Monitoring Air Quality Impacts on Wilderness

CSS 496
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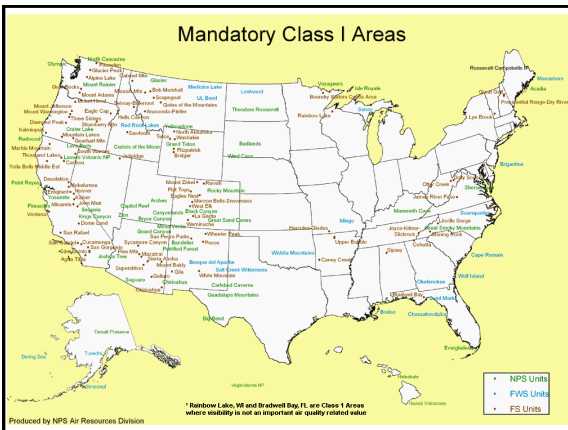

Why Monitor Air Quality?

- Clean Air Act of 1977 gives Federal land managers "…an affirmative responsibility to protect the air quality related values (including visibility)… within a class I area."
- AQRVs – air quality related values
- PSD – preventing significant deterioration

2

Mandatory Class I Areas

* Rainbow Lake, WI and Bradwell Bay, FL, are Class 1 Areas where visibility is not an important air quality related value

- NPS Units
- FWS Units
- FS Units

Produced by NPS Air Resources Division

Three Functional Groups of Air Pollutants

- **Acidifying pollutants**
  - gaseous emissions of SO_2 & NO_x
  - foliar injury, acidification of surface water
- **Particulate Matter**
  - trace elements & heavy metals (e.g. lead)
- **Photochemical Oxidants**
  - product of atmospheric reactions of gaseous emissions (e.g. SO_2 & NO_x) & oxygen & sunlight to produce ozone

4

Wilderness Attributes Impacted by Anthropogenic Air Pollution

Flora & Fauna

- Growth
- Mortality
- Reproduction
- Diversity
- Visible Injury
- Productivity
- Succession

5

Wilderness Attributes Impacted by Anthropogenic Air Pollution

Water

- pH
- Total alkalinity
- Metal concentrations
- Anion & cation concentrations

6

Wilderness Attributes Impacted by Anthropogenic Air Pollution

Soil

- Cation exchange capacity
- Base saturation
- pH
- Structure
- Metals concentration

7

Wilderness Attributes Impacted by Anthropogenic Air Pollution

Visibility

- Contrast
- Visual Range
- Coloration
- Viewshed

8

Wilderness Attributes Impacted by Anthropogenic Air Pollution

Odor

- Noticeable odors

Cultural, Archeological, Geologic

- Decomposition rate
- Patina deposition/erosion

9

AIR QUALITY MONITORING NETWORKS

- GPMN - http://12.45.109.6/
  - Gaseous Pollutant Monitoring Network
    - Ozone and meteorological monitoring – 40 NPS sites
- NADP/MDN - http://nadp.sws.uiuc.edu/
  - National Atmospheric Deposition Program
    - Wet acid deposition – 37 NPS sites
    - Mercury deposition – 8 sites nationwide
- CASTNet - http://www.epa.gov/castnet/
  - Clean Air Status and Trends Network
    - Dry acid deposition – 70 sites nationwide
    - Rural ozone and meteorology
- IMPROVE - http://vista.cira.colostate.edu/improve/
  - Interagency Monitoring of Protected Visual Environments
    - Visibility – 50 NPS sites

10

Indicators to Monitor Air Quality

- ***Visible foliar injury*** (vascular plants)
  - Leaf spotting, reduced flowering
  - Difficult for field staff to distinguish foliar injury from pollutants from frost, drought, insects
  - Must be observed in the field at proper time
  - Sensitive vegetation must be widely distributed

11

Indicators to Monitor Air Quality

- ***Lichens***
  - More sensitive--absorb water & air directly from atmosphere rather than through roots
  - Long lived, no deciduous parts--accumulate pollutants
  - Abundant and widely distributed
  - "Shrubby" fruticose forms hanging from trees most sensitive. "leafy" foliose & "encrusting" crustose forms
- ***Mosses***
  - Absorb pollutants directly from atmosphere & accumulate in tissue (particularly mercury pollution)

12

Indicators to Monitor Air Quality

- *Fauna* -- air pollution can affect bird, insect, mammal & fish populations
- *Salamanders & amphibians*
  - are sensitive in reproduction & growth
- *Accumulation & concentration*
  - Pollutants concentrate in certain tissue
  - Fatty tissue in fish & wildlife
  - Arsenic in wildlife hair in Mt. Rainier. Park
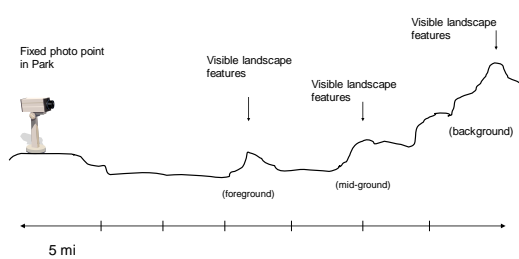 - Honeybees used to map fluoride & heavy metals & identify point sources

13

Indicators to Monitor Air Quality

Visibility
- Contrast – photos w/ control
- Visual Range – photos of landmarks
- Coloration – loss of visible color
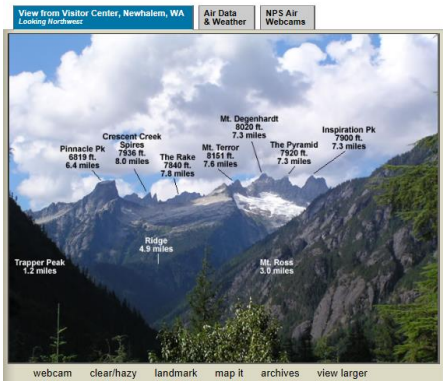- Viewshed – areas seen from key corridors and destinations

14
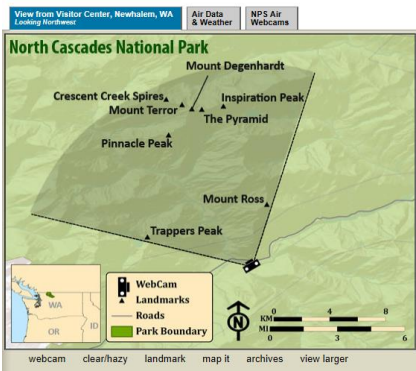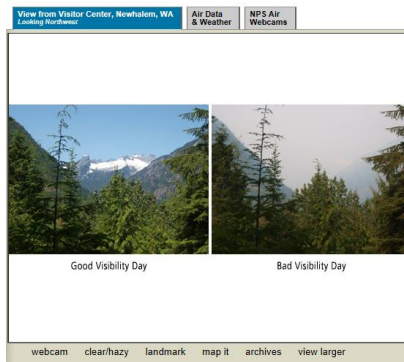
View Monitoring (% of maximum)

15

16

17

18

Slide 19

North Cascades National Park

View from Visitor Center, Newhalem, WA
Looking Northwest

Air Data & Weather | NPS Air Webcams

updated 04/16/2013 08:30 AM PDT

Webcam

webcam   clear/hazy   landmark   map it   archives   view larger

19

Slide 20

IMPROVE Monitoring Equipment

Every IMPROVE site deploys an aerosol sampler to measure speciated fine aerosols and PM10 mass. Select sites also deploy Transmissometer and Nephelometers to measure light extinction and scattering respectively, as well as automatic camera systems to measure the "scene".

The IMPROVE Modular Aerosol Sampler which, measure fine and total aerosol mass. The sampler was developed and refined by the IMPROVE program, and has been in operation since 1987.

The receiver for an Optec LPV-2 transmissometer, which measures the light extinction coefficient by measuring the attenuation of light from a light source.

The Optec NGN-2 integrating nephelometer, which estimates the atm. scattering coefficient by directly measuring light scattered by aerosols and gases in a sampled air volume.

20

Slide 21

San Juan Islands Visibilty Monitoring

Overall Scene Conditions
- No clouds
- Scattered clouds
- Overcast
- Haze concealing
- Weather concealing
- Cannot determine
- No haze

Haze Conditions
- Ground based
- Elevated
- Multiple
- Weather concealing
- Cannot determine

21

Slide 22

Monitoring Changing Air Quality in the Edwin B. Forsythe NWR

Exploring Visibility Concepts

AQ in Sequoia Kings Canyon NP

22