

Appendix H: Monitoring Programs in Northeast Temperate Network Parks

History of Monitoring Programs in NETN Parks

Summary of historical, recent, and ongoing monitoring programs within Northeast Temperate Network Parks (ACAD-MORR). >5 indicates an historical program more than 5 yrs. old, <5 indicates a more recent program that has been discontinued, and + indicates an ongoing monitoring program.

Monitoring Program	ACAD			APPA			BOHA			MABI			MIMA			MORR			
	Years			Years			Years			Years			Years			Years			
	<5	5	+	<5	5	+	<5	5	+	<5	5	+	<5	5	+	<5	5	+	
Air Quality																			
Ozone			X																
Visibility			X																
Particulates			X																
Deposition			X																
Toxics																			
Biota																			
Invertebrates			X																
Nuisance																			
Birds																			
Mammals																	X		X
Vegetation			X																
Vertebrates																			
Fish																			
Amphibians																			
Reptiles																			
Birds			X																
Mammals																			
Vegetation																			
R&E Species			X	X		X												X	X

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Monitoring Program	ACAD			APPA			BOHA			MABI			MIMA			MORR		
	Years			Years			Years			Years			Years			Years		
	√	△	+	√	△	+	√	△	+	√	△	+	√	△	+	√	△	+
Communities				X		X										X		X
Non-vascular																		
Exotic Plants			X															
Exotic Insects			X															
Fire Effects			X															
Forest Health											X					X		
Geologic Resources																		
Soils																		
Land Use Change																		
Soundscapes																		
Visitor Use/Carrying Capacity			X						X									
Visual Landscape																		
Water Quality																		
Ground Water																		
Surface Water	X		X													X		X
Wetlands																		
Lake	X		X															
Swim Beach Bacteria	X																	
UVB	X		X															

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Summary of historical, recent, and ongoing monitoring programs within NETN parks (ROVA-WEFA). >5 indicates an historical program more than 5 yrs. old, <5 indicates a more recent program that has been discontinued, and + indicates an ongoing monitoring program.

Monitoring Program	ROVA			SAGA			SAIR			SARA			WEFA		
	Years			Years			Years			Years			Years		
	>5	<5	+	>5	<5	+	>5	<5	+	>5	<5	+	>5	<5	+
Air Quality															
Ozone															
Visibility															
Particulates															
Deposition															
Toxics															
Biota															
Invertebrates						<u>X</u>									
Nuisance															
Birds													<u>X</u>		
Mammals										X			<u>X</u>		
Vegetation						<u>X</u>									
Vertebrates															
Fish															
Amphibians		X	<u>X</u>		X										
Reptiles															
Birds		X	<u>X</u>										<u>X</u>		
Mammals															
Vegetation															
R&E Species															
Communities															
Non-vascular															
Exotic Plants						<u>X</u>									

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Monitoring Program	ROVA			SAGA			SAIR			SARA			WEFA		
	Years			Years			Years			Years			Years		
	>5	<5	+	>5	<5	+	>5	<5	+	>5	<5	+	>5	<5	+
Exotic Insects						<u>X</u>									
Fire Effects											X	<u>X</u>			
Forest Health						<u>X</u>									
Geologic Resources															
Soils															
Land Use Change															
Soundscapes															
Visitor Use/Carrying Capacity															
Visual Landscape										X		<u>X</u>			
Water Quality															
Ground Water															
Surface Water			<u>X</u>			<u>X</u>		X	<u>X</u>						
Wetlands														X	<u>X</u>
Lake															
Swim Beach Bacteria															
UVB															

Current Monitoring Programs in NETN Parks

Summary of current monitoring programs taking place within Northeast Temperate Network parks.

PARK	PROGRAM	DESCRIPTION
ACAD	Air Quality: Class I	<p>Gaseous Pollutant Monitoring: 1)ground level ozone, 2)Sulfur Dioxide, 3)Nitrogen Oxides and volatile organic compounds; 1982-present</p> <p>Meteorological Monitoring</p> <p>Visibility Monitoring: 1)Fine particulate monitoring, 2)optical monitoring, 3)scene monitoring</p> <p>Atmospheric Deposition Monitoring: 1)Acid precipitation monitoring (NADP), 2)Mercury deposition monitoring, 3)dry deposition monitoring; 1978-present</p> <p>Ultraviolet Radiation Monitoring (UV-B): 1998-present</p> <p>PRIMENet Program: 1998-present</p>
	Water Quality	<p>Lake Monitoring: temp, dissolved oxygen, transparency, pH, specific conductance, alkalinity, color, total phosphorus, total nitrogen, chlorophyll <i>a</i>, lake stage, and light penetration; 1980-present</p> <p>Benthic Stream Macroinvertebrate Monitoring: benthic macroinvertebrates, habitat characterization, stream temp, pH, dissolved oxygen, specific conductance, color, and flow rate; 1997-present</p> <p>Atmospheric Deposition: National Atmospheric Deposition Program (NADP), 1980-present; and Mercury Deposition Network (MDN), 1995-present</p> <p>Geographic Information System Applications: Arc View databases and watershed atlas</p> <p>Cooperators: Maine Dept of Environmental Protection, USGS, and University of Maine at Orono.</p>
	Invertebrates	<p>Macroinvertebrate monitoring is part of the water quality program and Benthic Stream Macroinvertebrate Monitoring. Indicators are: habitat characterization, stream temp, pH, dissolved oxygen, specific conductance, color, and flow rate.</p>
	Vegetation	<p>1100 vascular plant species that represent a wide diversity of plant life adapted to thrive in acidic, low nutrient bogs and rocky, treeless mountain summits</p>
	Birds	<p>MAPS: Schoodic Point, habitat is evergreen woodland/mixed shrubland</p> <p>Peregrine Falcons and Bald Eagles in FY 2003 were monitored (nesting and reproduction) and data entered in an ACCESS database. Peregrine Falcons have been monitored since 1984 and Bald Eagles for several years.</p>
	Veg R&E Species	<p>25 species of plants are state listed rare plants</p>
	Exotic Plants	<p>Invasive Species: one quarter of the vegetation is non-native. In FY 2003, 24 plants are listed as high management concern and a distribution and abundance survey was completed for these. Garlic Mustard, Japanese Barberry, and Purple Loosestrife top the list. Control efforts on seven new exotic invasive plant species, treating 18 acres, was initiated.</p>
	Exotic Insects	<p>Integrated Pest Management: oversees management of and control of exotic insects. Indicators include the threat, or possible threat, to native species.</p>

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PARK	PROGRAM	DESCRIPTION
	Fire Effects	Hazard fuels management, fire suppression, prescribed fire, reduction of wildland/urban interface hazards, monitoring of prescribed fires and long-term forest conditions, and research into fire effects and the long-term history of wildland fire in the park.
	Visitor Use	Carrying capacity for carriage roads, climbing management plan, Leave No Trace and other public education, and visitor surveys.
APPA	Veg R&E Species	Rare and Endangered Species of plants have been identified and are being monitored through the cooperation of the state Natural Heritage Foundations.
	Veg Communities	Vegetation is being monitored with the cooperation of the Keeping Track protocol which helps participants use wildlife to assess habitat quality and overall forest health. This is occurring at transects on the Appalachian Trail corridor in Vermont. The Southern Appalachian Man and the Biosphere Foundation based Southern Appalachian Volunteer Environmental Monitoring Program is another program occurring on the AT. This program is taking place from north Georgia to southwest Virginia. Water quality, invasive exotic plants, and forest health in ten communities are being monitored.
	Water Quality	Water quality monitoring will be occurring through the assistance of the NPS Natural Resource Laureate Program and the Environmental Alliance for Senior Involvement. Scheduled to begin in May 2004 the goal of the program is to have a self-sustaining volunteer-based monitoring program that provides consistent, reliable water-quality information for approximately 50 to 200 key sites along the Appalachian Trail.
BOHA	Water Quality (Monitored by Ma. State Agencies)	Environmental Health Ecosystem Indicator: water clarity, nutrient/eutrophication status, sewage indicator bacteria, sediment profile/geochemistry, benthic infaunal community structure, blue mussel bioaccumulation, winter flounder monitoring, lobster monitoring, and eel grass BOHA Water Quality Parameters: surface + bottom: temperature, dissolved oxygen, salinity, turbidity, pH, Photosynthetically Active Radiation, secchi depth, transmissivity, fecal coliform bacteria, <i>Enterococcus</i> bacteria, Total Suspended Solids, Particulate Nitrogen, Total Dissolved Nitrogen, Nitrate/Nitrite, Ammonium, Total Dissolved Phosphorus, Orthophosphate, Particulate Organic Carbon, Chlorophyll <i>a</i> , Phaeophytin
	Visitor Use	Visitor Experience and Resource Protection (VERP): number of people at one time, tour group size, trail encounters, trail impacts, campsite impacts, litter, graffiti, ferry service, shuttle service, amount of information, quality of information
MABI	Forest Ecosystem Dynamics	Forest Monitoring has been occurring since 2001 at 64 different plots with the cooperation of the University of Vermont. Indicators are: size class distribution and dominance, mortality processes and self-thinning, compositional dynamics and regeneration demography, deer browse impacts, crown condition, beech bark disease, regeneration trends, vertical structure, downed coarse woody debris, dead tree structure, understory plant assemblages, and legacy trees.
MORR	Water Quality	Water quality is monitored at 11 sites on a monthly basis since 1988 for: dissolved oxygen, pH, TDS, water temperature, Cl (chloride).
	Mammals	Monitoring deer populations and the effects on the site using deer exclosures since 1988 and monitored annually, spot light counts are done annually since 1998, tree seedling plots monitored annually since 1994, and Jack-in-the-Pulpit populations inside and out of exclosure areas since 1998.

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PARK	PROGRAM	DESCRIPTION
	Veg R&E Species	5 plants are listed with New Jersey as threatened
	Veg Communities	<p>Field Mowing Program is in place to recreate the historic scene, 15 fields are mowed totaling 122 acres. Twelve fields are mowed once every year or two to maintain the field in an advanced successional or abandoned state. Three fields are mowed two to four times each year to provide a new field appearance for historical aesthetics.</p> <p>Exclosures: Five exclosure/vegetation studies are being conducted. One set of exclosures compares the differences in type and structure of vegetation with and without deer browsing and is sampled yearly (began in 1987-88); the second set of exclosures has four plots and will compare over time the rate of range expansion of two invasive non-native species: Japanese Barberry and Japanese Wiregrass with and without browsing (1995). Additional studies include exclosures to monitor the effect of deer browsing on Jack-in the Pulpit (1997), determine the viability of reintroduction of native wildflowers (1997), and to protect native seedlings (1995).</p>
ROVA	Water Quality	<p>Monthly: Monitoring began in 1994 and measures temperature, pH, dissolved oxygen, salinity, and conductivity</p> <p>Quarterly: chloride, alkalinity, phosphate, turbidity, and nitrate</p>
	Amphibians	<p>Targeted species monitoring since 1990 (mark/release); Terrestrial Salamander Monitoring Program (USGS protocol) started in 2000. State threatened blanding's turtle is at the site.</p>
	Birds	<p>MAPS 1990-present: Stanfordville, habitat is wetland/fields/forest/plantation</p>
SAGA	Water Quality	<p>Water quality is monitored at 5 stations since 1997 on a monthly basis May-November for 15-20 parameters, including: water temperature, water depth, dissolved oxygen, conductivity, pH, and turbidity. The results are reported annually. (There is one additional station just outside the park.)</p>
	Forest Health	<p>US Forest Service has been conducting the survey since 1995, checking 18 plots once every 4 years. Indicators are: species, diameter at breast height, distance, azimuth, live crown ratio, crown position, crown vigor, trunk/bole defects, crown dieback, foliage transparency, discoloration, defoliation</p>
	Invertebrates	<p>Macroinvertebrate monitoring in streams.</p>
	Vegetation	<p>Vegetation monitoring is done in conjunction with the Forest Monitoring in cooperation with the US Forest Service and is used to find exotic species and their effects on park vegetation.</p>
	Exotic Plants	<p>Purple Loosestrife is being monitored and controlled through a beetle release program in cooperation with the NH Dept of Agriculture. Other exotic plants are of management concern such as Norway Maple, multiflora rose, in addition to many others.</p>
	Exotic Insects	<p>Hemlock Woolly Adelgid: monitoring is extremely important, as early detection and subsequent mitigation may prevent significant damage to the approximately 1,100 hemlocks in the site's historic hedges. Forest health monitoring plots, established by the U.S. Forest Service, located in areas with high concentrations of hemlock will be used by park resource management staff to conduct annual examinations for the presence of hemlock woolly adelgid.</p> <p>Gypsy Moth, Asian Longhorned Beetles, Emerald Ash Borer monitoring is also occurring in the park.</p>

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PARK	PROGRAM	DESCRIPTION
SAIR	Water Quality	Water quality: has been measured since 1994 on a monthly basis May-October. Water: bacteria, pH, turbidity, dissolved oxygen Sediment Sample: inorganic elements, polyaromatic hydrocarbons, polychlorinated biphenyls, and organochlorine pesticides
SARA	Birds	Sparrows species listed by the state as “Species of Special Concern” use the fields in the park as nesting areas.
	Mammals	Deer population is being monitored to prevent possible ecological conflict between deer and vegetation.
	Fire Effects	Prescribed fire, fire suppression, hazard fuels reduction, history of fire effects in park.
	Visual Landscape	Preservation of historic landscape comprising the eighteenth century battlefield.
WEIR	Water Quality	Weir Pond has been monitored annually since 2000.

Current Aquatic Monitoring Programs at NETN Parks

Five parks currently have water-quality and (or) water-quantity monitoring programs. The parks are ACAD, MORR, ROVA, SAGA, and SAIR. BOHA benefits from a monitoring program conducted by the Massachusetts Water Resources Authority (MWRA). The monitoring programs are summarized in the Phase I scoping report. The period of data collection varies; some monitoring programs were initiated as early as the 1970s and some as recently as 1998. The parks that do have monitoring programs primarily include the measures included in the high-priority vital sign water chemistry selected for the NETN monitoring program. Data collected as a part of this program will provide historical comparisons and context for the data collected by the vital-signs program. In some cases, the NETN monitoring program will build on the program currently in place, especially where measures, sampling locations, and(or) sampling protocols are similar across programs. In other cases, however, because the monitoring programs at some of the parks are focused on specific aquatic resources or have different objectives than the vital-signs program, compatibility with the vital-signs program will vary. The remaining five parks (MABI, MIMA, SARA, WEFA, BOHA) have no known current freshwater-quality monitoring at present (2004) and will not be included in this part of the report.

Current Aquatic Monitoring Programs at NETN Parks Compared to High-Priority Vital Signs

The purpose of this section of the report is to determine the compatibility between data currently being collected (including protocols, quality assurance/quality control, and data-storage practices) and the measures associated with the high-priority vital signs selected for the NETN vital-signs monitoring program.

Direct comparisons or incorporation of the data from previous monitoring programs may be problematic for the following reasons. First, methods of analysis may have changed. For example, biological monitoring of stream macroinvertebrate communities has been conducted at four of the five parks, but the protocols or analyses are not consistent across the parks. For chemical analyses, there are different analyses used for certain constituents (e.g., pH) and so the results are not always comparable. Additionally, as chemical analytical methods advance and become more sensitive, detection limits decrease and accuracy and precision increase. As changes in methodology progress, comparability decreases. For those parameters that are consistent with the high-priority vital signs, the number of samples or the frequency of sampling may not be the same. This introduces differences in estimates of variability (standard deviations and coefficients of variation) and affects measures of central tendency such as the mean or median values. At many of the parks, data from the vital signs such as climate and water quantity, which are important for interpreting water quality data, are intermittent or unavailable. Without this contextual information, including information about vital signs such as channel morphology or lake morphometry, historical trends in water quality will be difficult to interpret. Concentrations of chemical components change with dilution, and thus depend on water quantity. Standardization of concentration data by using water quantity data to calculate annual loads and yields can not be accomplished without water-quantity data, and so year-to-year comparisons become difficult.

A matrix shows where suggested measures and current measures intersect (Table H1). The high-priority vital signs, and their mandatory and optional measures are listed down the vertical axis and the parks are listed along the top horizontal axis. In the corresponding box under each park are the components of the current monitoring programs.

Climate

None of the parks are collecting climate data. Meteorological measures such as precipitation, temperature, snowfall, snowpack conditions, and wind direction and speed are often available regionally from NOAA, National Weather Service, and the NADP. In some cases, meteorological stations run by these agencies are within or very close to park boundaries.

Stream geomorphology

Only ACAD and MORR are regularly collecting stream geomorphology data. The Rapid Bioassessment protocol conducted at MORR does not, however, include many of

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the mandatory measures identified for this vital sign. The ACAD program includes many of the mandatory and optional measures. SAIR has limited stream morphology data at the USGS gage.

Lake morphometry

Several parks have had bathymetric surveys done at lakes within the parks. Most parks have estimates of surface area and mean depth of the lakes.

Water quantity

All the parks have access to local USGS stream-gaging data as part of their monitoring program. ACAD has 2 continuous-record streamflow gages within the park, and SAIR has a continuous-record streamflow gage just upstream from its northern boundary. Incidental streamflow measurements are collected at SAGA as part of the monitoring program. A USGS ground-water program at ACAD monitors water levels. None of the parks, except for SAIR, have mapped or consistently measured discharge at springs or seeps.

Water chemistry

All the parks have some type of water chemistry monitoring program. Many of the mandatory high-priority vital signs are collected as part of these programs, e.g., water temperature, pH, dissolved oxygen, and conductivity. Differences then become park specific. Mandatory measures of NETN high-priority vital signs that are currently being measured by park personnel could be incorporated into the NETN monitoring program. The only park where this might pose some difficulty is at SAIR, where water chemistry (except for temperature and specific conductance) is sampled by volunteers.

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Table H.1. Comparison of current park aquatic monitoring program components with high-priority vital signs.

[Empty boxes indicate no program components for the vital sign at a specific park; USGS, U.S. Geological Survey; NADP, National Atmospheric Deposition Program; NOAA, National Oceanic and Atmospheric Agency; NWS, National Weather Service; NPS, National Park Service; DEP, Department of Environmental Protection].

Vital Sign	Proposed measures	Measures currently collected				
		Acadia National Park	Boston Harbor Island National Recreation Area	Morristown National Historical Park	Roosevelt-Vanderbilt National Historic Site	Saint-Gaudens National Historic Site
Climate	<p><u>Optional</u>: Air temperature and precipitation</p> <p>Wind speed and direction, precipitation by type, snow depth, snow water equivalent, relative humidity, and solar radiation.</p>	<p>NADP collects precipitation and air temperature data. NOAA and NWS collect precipitation, temperature, snowfall, snowpack conditions, wind direction and speed data.</p>				<p>USGS collects precipitation, air temperature, wind speed and direction data just upstream from park (station does not conform to National Weather Service standards).</p>
Stream geomorphology	<p><u>Mandatory</u>: Stream order, drainage area, gradient</p> <p><u>Optional</u>: Run/riffle/pool geometry, bank full cross-sectional geometry, stream sinuosity a substrate map of the stream bottom,</p> <p>surveys of channel geomorphologic units</p>	<p>Stream physical habitat data is collected at six macroinvertebrate monitoring sites by NPS. Data include channel width, depth, substrate composition, and canopy cover. Data not yet analyzed.</p>	<p>Not applicable</p>	<p>Stream habitat is evaluated with the rapid bioassessment program (Plafkin and others, 1989).</p>		<p>USGS has drainage area and bankfull cross-sectional geometry data just upstream from park.</p>

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<p style="text-align: center;">Lake morphometry</p>	<p><u>Mandatory:</u></p> <p>Surface area, maximum and mean depth, drainage area, lake type and origin, bathymetry, and elevation</p> <p><u>Optional:</u></p> <p>Flushing rate</p>	<p>Surface area, maximum and mean depth, lake type and flushing rates for many of Acadia's lakes including the five largest lakes from the 1982 resource management plan. Lake surface areas included in 2000 Water Resources Management Plan.</p>	<p>Not applicable</p>	<p>There is some monitoring of Cat Swamp Pond due to concern over dam integrity.</p>	<p>A bathymetric study of the impounded part of Fall-Kill Creek was conducted by Pandullo-Quirk Associates (1979).</p>	<p>Pond and wetland bathymetry mapped (Cronan and Associates, 1981) and Bureau of Reclamation survey of dams</p>	<p>Not applicable</p>
<p style="text-align: center;">Water quantity</p>	<p><u>Optional:</u></p> <p>Streamflow, spring seep volume, and inventory, lake water levels, groundwater levels, groundwater inputs</p>	<p>Two USGS continuous-record, streamflow gaging-stations in park: (USGS stations 01022835 and 01022860). Period of record is 1999 to 2004</p> <p>USGS monitors water levels and water quality at four ground-water wells on Mount Desert Island. (USGS well numbers 441516068194101, 441650068210801, 442238068154101, and 442450068175201). Three of these wells are within park boundaries. Period of record is 2003 to 2004.</p>	<p>Two USGS stage-gages in park (USGS station 01378775 and USGS station 01378778). Period of record is 2003 to 2004.</p> <p>There are several groundwater wells installed in the park-not currently in operation.</p>			<p>Incidental discharge measurements taken concurrently with water quality measurements by NPS.</p> <p>Locations of wells and seeps shown in 1992 report USGS WRIR 92-4013.</p>	<p>USGS continuous-record, streamflow gaging-stations on the Saugus River (USGS station 01102345) just upstream from the park. Two freshwater springs in park have been mapped and discharge measured.</p>
<p style="text-align: center;">Water chemistry</p>	<p><u>Mandatory:</u> Water temperature, specific conductance, pH, dissolved oxygen, percent dissolved oxygen saturation, color and turbidity</p> <p><u>Optional:</u> Anions, cations DOC, alkalinity, ANC, iron,</p>	<p>Lake monitoring by NPS in cooperation with the Maine Department of Environmental Protection in selected lakes on Mount Desert Island to monitor change due to eutrophication and atmospheric deposition. Monitoring started in the late 1970s includes secchi disk water-column transparency and surface temperature. The program continues today, with monitoring expanded to include the following:</p> <p>pH, Acid neutralizing capacity,</p>	<p>The Massachusetts Water Resources Authority has monitored wastewater and effluent components, nutrients, and water chemistry (1992-2004).</p> <p>Parameters (not all collected at all stations) include surface and bottom</p>	<p>NPS monitors the following parameters on 11 sites since 1982:</p> <p>temperature, pH, conductivity, and salinity; and concentrations of dissolved oxygen, chloride, total dissolved solids, and fecal coliform on a monthly basis at 11</p>	<p>The park initiated a water-quality monitoring program in 1994.</p> <p>Temperature, pH, dissolved oxygen, salinity, and conductivity are being collected at all three units on a monthly basis. Data on additional parameters, including</p>	<p>Water-quality parameters are measured at six permanent monitoring stations: water temperature, water depth, dissolved oxygen, conductivity, pH, and turbidity.</p> <p>NH₄ - ammonia, NO₃</p>	<p>Water- quality parameters collected monthly by the Saugus River Watershed Council include pH, dissolved oxygen, temperature, and bacteria – fecal coliform (1998-2000) and e. coli (2001-2002)</p> <p>Water temperature and specific conductance</p>

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	aluminum	Specific conductance, True color, Dissolved organic carbon, Dissolved inorganic carbon, Major ions, Aluminum (total dissolved), Total phosphorus, Total nitrogen, Chlorophyll a, Lake stage, Dissolved oxygen/temperature profile. Stream Monitoring: Stream temperature, pH, dissolved oxygen, specific conductance, color, and flow rate measured since 1997 on Duck Brook, Stanley Brook, Canon Brook, and Hunters Brook, and since 1998 on Lurvey Spring Brook and Heath Brook (Breen and others, 2001).	water temperature, dissolved oxygen, salinity, secchi depth, total suspended solids, and pH.	stations. Occasional samples for fecal coliforms and fecal streptococcus may be taken and forwarded to an independent laboratory for evaluation. Sites are monitored once a week during the summer and once a month the rest of the year.	concentrations of chloride, phosphate, and nitrate, and measurements of turbidity, and alkalinity, are being collected quarterly. Starting in 1998, this work has been contracted to a private laboratory.	– nitrate and phosphorus (PO ₄ - orthophosphate) were measured in previous years This program will resume in 2003.	determined at USGS gage
Fish community composition in streams	<u>Mandatory:</u> Species composition and relative abundance		Not applicable	Fish community composition data available from surveys by US Fish and Wildlife Service for Great Swamp Refuge downstream of the park		Fish species list for park made in 1986	
Zooplankton community composition in lakes	<u>Mandatory:</u> Species composition and relative abundance		Not applicable				Not applicable
Trophic status	<u>Mandatory:</u> Algal biomass, measures of water clarity such as secchi disk, and total and dissolved phosphorus	See water chemistry, lake monitoring	Massachusetts Water Resources Authority monitors nutrients, phytoplankton composition, and productivity.	Dissolved phosphorus is monitored			

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	<p><u>Optional:</u> Macrophyte distribution, (diel oxygen curve and, periphyton in streams), dissolved oxygen profiles</p>	<p>Parameters are photosynthetically active radiation,</p> <p>transmissivity, particulate nitrogen, total dissolved nitrogen, nitrate/nitrite, ammonium, total dissolved phosphorus, orthophosphate, particulate organic carbon, Chlorophyll <i>a</i>, Phaeophytin</p>	<p>Dissolved phosphorus is monitored</p>
<p>Macroinvertebrate community composition in streams</p>	<p><u>Mandatory:</u> Taxa richness and relative abundance</p> <p>Macroinvertebrates are monitored in six streams following Maine DEP protocols (Davies and Tsomides, 1997). It has been well documented, reviewed, and provides data and analyses comparable to other streams in the state. Protocols are comparable with USEPA and the USGS National Water Quality Assessment Program protocols. The resultant data are analyzed using accepted biological and taxa composition indices.</p>	<p>Massachusetts Water Resources Authority monitors benthic communities.</p>	<p>New Jersey DEP has recently initiated a Level II Rapid Bioassessment Program (Plafkin and others, 1989) throughout New Jersey including several sites along the Upper Passaic River, Indian Grave Brook, and Primrose Brook in park. New Jersey DEP conducts macroinvertebrate sampling on the West Branch of Primrose Brook.</p> <p>Two macroinvertebrate studies have been conducted in the park by the Department of Environmental Conservation in Albany, New York.</p> <p>The Izaak Walton League of America's Stream Quality Survey (SQS) was performed at 4 stations in the park to quantitatively evaluate the distribution and diversity of the benthic macroinvertebrates in park streams.</p>
<p>Landcover/land use inventories</p>	<p><u>Mandatory:</u></p> <p>landcover/ecological system map</p> <p><u>Optional:</u></p> <p>Patch size distribution, patch</p>		

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	<p>connectivity, patch fragmentation, % impervious surface in buffer or watershed, canopy shading, buffer vegetation and width</p>			
<p>Atmospheric deposition</p>	<p><u>Optional:</u> Wet deposition, dry deposition, inorganic toxics, mercury</p>	<p>Park Research and Intensive Monitoring of Ecosystems (PRIMENet)- cooperative program between the USEPA and the NPS. Includes mercury and nitrogen sampling in Hadlock and Cadillac Brooks from 1998 to 2000 and air-quality monitoring of ozone, wet and dry deposition, visibility, meteorology, and UV-B monitoring.</p> <p>NADP sites in park include collection of wet precipitation chemistry, ozone, particulates, sulfur dioxide and mercury wet deposition.</p> <p>University of Maine collects fog chemistry data</p>		
<p>Contamination</p>	<p><u>Optional:</u> Air toxic concentrations,</p>	<p>See atmospheric deposition</p>	<p>Massachusetts Water Resources Authority monitors toxic contaminants,</p>	<p>The wetland is contaminated with polyaromatic hydrocarbons and</p>

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	<p>MTBE, chloroforms, trichloroethylene, contaminant spills, toxic boat point, sediment contaminants, metals, bioaccumulation in indicator species</p>	<p>pathogens, and fish and shellfish pathology.</p>	<p>arsenic. The slag pile has arsenic levels above the Imminent Hazard threshold, (Goff-Chem, 1996).</p> <p>The USGS & Massachusetts DEP, are sampling sediments in the Saugus River for heavy metals. One site is just downstream from SAIR.</p>
<p>Invasive exotic species</p>	<p><u>Mandatory:</u> Presence/absence</p> <p><u>Optional:</u></p> <p>Abundance</p>	<p>Multiple level surveys conducted for aquatic invasive species</p>	<p>Proposed restoration of historic site includes removal of invasive plants.</p>
<p>Septic systems/ Wastewater Discharge</p>	<p><u>Mandatory:</u></p> <p>the number of septic systems</p> <p><u>Optional:</u></p> <p>Nearby permits</p> <p>Waste water discharges</p>	<p>An estimate of number of houses in rural Bar Harbor was made from 1998 digital orthophotographs and field checks in 2001 (Glenn Guntenspergen, USGS, written commun., 2001).</p> <p>Bar Harbor Water Company tracks municipal water use</p>	<p>Massachusetts Water Resources Authority monitors wastewater and effluent components and sewage indicator bacteria, including fecal coliform bacteria and <i>Enterococcus spp.</i></p> <p>See water quality</p> <p>Fecal coliform levels were assessed three times in 2002 at four stations</p>

Fish community composition

None of the parks are monitoring fish community composition in streams as part of their environmental monitoring programs.

Zooplankton community composition in lakes

None of the parks are monitoring zooplankton community composition in streams as part of their environmental monitor programs

Water quality – trophic status

Nutrient chemistry data and water clarity are collected as part of water chemistry monitoring at ACAD, ROVA, and SAGA. These programs are very close to the mandatory measures for this vital sign.

Macroinvertebrate community composition in streams

All the parks except SAIR have some form of invertebrate community composition monitoring for streams. The protocols vary among the parks so there is a lack of consistency. Modification of the existing protocols to a common methodology will provide consistency for the mandatory measures.

Land use/land cover inventory

None of the parks currently have a land-use/land-cover program, but these data should be available for all the parks as state or national GIS layers.

Atmospheric deposition

Only ACAD has an atmospheric deposition component in the current program as part of National Networks such as NADP and PRIMENet.

Contamination inventory

As part of the atmospheric deposition research at ACAD, mercury and nitrogen are monitored. States provide consumption advisories for fish, but none of the parks has an active contaminants sampling program. SAIR has had sediment sampling for contaminants associated with several research projects.

Invasive exotic species

All the parks have lists of potential invaders, but monitoring is not performed on a standardized schedule.

Septic systems/wastewater discharge

This information is generally tracked by municipalities where available. In some cases it must be estimated from water use.

Protocols, Quality control, and Data Storage at NETN Parks

Each of the parks with a water quality monitoring program has components of the program that correspond to one or more vital signs; however the design of each of the programs however differs due to the objectives associated with it. Documented protocols, quality assurance/quality control, and data storage of the current monitoring programs are presented where available (table H2) in order to understand some of these differences.

Appendix H: Monitoring Programs in Northeast Temperate Network Parks

Most of the monitoring programs do not have sufficiently documented protocols, quality-assurance/quality-control procedures, or data storage. Although each park has limited internal documents that provide some of this information, few published reports are available. For the data at these parks to be incorporated into the vital-signs programs and analyses, protocols will need to be standardized and documented, quality-assurance/quality-control procedures will need to be adopted and(or) documented, and data-storage practices will need to be updated. The exception is at Acadia where many of these protocols and documentation are already in place. The environmental monitoring and research program at Acadia has written protocols, written quality control specifications, a database, and an annual reports program to publish the data and analyses. As such, very little modification to the current Acadia aquatic environmental monitoring program will be required to include all the necessary vital signs.

Table H2. Standardized protocols, quality control, and data storage at the four parks with current environmental monitoring programs.

Park	Protocols	Quality Assurance/Quality Control Procedures	Data Storage
ACAD	Gawley, 1996, Acadia National Park lake monitoring: field and laboratory methods.: Acadia National Park Natural Resources Report 96-01 Kahl, and Manski, 1997, Developing long-term monitoring protocols for freshwater resources at Acadia National Park: Interim report from a workshop, January 9-10, 1997.	Gawley, W. G. 1996, Acadia National Park lake monitoring: field and laboratory methods: Acadia National Park Natural Resources Report 96-01	Internal database, Annual report series, Year end reports for lake, water, and macroinvertebrates.
MORR	J. Runde, 2004, Draft Report: Synthesis, analysis, and interpretation of water resources at Morristown National Historical Park Technical Report NPS/NRWRD/NRTR-xx/xx Morristown National Historical Park Standard Operating Procedure SOP Number: 601 Subject: Water Quality Testing Effective Date: October 1992 Revision Dates: April 2001	J. Runde, 2004, Draft Report: Synthesis, analysis, and interpretation of water resources at Morristown National Historical Park Technical Report NPS/NRWRD/NRTR-xx/xx Morristown National Historical Park Standard Operating Procedure SOP Number: 601 Subject: Water Quality Testing Effective Date: October 1992 Revision Dates: April 2001	Results of water quality inventory studies in the park have been reported by Mele and Mele (1983), and Trama and Galloway (1988). Storet Excel spreadsheet
SAGA	Zubricki, B., 1995, Water resources monitoring plan, Saint-Gaudens National Historical Site Izaak Walton League of America, 1994, Save our streams, volunteer trainers handbook.	Instrumentation calibrated and checked for accuracy	Annual interpretive reports Water quality data in Storet
SAIR			Data collected by Saugus River Watershed Council Hard copy only

Appendix H: Monitoring Programs in Northeast Temperate Network Parks