INVESTIGATOR'S ANNUAL REPORT

United States Department of the Interior

National Park Service

All or some of the information you provide may become available to the public.

OMB # (1024-0236)
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Reporting Year:	**Park:**	**Select the type of permit this report addresses:**
2006	Shenandoah NP	Scientific Study

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Project Title (maximum 300 characters):

Spatial Patterns of Forest Disturbance and Consequences for Regional Water Quality

Park-assigned Study or Activity #:	**Park-assigned Permit #:**	**Permit Start Date:**	**Permit Expiration Date:**
SHEN-00320	SHEN-2005-SCI-0013	Apr 17, 2006	Dec 31, 2007

Scientific Study Starting Date:	**Estimated Scientific Study Ending Date:**
Apr 17, 2006	Aug 31, 2008

For either a Scientific Study or a Science Education Activity, the status is:

Continuing

For a Scientific Study that is completed, please check each of the following that applies:

__ A final report has been provided to the park or will be provided to the park within the next two years

__ Copies of field notes, data files, photos, or other study records, as agreed, have been provided to the park

__ All collected and retained specimens have been cataloged into the NPS catalog system and NPS has processed loan agreements as needed

Activity Type:

Research

Subject/Discipline:

Water / Hydrology

Purpose of Scientific Study or Science Education Activity during the reporting year (maximum 4000 characters):

An important objective of watershed assessment is the identification and modeling of the factors and processes that affect the quantity and quality of water exported to streams, rivers, and other receiving bodies of water. In many situations, land cover or land use changes and other human-originated watershed-scale disturbances are regarded as important factors influencing hydrological and hydrochemical conditions in associated aquatic ecosystems. In forest ecosystems, in particular, nitrate-N losses to surface waters and groundwaters provide a sensitive indicator of the biogeochemical status of the forest and of its response to land disturbances. At the same time, forest disturbances-both human-induced and natural-dramatically affect forests by altering species composition, structure, ecosystem functions, and successional processes. While effects of human-induced forest disturbances have been relatively well-studied in carefully controlled field experiments, natural forest disturbances and their ecosystem-level impacts are far less well understood. The majority of our empirical understanding of the hydrological and biogeochemical effects of forest disturbances has

resulted from either controlled plot-scale or catchment-scale experiments (usually involving harvesting practices) or, more commonly, from simple serendipity (i.e., natural "experiments"). Our review of the extant literature suggests that most natural forest disturbances are: (1) ubiquitous; (2) transient; (3) highly variable in extent, frequency, and intensity; (4) often "stealthy" and poorly documented in both spatial and temporal dimensions; and (5) infrequently associated with demonstrable and quantifiable eco-hydrological effects at scales ranging from small plots to river basins. In the U.S., those natural disturbances thought to have the greatest effects on forests include fire, drought, introduced species, insect and pathogen outbreaks, hurricanes, windstorms, ice storms, and landslides.

In this proposal we focus on quantifying the eco-hydrological effects of historical, present, and possible future disturbances in three large predominantly forested areas of the eastern U.S.: Shenandoah National Park (Virginia), Savage River basin (Maryland), Fifteenmile Creek basin (Maryland & Pennsylvania). Each of these study areas is predominantly forested, has been extensively disturbed within the last 20 years by one or more human-induced or natural disturbance agents, and covers an area of several hundred square kilometers. We propose to develop and understand relationships between transient land cover alterations/disturbances and measurements of surface water quality. The research will integrate a study of landscape dynamics (using remote sensing), surface water dissolved N concentrations, and ecosystem processes within forests (plot level analyses). We will experimentally determine whether small forest plots (fine scale), first-order forested subwatersheds (watershed scale), and larger predominantly-forested watersheds (landscape scale) within the three study areas affected by a variety of types of natural and human-induced forest disturbances are characterized by higher soil-water nitrate-N concentrations, nitrate-N leaching rates, and surface water nitrate-N concentrations than comparable undisturbed systems. Using estimates of forest disturbance derived from satellite-based remote imagery, we will also determine whether nitrate-N concentrations in soil water and surface water vary as linear functions of the magnitude (intensity, frequency, and extensity) and direction of disturbance at three different spatial scales (plot, watershed, and landscape). Finally, by studying disturbance effects in a group of small forested watersheds that was last disturbed more than a decade ago, we will attempt to quantify a disturbance legacy in the form of elevated nitrate-N concentrations in soil and surface waters, as well as changes in species composition.

Findings and status of Scientific Study or accomplishments of Science Education Activity during the reporting year (maximum 4000 characters):

We sampled 71 different reaches on each of three occasions in calendar year 2006. These were the same reaches that were sampled by Rick Webb and his SWAS team beginning in the 1990's as part of the FISH project (sponsored by NPS), although some reaches in Staunton River were eliminated following the Rapidan flood of July 1995.

January '06/late March or early April '06/November '06

Paine Run: 36 reaches

Piney River: 19 reaches

Staunton River: 16 reaches

We also collected 6 or 7 random samples on each survey for duplicate analysis. All samples were analyzed for our complete suite of analytes at University of Maryland Center for Environmental Science â Appalachian Laboratory:

pH (temp-compensated meter)

acid neutralizing capacity (acidimetric Gran titration)

specific conductance (temp-compensated meter)

major anions: sulfate, nitrate, chloride (IC)

major cations: calcium, magnesium, potassium, sodium (FAAS)

total dissolved N (FIA)

nitrate+nitrite (FIA)

nitrite (FIA)

nitrate (FIA)

ammonium (FIA)

dissolved organic N (FIA)

dissolved organic carbon (UV/persulfate digestion)

We intend to resample in late March/early April of 2007 to complete the resurvey of these stations as part of our NASA-sponsored grant on forest disturbance. We will compare water quality data from the different periods using an appropriate "paired" statistical analysis, and determine whether water quality changes (estimated from paired analyses) are associated with forest disturbances (based on analysis of Landsat images).

For Scientific Studies (not Science Education Activities), were any specimens collected and removed from the park but not destroyed during analysis?

No

Funding specifically used in this park this reporting year that was provided by NPS (enter dollar amount):	**Funding specifically used in this park this reporting year that was provided by all other sources (enter dollar amount):**
$0	$5000

List any other U.S. Government Agencies supporting this study or activity and the funding each provided this reporting year:

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