National Wildlife Refuge System




Alaska Maritime National Wildlife Refuge (NWR) - Tuxedni Wilderness

Air Pollution Impacts

Natural and scenic resources in the Tuxedni Wilderness are susceptible to the harmful effects of air pollution. Fine particles and toxic emissions, nitrogen/sulfur deposition, and formation of ozone can impact scenic resources. In addition to affecting visibility, these pollutants can potentially harm natural resources such as surface waters, fish, wildlife, and vegetation. Click on the tabs below to learn more about air pollutants and their impacts on natural and scenic resources at the Tuxedni Wilderness.

Visibility | **Fine Particles** | **Nitrogen & Sulfur** | **Toxics & Mercury** | **Ozone**

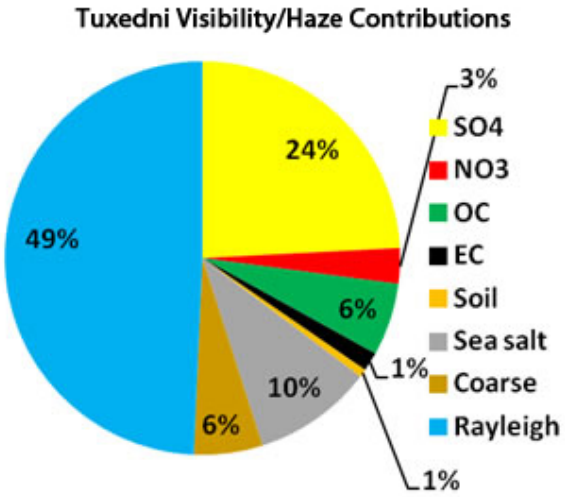
Visibility

Many visitors come to refuges to enjoy the spectacular vistas. Unfortunately, these vistas are sometimes obscured by haze caused by fine particles in the air. Each major chemical component that contributes to haze or visibility at Tuxedni Wilderness is shown in the pie chart below. Organic compounds, soot, and dust reduce visibility as well. The pie chart below shows the average percent contribution to haze at Tuxedni Wilderness by each major chemical component. Sulfate contributes

to about 25% of the haze at Tuxedni Wilderness and is mostly due to large industrial sources, such as coal-fired power plants. Elemental (EC) and organic carbon (OC) contribute to about 7% of the haze and sources include wildfires, energy development and motor vehicles. Fine soil and coarse mass (dust) contribute 7% to the haze. Rayleigh scattering is a natural optical phenomenon where light is deflected by matter. While this natural phenomenon contributes to visibility impairment, it also gives the atmosphere its blue color. Sea-salt, from sea spray, also natural, contributes about 10% to the haze at Tuxedni Wilderness. The other contributors to visibility are a combination of man-made and natural elements.

Visibility effects at Tuxedni include:

- A reduction of the average natural visual range from about 150 miles (without the effects of pollution) to about 125 miles (with the effects of pollution) at the refuge.
- A reduction of the average visual range to 68 miles on the most polluted days (20% highest pollution days).
- Human produced haze occasionally impairs scenic vistas at the refuge.



Visibility Data at Tuxedni more>>

Fine particles

Public Health Concerns
Fine particles can get deep into human lungs and can cause serious health problems. Numerous scientific studies have linked particle pollution exposure to irritation of the airways, coughing, difficulty breathing, aggravated asthma, chronic bronchitis, heart attacks, and premature death in people with heart or lung disease.

Concentrations of fine particles at the wildlife refuge comply with the National Ambient Air Quality Standards set by the U.S. Environmental Protection Agency to protect public health. Fine particles (smaller than 2.5 micrometers) originate from either direct emissions by a source (primary particles), such as construction sites, power plants and fires, or secondary reactions which are created from reactions with gases and aerosols in the atmosphere emitted from sources upwind. For example, power plants, industries, and automobiles emit gases such as sulfur dioxides and nitrogen oxides, which form particles of sulfate and nitrate in the atmosphere.

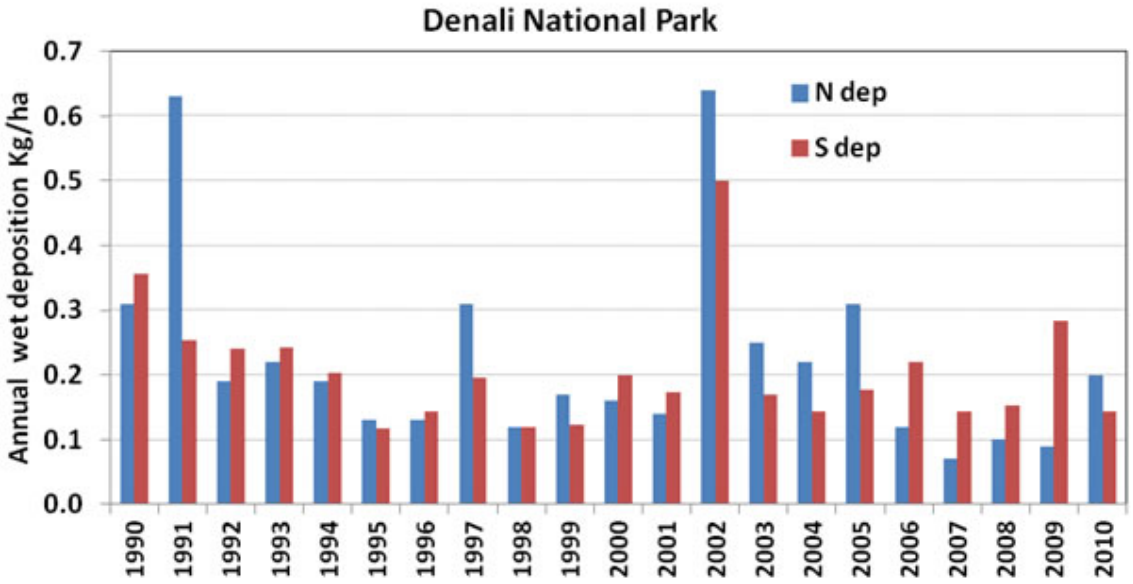
Nitrogen and Sulfur

Nitrogen and sulfur compounds deposited from the air may cause acidification to ecosystems at Tuxedni Wilderness. Nitrogen deposition may also cause nutrient imbalances in ecosystems, sometimes leading to increases in weedy plant species and cause the loss of native species. Although the EPA's Acid Rain Program and other air quality management programs have

significantly reduced nitrogen and sulfur deposition, some areas continue to show the effects of acid deposition.

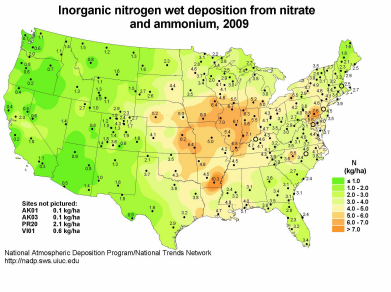
Wet deposition of nitrogen and sulfur at Denali National Park 2000-2010

The nearest wet deposition (from rain and snow) monitoring site is in Katmai National Park (site AK97), about 130 miles southwest of Tuxedni Wilderness. The Katmai National Park site has only operated since 2009. Long-term wet deposition data is available (since 1980) at Denali National Park (site AK3), about 400 km north of Tuxedni Wilderness. The plot below shows annual average values of nitrogen and sulfur from wet deposition at Denali National Park from the years 1990-2010.

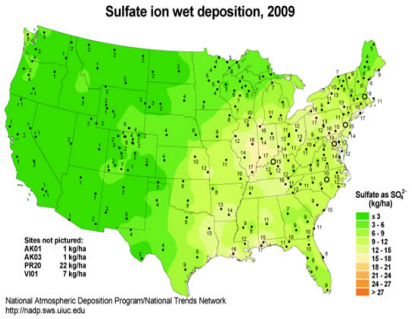


Nationwide Nitrogen and Sulfur Deposition

The nitrogen and sulfur deposition near Tuxedni Wilderness are very low. The total annual sulfate (SO4) and nitrogen wet deposition throughout the United States for 2009 is shown below. Click on the maps to see better resolution images.



Inorganic Nitrogen Wet Deposition 2009



Sulfate Ion Wet Deposition 2009

Nitrogen and Sulfur Deposition Data at Tuxedni more>>

Toxics & Mercury (Hg)

Toxics, including heavy metals like mercury, accumulate in the tissue of organisms in a process called bioaccumulation. In the environment, mercury converts to methylmercury in the environment and then enters the food chain. The effects of mercury can include reduced reproductive success, impaired growth and development, and decreased survival. Human activities have greatly increased the amount of mercury in the environment through processes such as burning coal for electricity and burning waste. Deposition of mercury from the air into water bodies often starts the bioaccumulation process. An example of bioaccumulation is where plankton will take up mercury and are eaten by

smaller fish, which are eaten by larger fish and then eaten by humans. This bioaccumulation affect causes potential adverse health effects in people.

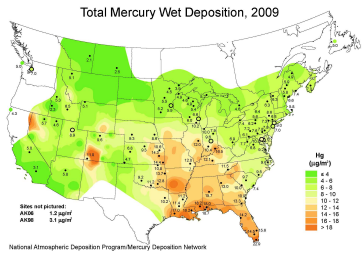
Other toxic air contaminants of concern include pesticides, lead, industrial by-products, and emerging chemicals such as flame retardants for fabrics, some of which are also known or suspected to cause cancer or other serious health effects in humans and wildlife.

Effects of mercury and airborne toxics on ecosystems at Tuxedni Wilderness include:

- Mercury deposition levels in Alaska are well below national averages. The State of Alaska has not issued any fish consumption advisories for adverse levels of mercury or other toxics and considers the health benefits of fish consumption to outweigh any risks.

Additional Information:

The closest mercury wet deposition monitoring is in Kodiak, Alaska (site AK98) about 125 miles southwest of Tuxedni Wilderness. The site began monitoring in 2007 and is part of the National Atmospheric Depositions Program's Mercury deposition network. The map below shows a continental nationwide outlook on the mercury deposition (NADP). Click on the map to see a better resolution image.



Map of Mercury Deposition

Mercury data at Tuxedni more>>

Ozone

Public Health and Ecosystem Concerns

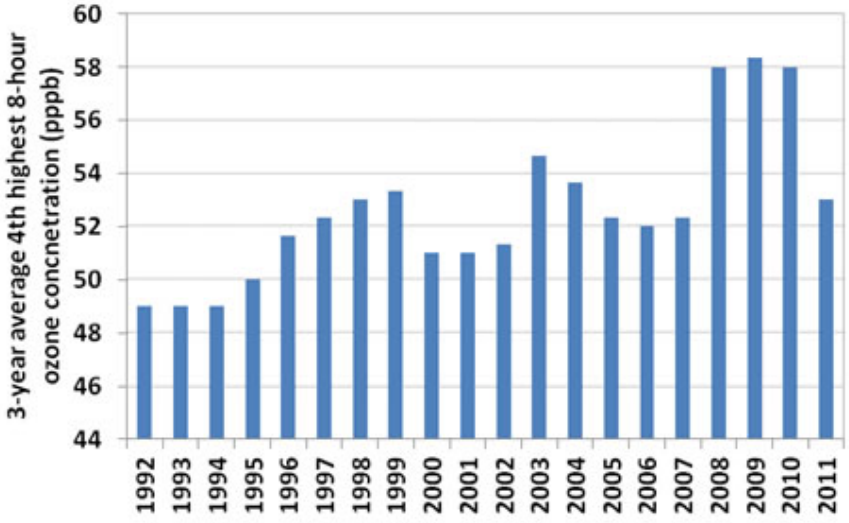
Naturally-occurring ozone in the upper atmosphere forms a layer that absorbs the sun's harmful ultraviolet rays and protects all life on earth. However, in the lower atmosphere, ozone is considered an air pollutant. Ozone forms when nitrogen oxides from vehicles, power plants, and other sources combine with volatile organic compounds from gasoline, solvents, and vegetation, in the presence of sunlight. In addition to inducing respiratory problems in people, elevated ozone exposures can injure plants. Ozone enters plant's leaves through pores (stomata), where it can kill plant tissues, causing visible injury like bleaching or dark stippling, or reduce the plant's photosynthesis, growth, and reproduction abilities.

In humans, ozone is a respiratory irritant. Research shows that ozone can cause coughing, sinus inflammation, chest pains, scratchy throat, permanent lung damage, and reduced immune system functions. Children, the elderly, people with existing health problems, and active adults are most vulnerable.

Ground-level ozone concentrations at Tuxedni Wilderness are expected to be well within the National Ambient Air Quality Standard (NAAQS) set by the U.S. Environmental Protection Agency to protect public health.

The current 8-hour average standard is 75 parts per billion (ppb). Compliance with the standard is based on the three-year average of the 4th highest daily value per year. EPA's Clean Air Scientific Advisory panel has recommended a standard to 60-70 ppb. The nearest ozone monitoring sites are 2 sites in Anchorage, about 125 miles northeast of Tuxedni Wilderness. The Anchorage sites have only been monitoring ozone since 2010 and 2011. The is long term ozone data at Denali National park, about 248 miles north of Tuxedni. The three-year average of 4th highest daily 8-hour average is shown in the Figure below. Values have ranged from 48-58 ppb, well within the current NAAQS of

75 ppb and lower than the recommended standard of 60-70 ppb. There has, however been an upward trend in concentrations.



Effects of ozone on vegetation at Tuxedni Wilderness

The USEPA has proposed that a weighted index, called "W126" be used to evaluate potential damage to vegetation from ozone. EPA proposed a secondary air quality standard for ozone to protect vegetation with a W126 between 7-15 ppm-hr based on a 3-year average. The 3-year average indices at Denali National Park for the period 1990-1992 until 2009-2011-2011 (shown below) ranged from 1.6 to 3.7 ppm-hr which is less than the recommended standard to protect vegetation from injury.