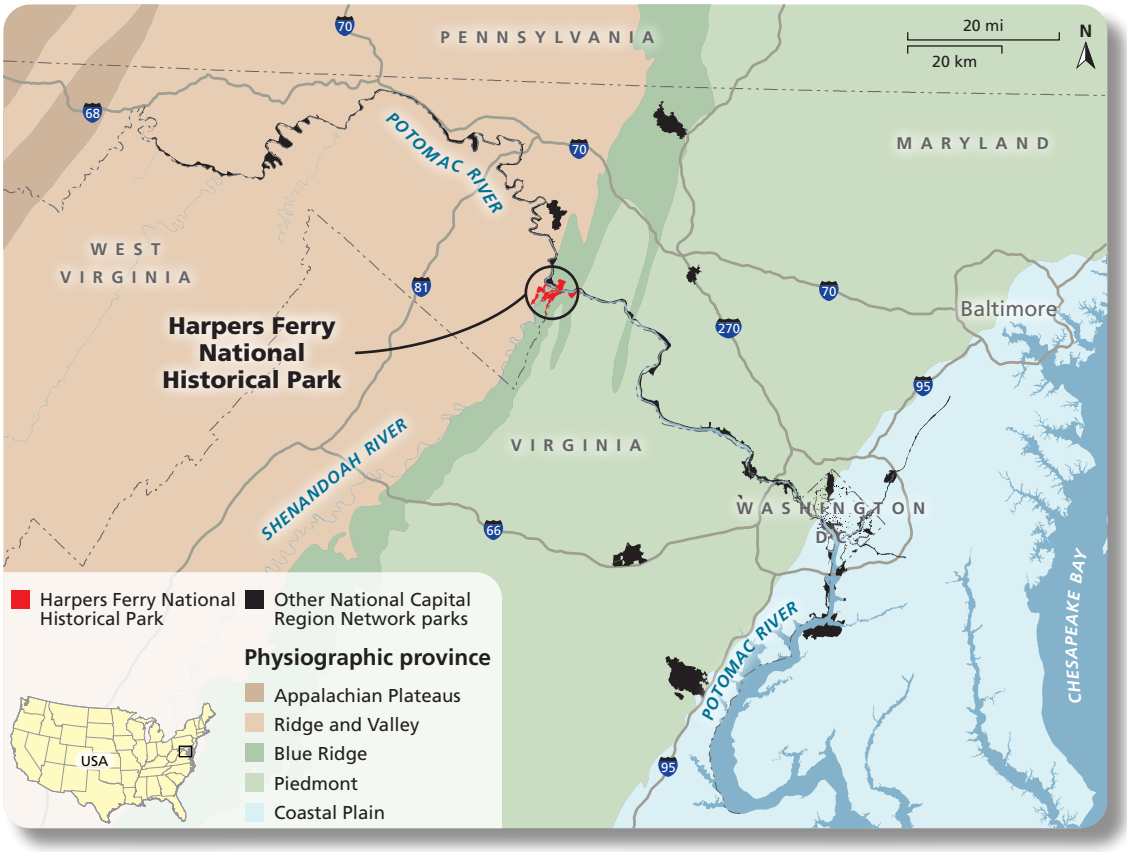
Key findings	Management implications	Recommended next steps
• Forest interior area and forest cover within the park are in good to very good condition, and impervious surface is in very good condition within and adjacent to the park	• Supports wildlife and slows the flow of stormwater entering park streams	• Maintain quality of existing forest habitat by managing for exotic species and forest pests
• Forest metrics were in moderate to very degraded condition adjacent to the park, and road density was very degraded at both spatial scales	• Road density may increase surface runoff/stormwater in the park, and may increase wildlife mortality • Poor forest habitat may impact wildlife habitat and movements	• Continue to maintain pervious surfaces within the park and consider installing stormwater retention basins in areas of high stormwater input • Maintain quality of existing forest habitat by managing for exotic species and forest pests

Landscape Dynamics. Data gaps, justification, and research needs for landscape dynamics in Harpers Ferry National Historical Park.

Data gaps	Justification	Research needs
• Implications of external land use changes on park resources	• Connectivity of ecological processes from park to watershed	• Landscape analysis at multiple scales
• Impacts of climate change on habitat connectivity	• The park acts as a habitat corridor through the region	• Modeling of the potential effects of climate change on habitats within the park and surrounding region

CONCLUSIONS

Natural resoures in Harpers Ferry National Historical Park are in degraded condition overall and are under threat from surrounding land use, regionally poor air quality, and overpopulation of deer. Climate change is predicted to negatively affect many of the natural resources of the park, including increasing ozone levels and particle pollution, raising the water temperature of cold-water, trout-supporting streams, changing forest composition, and affecting exotic species and forest pests and diseases.


PENNSYLVANIA
MARYLAND
WEST VIRGINIA
VIRGINIA
WASHINGTON D.C.
Baltimore
Harpers Ferry National Historical Park
POTOMAC RIVER
SHENANDOAH RIVER
CHESAPEAKE BAY
20 mi
20 km
N
Harpers Ferry National Historical Park
Other National Capital Region Network parks
Physiographic province
Appalachian Plateaus
Ridge and Valley
Blue Ridge
Piedmont
Coastal Plain
USA


Harpers Ferry National Historical Park
To Kennedy Farm
MARYLAND
WEST VIRGINIA
VIRGINIA
C & O Canal Towpath
Harpers Ferry Road
POTOMAC RIVER
BLUE RIDGE
SOUTH MOUNTAIN
Appalachian Trail
MARYLAND HEIGHTS
Sandy Hook Road
Keep Tryst Rd
HARPERS FERRY
BOLIVAR
VIRGINIUS/HALL'S ISLANDS
POTOMAC RIVER
POTOMA WAYSIDE
Bakerton Road
BOLIVAR HEIGHTS
RIDGE
SCHOOLHOUSE
Millville Road
Visitor Center
CAVALIER HEIGHTS
LOUDOUN HEIGHTS
Lower Town
SHORT HILL
SHENANDOAH RIVER
MURPHY–CHAMBERS FARM
Appalachian Trail
BLUE RIDGE
Harpers Ferry Road
SHORT HILL MOUNTAIN
67
340
230
27
671
1 mi
1 km