Ranger Toolkit

National Park Service
U.S. Department of the Interior

Urban Ecology Research Learning Alliance
Washington DC

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https://www.nps.gov/rlc/urbanecology/index.htm

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GEORGE MASON UNIVERSITY
CENTER *for* CLIMATE CHANGE COMMUNICATION

Introduction

The National Park Service preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.

The National Park Service recognizes that climate change is real and that it affects the natural and cultural resources found in the parks.

Tooklit Purpose

This Kenilworth Park and Aquatic Gardens (KEPA) Ranger Toolkit is meant to help rangers have conversations with park visitors about climate change and its impacts on the ecosystem of the park, on the greater DC region, and on human health.

This toolkit also serves as an overview of the history, biology, and ecology of KEPA, focusing on the importance of the wetlands, pollinators, as well as land and aquatic plants.

It is important to note that ecosystems depend on a state of balance. Some organisms are able to adapt to imbalance, while others cannot handle disruptions to their accustomed equilibrium.

These disruptions can either be natural or a result of human-induced changes such as climate change. The ecosystem of KEPA is facing challenges due to a changing climate, and the NPS is making efforts to reduce its contribution to greenhouse gas emissions which cause changes to destabilizing ecosystem balance.

NPS Stance on Climate Change

The key NPS messages are as follows:

Climate change is happening and human activities are contributing to and accelerating it.

The changing climate has consequences for parks, people, and the planet.

The NPS is responding with practices that address climate change.

The choices we make now may help to avoid catastrophic impacts in the future. **[2]**

Four Areas of NPS Response to Climate Change [03]

Using Science to Help Us Manage

Park scientists conduct research to help us understand the effects of climate change on national parks. The National Park Service also collaborates with other scientific agencies and institutions to manage using the best available climate science.

This information is then applied to address the specific needs of park managers and park partners as they confront the challenges of climate change.

Reducing Our Carbon Footprint

The most effective way to lessen the long-term effects of climate change is to reduce greenhouse gas emissions.

The National Park Service aims to be a leader in reducing its carbon footprint through energy efficient practices and integrating climate-friendly practices into administration, planning, and workforce culture.

Adapting to an Uncertain Future

Climate change will alter park ecosystems in fundamental ways. The National Park Service must remain flexible amidst this changing landscape and uncertain future. **[02]**

In some cases we must take bold and immediate actions, while in others we may be methodical and cautious. Many techniques will be utilized, evaluated, and refined as new science becomes available and the future of climate change unfolds.

Educating About Climate Change

National parks are visible examples of how climate change can affect natural and cultural resources.

Park rangers engage visitors about climate change by sharing information concerning the impacts to parks and steps the agency is taking to preserve our heritage.

[01]

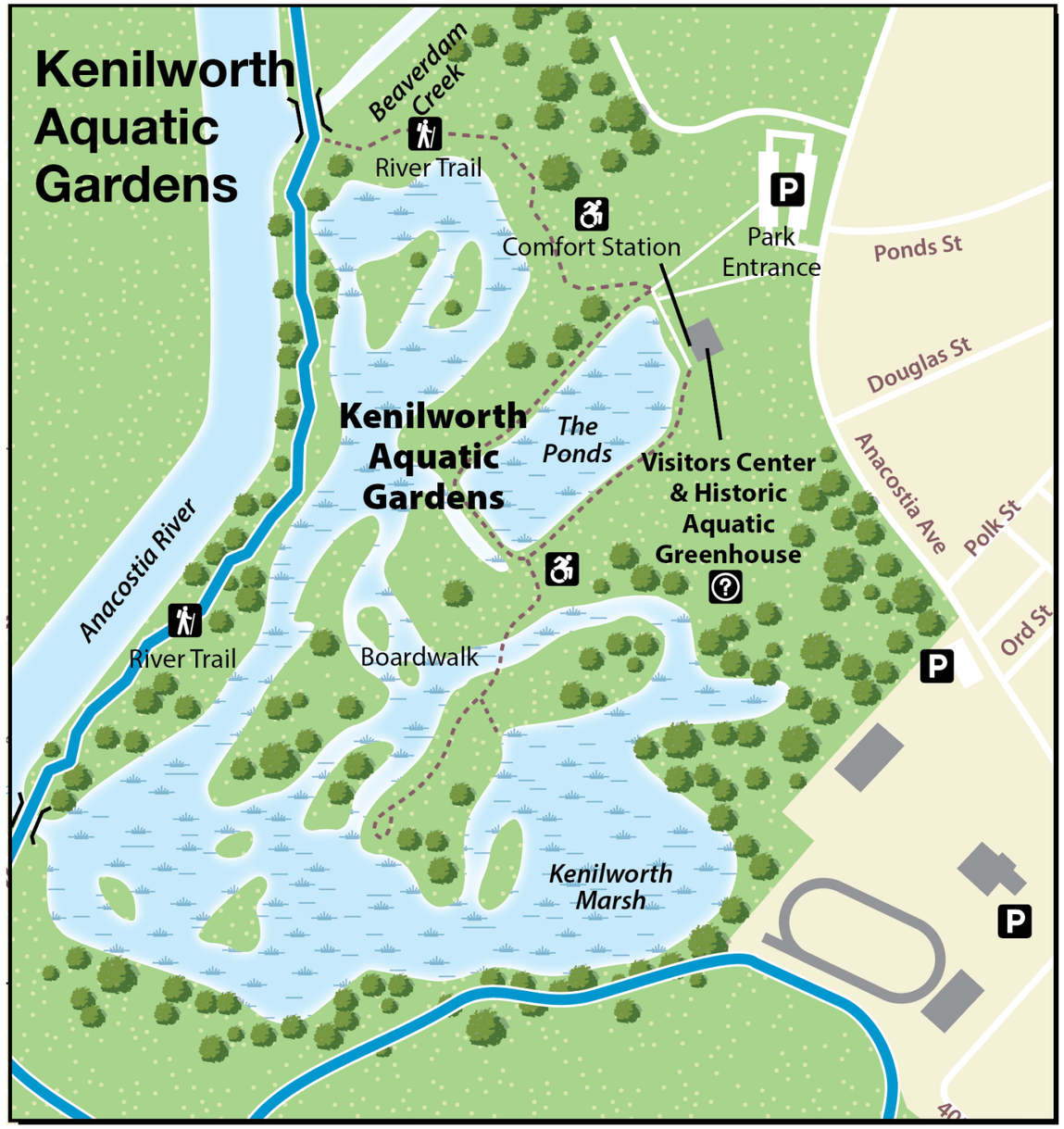
What is Climate Change?

Climate change is broadly defined as a change in global or regional climate patterns. More specifically, current references to climate change allude to the changes apparent from the mid- to late 20th century onwards that are largely attributed to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels.

While climate change can sometimes be a divisive topic, we hope that this guide will allow rangers to feel more comfortable having informative conversations with interested park attendees.

For more information about climate change actions, visit the NPS climate change website.

KEPA Map



Overview of Kenilworth Park and Aquatic Gardens

Kenilworth Aquatic Gardens encompass eight and a half acres on the edge of the marsh bordering the east side of the Anacostia River, on the 1500 block of Anacostia Avenue in the northeast quadrant of Washington, DC.

Just south of the District of Columbia line with Maryland, the site boundaries roughly approximate the original property line following acquisition by the National Park Service between 1939 and 1942. The curving path of Anacostia Avenue, N.E. defines its eastern edge, while to the north, south and west the boundary roughly follows the perimeter of the currently existing ponds.

Today, a network of grassy paths lead between 45 ponds separated by earthen dikes whose underground drainage pipes control water flow. To the east of the ponds, the building complex includes a visitor center, two greenhouses and a restroom facility. Access to the site is provided by a gravel path that leads from a parking lot through a chain link fence to the northeast corner of the gardens.

The Corps of Engineers bought the aquatic gardens from Lucy Helen Fowler, the daughter of founder Walter B. Shaw, in 1938, and the property came under the jurisdiction of the National Park Service the following year.

As the only National Park Service site devoted entirely to the propagation and display of aquatic plants, Kenilworth Aquatic Gardens is a unique resource. More specifically, it is nationally significant for its unique landscape and botanical, educational and recreational contribution to the history of the District of Columbia and the nation.

The historic period of significance for the site is 1882 to 1938, lasting from the first year that Shaw may have planted water lilies there to its conversion from a commercial farm to a public park. As a landscape associated with the lives of persons significant to our past, in particular early aquatic horticulturalist Walter B. Shaw and his daughter, Helen Fowler, the gardens meet Criterion B of the National Register of Historic Places Criteria for Evaluation.

The site also qualifies for listing under Criterion C, for its significant and distinguishable character as a once nationally-recognized aquatic water garden that was one of the first of its kind in the United States. Consequently, the park has been listed on the National Register of Historic Places since August 25, 1978.

Today, the cultural landscape of Kenilworth Aquatic Gardens is in fair condition, and retains a high level of integrity to its historic period of significance. The site consists of 45 ponds, six display pools and three associated structures. Although some changes in vegetation and pond layout have taken place, the wandering paths and beautiful water lily displays make it easy for visitors to envision the site as it was historically.

Views across the ponds are still marked by overhanging hardwood trees, while the buildings nearby have undergone only minimal alterations from their original appearance. **[04]**

KEPA and Ward 7 Cultural History [05]

Approximately 4000 BCE

The earliest residents to this region are Native Americans of the Nacotchtank tribe. They began living in this region over 4,000 years ago. The village of Nacotchtank (from which the name Anacostia is derived) was the largest of the three American Indian villages located in the Washington area and is believed to have been a major trading center. **[06]**

2200 BCE

The Savannah River people lived along the major rivers east of the Blue Ridge Mountains

Approximately 1500 BCE

The region of the District of Columbia was first inhabited by humans.

1400-1450 CE

The first Convoy arrived on the inner coastal plain to settle along the Potomac River.

1608 CE

The Conoy groups living along the eastern shore of the Potomac River cultivated corn, fishing, hunting, and making ceramics. The total population, centered around Nacotchtank village, numbered between 400 and 500 people.

1608 CE (continued)

Captain John Smith was the first documented European to have reached the navigable head of the Potomac River during his explorations in 1608. Smith's explorations led to several subsequent contacts with American Indians and ultimately resulted in the European settlement of the land and the displacement of the local American Indians.

1632 CE

Europeans began to colonize the Anacostia region more aggressively. Wetlands were cleared to build tobacco farms run through slave labor.

1650 - 1700 CE

European settlers established themselves in the DC area and soon after cleared much of the land for the cultivation of tobacco.

1650 - 1700 CE

Lord Baltimore creates Charles County, which reaches along the Potomac River as high as the settlements extend.

1686 CE

On April 13, John Beall surveyed a tract known as The Barrens—or The Barrons—that included what is now the site of Kenilworth Park and Aquatic Gardens.

1700s CE

Bladensburg became a popular port on the Anacostia River and was used to transport local tobacco harvested by slaves.

1790 - 1800 CE

By this decade, some of the fields around the District of Columbia were restored to successional woodland due to the depletion of the soil by tobacco crops.

1790s - 1840s CE

Industrial Revolution begins. Humans increased deforestation by cutting down trees for fuel, fencing, and houses. Industrialization/farming caused soils to wash away into the river, filling its deep channels with silt. Once a home to sturgeon fish and used to transport goods, the river was too shallow and became increasingly polluted.

1791 CE

Pierre L`Enfant laid out his design for the new capital city at the confluence of the Potomac River and the Eastern Branch, later known as the Anacostia River.

1815 CE

After years of work by the Washington Canal Company, the Washington Canal was opened, creating a new link between the bustling business of Georgetown and the Eastern Branch.

1861 - 1865 CE

The Civil War breaks out. D.C. served as the Union capital and underwent much cultural, social, and political change during this time.

Fortifications were built to protect the city, and the population of the city doubled during the war. Few black families were free in Washington D.C.; most individuals were enslaved. **[07]**

1867 CE

The responsibility for the maintenance of public works in the District of Columbia was transferred to the U.S. Army Corps of Engineers.

1870 CE

The U.S. Corps of Engineers began dredging along the Potomac River following an appropriation of funds by Congress

1871 CE

The Maryland Railroad Company purchased land east of the Anacostia River in order to extend rail lines across the river for the first time.

1872 CE

At the request of Congress, the U.S. Corps of Engineers conducted a study of the Anacostia River for the first time since the Civil War. Despite the recommendation of a six million dollar project to resolve silt buildup and health-related issues, no action was taken.

1875 CE

L. Helen Shaw was born. The second child and only daughter of Walter Shaw, she would marry Marion Fowler, be widowed and become the partner, then proprietor, of Shaw Gardens, which is now Kenilworth Park and Aquatic Gardens. Helen Fowler was the last private owner of the Gardens and was a driving force in its success and preservation.

1875 CE (continued)

Fowler was the first woman in Washington, D.C. to have a commercial driver's license.

The Washington Engineer District was formed with the primary purpose of managing the Potomac River.

1879 CE

On May 26, Civil War veteran and US Treasury clerk Walter B. Shaw, and his wife Luciana purchased 33 acres of land then known as Parcel 179/2 or the Barrens.

They would turn this land into a commercial water garden to later become Kenilworth Park & Aquatic Gardens.

1880 - 1882 CE

A native of Maine, Walter B. Shaw soon began adapting a nearby ice pond down by the Anacostia marsh for use in growing a few hardy water lilies that he brought with him from New England.

1880 - 1882 CE

For the first time, the Annual Report of the Corps of Engineers laid out a plan to dredge the Anacostia River as far north as Bladensburg and use the dredged materials to fill in the adjacent flats.

1887 CE

On February 23, a new bridge across the Anacostia River at Pennsylvania Avenue was approved by Congress.

1890 CE

On March 20, the new Pennsylvania Avenue bridge across the Anacostia was officially opened to traffic.

1891 CE

Following a Congressional appropriation of $20,000 for the purpose, work began on the dredging of the Anacostia River between the Navy Yard and Giesboro Point.

Col. Peter Hains of the U.S. Corps of Engineers began a detailed survey of the Anacostia River within the District of Columbia.

1894 CE

By this date, W.B. Shaw had constructed a second building on his property, down next to his first lily pond by the marsh`s edge.

1898 CE

On April 11, Congress appropriated funds to improve the Anacostia River and reclaim the associated flats, in accordance with plans laid out by Colonel Allen of the U.S. Corps of Engineers.

1900 CE

Shaw introduced Nymphaea odorata 'Helen Fowler', a deep rose colored water lily named after his daughter

1901 - 1902 CE

The Senate Park Commission, also known as the McMillan Commission, laid out a master plan for development of the capital city, including the Anacostia River.

The submitted plan included designs for a 1,100-acre Anacostia water park that would consist of half water, half land.

1902 CE

W.B. Shaw left his position at the U.S. Treasury to cultivate and sell water lilies full time.

1902 CE

Around this year, W.B. Shaw first began to pay special attention to the cultivation of lotus, in response to a rise in demand for these plants as well as water lilies.

1905 CE

By this year, dredging along Section One of the Anacostia—or the area between the river mouth and the Navy Yard Bridge—had been completed and several thousand acres of adjacent ground were reclaimed.

1905 CE

By this year, Shaw had introduced Nymphaea odorata 'Luciana', a pink water lily named after his wife.

Shaw made an approximate $1,200 per acre from his aquatic gardens. Lilies are shipped regularly to New York, Boston, Philadelphia, and Chicago. Shaw was also keeping Japanese carp and paradise fish for sale.

1908 CE

At this point, Shaw had nine ponds spread out over four acres and housing 40 different types of water lilies, fifteen of which are night-blooming varieties.

1912 CE

Shaw took steps to more fully commercialize his business, with increased bulk shipments to out-of-town markets and a new lily truck for the sale of lilies around Washington. Shaw has a small, two-story board and batten building constructed to serve as the sales building for his growing aquatic enterprise.

Shaw retired and turned the business over to his daughter Helen Fowler.

1912 - 1930 CE

A dredging project began on the Anacostia River by the US Army Corps of Engineers, and reached the Shaw gardens in the 1930's. Mrs. Fowler received notice of condemnation of land.

1913 CE

Shaw had two steam-heated greenhouses constructed on either side of the new sales building to help care for the tender new water lilies and tropical varieties.

Shaw introduced Nymphaea 'Eugenia de Land' (also known as 'Eugenie de Land'), a pink lily named after a local artist.

1915 CE

Helen Fowler introduced the coral-pink colored Nymphaea 'Pink Opal'.

1916 CE

The Board on Reclamation and Development of the Anacostia River and Flats decided against the original idea of building a dam, and instead drew up plans to open a western channel in the river to create today's Kingman Lake and Kingman Island.

On August 25, Woodrow Wilson approved legislation to create the National Park Service.

1918 CE

On August 31, Congress laid aside the reclaimed land along the Anacostia River as part of the District of Columbia's park system, naming it Anacostia Park.

1921 CE

Helen Shaw Fowler introduced Nymphaea 'Rose Arey', a rich pink colored lily named after a cousin and awarded the silver medal for best new lily by the New York Horticultural Society.

1921 CE (continued)

This year, the gardens produced 75 different varieties of water lilies, in addition to other aquatic plants.

The Suburban Gardens, just south of Shaw gardens, was constructed and served as the only amusement park in D.C. until 1940. The park largely served local black communities, who were segregated from the Glen Echo Amusement Park in Maryland.

1930 CE

Fowler introduced Nymphaea 'Radiance', an iridescent pink flower whose color deepens toward its center.

1930 - 1938 CE

Helen fought for protection of the Shaw gardens from the dredging project, and Congress authorized payment of $15,000 for 8 acres. The gardens, saved from being filled, were added to Anacostia Park.

1933 CE

Congress again authorized a plan to fill in the Anacostia marsh areas in order to control malaria-bearing mosquitoes.

Administration of the parks in the capital was transferred to the National Park Service.

1935 CE

By this year, the gardens encompassed 42 ponds covering nine acres.

The residential neighborhood known as Eastland Gardens was founded to the south and east of the Shaw property.

1936 CE

In March, the Great Flood of 1936 inundated the Shaw ponds with water from the Anacostia River. Luckily, the associated structures at the site were undamaged, and the gardens recovered in time for the summer lily season.

1938 CE

On December 19, the U.S. Corps of Engineers purchased Parcel 179/2 and a portion of Parcel 184/9, in all totaling some 8.5 acres, from Charles Shaw, his wife Alberta, and Helen Fowler. The acquisition was made possible only by a special appropriation of funds by Congress under the District Appropriation Act.

1939 CE

The National Park Service assumed jurisdiction of what is now known as Kenilworth Park and Aquatic Gardens. This area became known as Anacostia Park, Section G, U.S. Reservation 343.

1940 - 1942 CE

During this period, various small tracts of land to the east of the gardens were acquired by the National Park Service to complete its ownership of the land within the current site boundaries.

1941 CE

The Army Corps of Engineers reported that the dredge and fill operations along the Anacostia River were 89% complete, only to cease work on the project soon afterwards due to World War II.

1942 CE

Open burning of trash began at the Kenilworth Landfill, to the south of Kenilworth Park and Aquatic Gardens. Over the next twenty years, the landfill was burned consistently, releasing toxic fumes into predominantly black neighborhoods.

On December 2, the remaining portion of the original Shaw Aquatic Gardens, including the buildings directly east of the gardens, was acquired by the National Park Service.

1945 - 1950 CE

The government built a large war veteran housing complex adjacent to Kenilworth Park and Aquatic Gardens, effectively surrounding the site on its north and east sides.

1946 CE

Mayfair Mansions was built as an elite housing complex for upwardly-mobile African Americans who could not find housing downtown due to racial discrimination and segregation.

1950 - 1959 CE

Mr. Fred Lundy, a gardener for the NPS, learned about water lilies from Helen Fowler who continued to live on the property for fifteen years until she died. Mr. Lundy continued the tradition of caring for her flowers.

African American architects constructed the Eastland Gardens, DePriest Village, and other buildings to attract middle-class black residents to Ward 7.

After World War II, the population of Ward 7 increased. The city's action to condemn lots in Marshall Heights, Northeast Boundary, and Lincoln Heights was protested by residents. These buildings were replaced with segregated public housing.

1950 - 1959 CE (continued)

11 parents of African American students petitioned John Philip Sousa Junior High School to integrate and their request was denied despite the school having space available. This developed into the Bolling vs. Sharpe court case that was combined with several other cases into the Supreme Court case Brown vs. the Board of Education. By September 13, 1954 all schools in Washington D.C. had fully integrated faculty and students.

1952 CE

In February, a group of four new ponds was built in the southwest corner of the main gardens, adjacent to the three pools added in the 1920s.

Mrs. Ruth Gover, a former employee of Mrs. Fowler`s, coaxed a 1,000 year old lotus from Southern Manchuria into bloom.

By this year mosquito fish, a recent introduction to the ponds, were thriving.

1953 CE

This year, the gardens were documented to contain80 varieties of water lilies kept in a total of 49 ponds.

1959 CE

The Kenilworth Courts housing development was built to the east of the aquatic gardens.

Development of Anacostia Park is completed.

1960 - 1968 CE

Protests and marches abound in D.C. People came to protest the Vietnam War and march for civil rights, including the March on Washington in 1963 where Dr. Martin Luther King Jr. gave his famous "I Have a Dream" speech.

In April 1968, riots broke out in cities all over the country, including D.C., following the assassination of Martin Luther King Jr. The Civil Rights Act of 1968 and Fair Housing Act of 1968 were results of these riots.

1962 CE

The National Park Service revisited the idea of reclaiming the Anacostia flats and planned to continue with the reclamation efforts originally begun by the U.S. Corps of Engineers.

1968 CE

7-year-old Kelvin Tyrone Mock died in the landfill after being trapped in the flames, prompting the landfill to close. The landfill was "capped" with a permeable layer of 3ft of soil/sewage sludge and converted to a sanitary landfill.

The National Park Service ceased its practice of supplying water lilies and other aquatic plants to the Lincoln Memorial Rainbow Pool. Much of this vegetation had historically been cultivated at Kenilworth Park and Aquatic Gardens before being sourced out to local parks.

1972 CE

After thirty years of use as both an open burning site and a sanitary dump, the Kenilworth Landfill was closed.

On March 25, Kenilworth Park and Aquatic Gardens was opened.

1974 CE

At the request of the Director of the National Capital Planning Commission, a study of the situation at Kenilworth Marsh was completed in April and entitled Preliminary Master Plan Comments.

1974 CE (continued)

The first black mayor and a majority black city council were voted in and passed fair housing laws, increasing middle class black residents' access to Washington's suburbs.

1978 CE

The Kenilworth Park and Aquatic Gardens are added to the National Register of Historic Places.

1979 CE

By this year, the number of water lilies growing in the gardens had shrunk to sixty, including five types of lotus.

1981 CE

The National Park Service developed an Environmental Assessment and Information Base for Kenilworth Park and Aquatic Gardens.

By this year, the gardens gew roughly 75 different varieties of water lily, including several types of lotus.

1983 CE

The Division of Special Programs and Populations issues an Accessibility Survey of Selected NCR - East Park Units that included an assessment of Kenilworth Park and Aquatic Gardens and recommendations about how to improve accessibility at the site.

1989 CE

A series of additions were made to the Administration Building, including ramps on the west and south sides for accessibility. A small entryway was added on the south side, and the restrooms were built on the north side.

1990 CE

A preliminary draft Kenilworth Park and Aquatic Gardens Pond Management Plan laid out procedures for management of the gardens, including dredging and control of vegetation in ponds and repairs to display ponds in the vicinity of the administration building.

It also called for an increase in pond maintenance staff and provided a list of equipment needed for proper care of the gardens.

1990 CE

One of the smaller display ponds, located to the north of the Shaw sales building and next to the employee parking lot, was filled in and used instead as a flower bed.

1993 CE

The 32-acre restored Kenilworth Marsh was dedicated on September 21.

1996 CE

The northern snakehead fish, an invasive species from Asia, appeared in the ponds.

1996 CE

Unauthorized landfill dumping was justified by Gentry Davis, superintendent of National Capital Parks-East. He was promoted a year later to deputy regional director for the National Capital Region.

2000 - 2002 CE

During these years, a boardwalk with interpretive display boards was built from the southwest corner of the gardens out into Kenilworth Marsh.

2000 CE - Present

This is the first time since World War II that the population of D.C. reached 600,000.

The increase in residents leads to a rise in rent and property values, which increased taxes. This caused Kenilworth to become a mixed-income redevelopment with moderate-rent apartments and townhouses.

In recent years, Metro stops, shopping centers, and recreation centers have opened in Ward 7, where Kenilworth is located.

2003 - 2006 CE

A series of water service upgrades were made throughout the garden ponds, including the installation of new, shallower 4-inch PVC pipes to allow continuing water circulation between pools.

2007 CE

A network of internal wire fencing was installed within the dikes throughout the ponds in order to prevent further damage from the tunneling of muskrats.

For More Information

For more detailed information about the history of Kenilworth Park and Aquatic Gardens, check out the National Park's Cultural Landscape Inventory **https://irma.nps.gov/DataStore/DownloadFile/450575**

Figure 13. Helen Fowler posing with her workers on one of the pond paths, circa 1910 to 1930 (CHS 10455.06, MS 710, Historical Society of Washington, DC).

[Left: Walter Shaw; Source: NPS]

KEPA Ecosystem Services

Kenilworth Park and Aquatic Gardens is a part of the floodplain of the Anacostia River that serves the public by **filtering water, reducing flood damage, and preserving the biological and cultural resources** that let us see from the past into the future. **[08]**

Streambank Stabilization & Erosion Control

Wetlands along rivers and streams absorb energy and store water during storms, which reduces downstream flood damage and lessens the risk of flash floods.

The slow release of this water stored in the wetlands can help streams flow even during periods of drought. **[09]**

Ecosystem Productivity

Some wetland types are among the most productive ecosystems on Earth. Nutrients and plant material flushed from some wetland systems during storms provide essential food for plants, fish, and wildlife in estuaries and other downstream ecosystems.

Recreation

Many wetlands contain a diversity of plants, animals, and water features that provide beautiful places for sightseeing, hiking, fishing, hunting, boating, birdwatching, and photography.

Wildlife Habitat

Wetlands provide habitat for many species of amphibians, reptiles, birds, and mammals that are uniquely adapted to aquatic environments.

Upland wildlife like deer commonly use wetlands for food and shelter. Wetlands are vital to many migratory bird species.

Water Treatment

Wetlands serve as a water filter by reducing sediment and chemicals in runoff before it gets into open water. **[12]**

Carbon Sequestration

Wetlands can accumulate large amounts of carbon in their soils by plants and photosynthetic bacteria absorbing carbon dixoxide from the atmosphere during the photosynthetic process. Algae is a great example of a wetland plant involved in the carbon sequestration process.

The Unique Landscape of KEPA

Kenilworth is the only native freshwater tidal wetland in Washington D.C. and the only National Park that prominently features aquatic plants.

Ecosystem services provided by this wetland are threatened by the impacts of climate change in Washington D.C. Higher temperatures, more frequent and intense flooding, habitat loss, and increased competition from invasive species all pose a compounding threat to the resilience of the wildlife at KEPA.

Storm Surge & Flood Protection

Wetlands serve as nature's sponge by absorbing and slowly releasing water. By slowing the flow of water during flooding events, wetlands replenish the groundwater that supplies most plants and water that many people depend on, and reduce flood damage in surrounding areas and downstream. **[10]**

Wetlands in urban areas, such as DC, are of great importance because urban areas tend to have large amounts of water runoff from concrete areas and buildings. **[11]**

Examples of Fauna at KEPA

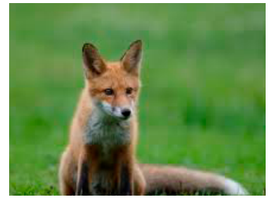
Mammals

North American River Otter

Lutra canadensis

Eastern Grey Squirrel

Sciurus carolinensis



Red Fox

Vulpes vulpes

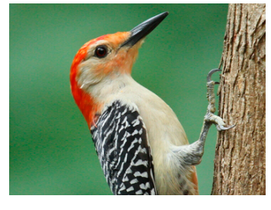
Birds

Great Blue Heron

Ardea herodias

Barred Owl

Strix varia



Red Bellied Woodpecker

Melanerpes carolinus

Amphibians

Fowler's Toad

Anaxyrus fowleri

Bullfrog

Rana catesbeiana

Spotted Salamander

Ambystoma maculatum

Reptiles

Spotted Turtle

Clemmys guttata

Northern Red-Billed Cooter

Pseudemys rubriventris

Eastern Ratsnake

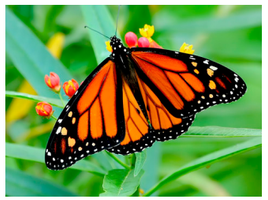
Pantherophis alleghaniensis

Examples of Flora & Fauna at KEPA

Insects

Six Spotted Tiger Beetle

Cicindela sexguttata



Eastern Monarch Butterfly

Danaus plexippus

Cecropia Moth

Hyalophora cecropia

Fish

American Eel

Anguilla rostrata

Eastern Mosquitofish

Gambusia holbrooki

Largemouth Bass

Micropterus salmoides

Plants

Green Arrow Arum

Peltandra virginica

River birch

Betula nigra

Milkweed

Asclepias syriaca

Bird's eye speedwell

Veronica persica

Paw-Paw

Asimina triloba

American lotus

Nelumbo lutea

Pollinators Overview

Overview

Pollinators are organisms that transport pollen from the male anther of a flower to a female stigma. This process results in the production of seeds and allows the flowers to reproduce. **[13]** Because they are vital for plant reproduction, pollinators play a necessary role in the ecosystem.

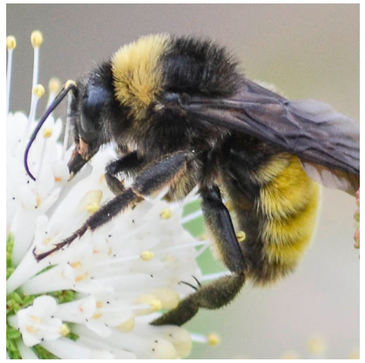
This relationship is mutualistic because it results in benefits for all parties involved. While the plants spread their pollen with the help of the pollinators, the pollinators in return drink the nectar from the plants as a food source.

Major pollinators in Kenilworth Park and Aquatic Gardens include ants, bats, bees, beetles, birds, butterflies, flies, moths, wasps, and more.

Pollinators affect humans as well, as many of the resources and products we use daily are a result of the pollination process including the food we eat, medicines that come from plants, and much more.

Eastern Monarch Butterfly

Danaus plexippus



American Bumblebee

Bombus pensylvanicus

Syrphid Fly

Eupeodes americanus

Day (Diurnal) Pollinators

Day pollinators— like honey bees and butterflies— pollinate plants that bloom during the day. The majority of pollinators are day pollinators and typically visit plants on warm, sunny days.

Visit the NPS IRMA park species list, Friends of the Kenilworth Park and Aquatic Gardens website and iNaturalist.org for more iconic species!

Pollinators Overview

Firefly

Lampyridae

Grapevine Beetle

Pelidnota punctata

Cecropia Moth

Hyalophora cecropia

Night (Nocturnal) Pollinators

Moths, bats, and beetles are widely recognized night pollinators, dubbed by many as 'night shift employees'. These pollinators are generally attracted to pale or white nocturnal flowers (i.e., those that bloom during the night). They typically pollinate plants that are skipped over during the day by other pollinators. **[14]** Nighttime pollinators are negatively affected by artificial lighting, especially in concentrated urban areas like D.C. because they mistake it for the light colored flowers they seek.

Loss of Pollinators

The spread of **invasive plant species** is a major factor contributing to undesirable landscape level change and ecosystem instability in national parks. The NPS is working to manage invasive species in park units through a suite of national and local programs. **[22]** Climate change exacerbates the invasive plant species through longer growing seasons that helps them crowd out the native plant species of the area.

The use of some pesticides and herbicides can be harmful to non-target plants due to their toxic chemicals. Use of pesticides is a last resort for NPS and all pesticides used on national park lands must be approved prior to use. **[23]**

Invasive animals—including the Emerald Ash Borer and the Gypsy Moth found in KEPA—are a threat to the natural resources and can completely reorganize an ecosystem. Climate change worsens the invasive animals issue, as changing conditions can add stress to the native plants give the invasive species an advantage.

Vegetative zones are shifting in numerous ways, causing wide-ranging impacts as a result of climate change effects. Many species are moving poleward and to higher elevations to find more suitable climates for survival.

Ways to Help Pollinators

Avoid the use of pesticides and herbicides

While these chemicals can be useful in getting rid of nasty bugs that are bothering plants, pesticides and herbicides can be harmful to pollinators and the plants. By avoiding using these chemical sprays, pollinators and plants stay healthy longer.

Compost and Recycle Your Trash

Composting is a great way to help our pollinator friends! By saving certain food and organic items in a bin, these items can then be added to the soil and help plants grow. Talk to friends and family about starting a composting bin and make sure that you recycle.

Have Conversations with Friends and Family

Talking with friends and family is a huge way to help pollinators. When people share their knowledge that they learn in the park with others, they increase the number of helpers in the fight to protect pollinators.

Volunteer with Local Organizations

A healthy environment that is free of trash is a win for everyone. There are many organizations that work to clean up communities, including the Anacostia Watershed Society, which clears trash from the Anacostia river that runs into Kenilworth Park and Aquatic Gardens.

Additionally, working with organizations that help plant trees is another great way to help pollinators. Trees not only provide so many benefits to an ecosystem, but also help to take carbon dioxide out of the atmosphere. Some trees (oaks) support hundreds of butterfly species while others (flowering trees like the Liriodendron tulipifera) generate nectar for an enormous number of pollinators.

Plant a Pollinator Garden [15]

Garden's are like mini parks filled with natural resources. Native plant gardening is a fantastic way to enjoy some national park-style nature observation without ever leaving your yard. It is and a great way to partner with the National Park Service in preserving biodiversity by offering wildlife food and shelter outside of parkland. **[16]**

For More Information

For more information about pollinator garden planting, **visit https://www.nps.gov/subjects/pollinators/helping-in-our-own-backyards.htm**

Check out the next page for more information on Kenilworth's most famous pollinator, the Monarch Butterfly

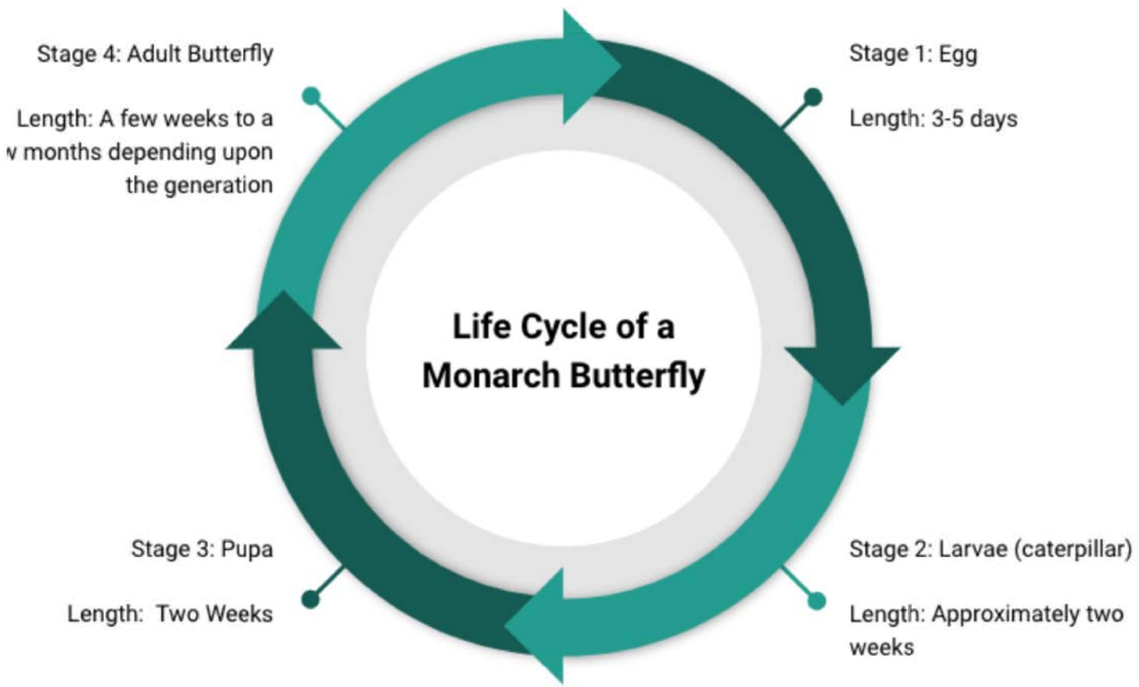
Eastern Monarch Butterfly

Monarch butterflies play an important role in the overall ecosystem. They are pollinators and also serve as a food source for many organisms, including birds and other insects. The species of butterfly found in KEPA, and throughout the US, is the Eastern Monarch Butterfly, Danaus plexippus.

Monarch butterflies not only rely heavily on plants as a food source but also as a place to lay their eggs. For Monarchs, milkweed plants are the only suitable site for laying eggs. Milkweed serves as a source of food for the caterpillars and larvae, while adult butterflies typically feed on wildflower nectar as a source of energy. The milkweed is an essential part of their diet, and while the milkweed is toxic to most organisms, it is not to the monarch butterfly.

In fact, this diet allows monarchs to become toxic themselves to other prey, which is why they have distinct colors that warn potential predators of their toxicity. **[17]**

The Eastern Monarch butterfly population has declined by 80% from 2000 - 2020, causing them to be considered for the endangered species list. This decline can be attributed to human-induced factors, such as reduction and disappearance of milkweed from herbicides and land changes, loss of their habitat due to industrialization and deforestation, and climate change. **[18]**



National Park Service

Climate Change Impacts on Eastern Monarch Butterflies

Since monarchs are sensitive to temperature and climate, climate change is affecting the biological processes of the monarch.

Changing temperatures affect their ability to know when to reproduce and migrate; when spring comes early, monarchs may head north before the milkweed has developed enough.

If they arrive before the milkweed has developed, they do not have a place to lay their eggs.

Additionally, extreme weather events—which are exacerbated by climate change—play a role in their survival. Storm surges from tropical storms and hurricanes affect not only the butterflies, but also the survival of milkweed.

Plants Overview

Overview

Plants are the primary producers of life on our planet, generating over 99.9% of the Earth's biomass. **[19]** Plants provide a variety of ecosystem services including:

Oxygen

Through photosynthesis, plants use carbon dioxide, sunlight, and water to create energy and release oxygen.

Food

Thousands of species of plants have been cultivated for consumption throughout human history.

Medicine

Many medicines are derived or modelled upon compounds provided by the natural world.

Recoverey from Natural Disasters

Plants help protect soil from erosion and release nutrients to keep soils fertile. **[20]**

Purify Drinking Water

Wetland plants, for instance, help remove heavy metals and excessive levels of nutrients.

The growth and survival of plants depend on an ecosystem characteristics including the amount of sunlight, soil moisture, soil pH, flood depth, and salt tolerance. **[21]**

There are over 400 different species of plants found in Kenilworth. This site is home to both cultivated, historic water gardens, and wild wetlands including some of the original tidal freshwater wetlands that characterized the area before a city was built.

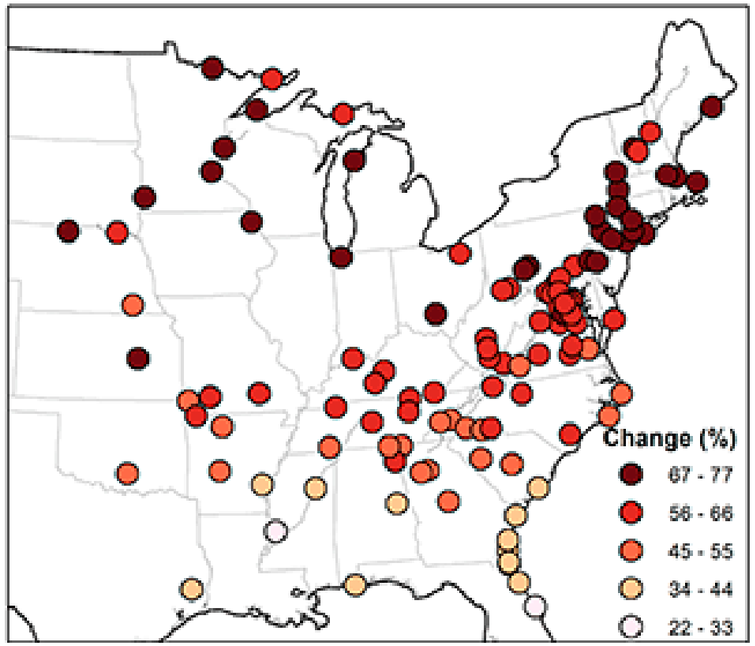


Figure 2. Total number of nonnative tree pest species with infestation zones intersecting park boundaries.

Loss of Plants

Plant species face many different problems. **The spread of invasive plant species is a major factor contributing to undesirable landscape level change and ecosystem instability in national parks. The NPS is working to manage invasive species in park units through a suite of national and local programs. [22]**

Climate change exacerbates the invasive plant species through longer growing seasons that helps them crowd out the native plant species of the area.

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Vegetative zones are shifting in numerous ways, causing wide-ranging impacts as a result of climate change effects. Many species are moving poleward and to higher elevations to find more suitable climates for survival.

Aquatic Plants

Overview

Aquatic plants live either fully or partially submerged in water. They are generally wider than they are tall, have spongy leaves, and their roots hang freely.

Some aquatic plants evolved to float in open water, while others root into soils that are partially or fully below sea level.

Common Duckweed

Lemna minor

Water Lettuce

Pistia stratiotes

Eastern Mosquito Fern

Azolla filiculoides

Floating

Floating plants have unanchored root systems that allow them to move freely with the bodies of water in which they reside. These plants vary in size from a few inches to over a foot in diameter. **[24]**

Pickelwerweed

Pontederia cordata

Green Arrow Arum [25]

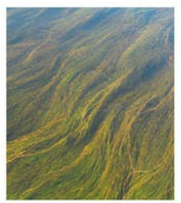
Peltandra virginica

American Lotus

Nelumbo lutea

Emergent

Emergent plants are usually partially submerged in water and are found at the shorelines of bodies of water. These plants root in the soil and their stems are firm enough to hold their weight above sea level. **[27]**



Sago Pondweed

Stuckenia pectinatus

Green Algae [25]

Phylum chlorophyta

Brittle Waternymph

Najas minor

Submerged

Submerged plants are fully submerged in water and usually reside on the bottom of rivers, lakes, and ponds. They root in the soil and their stems are held up by the water around them. **[26]**

Climate Change Impacts on Aquatic Plants

There are a variety of ways in which climate change impacts the many species of aquatic plants found in KEPA.

Sea Level Rise

As **sea level rises**, water from the surrounding areas will intrude into the aquatic ecosystems. This can bring in increased risk of saltwater intrusion, which can be harmful to plants and disrupt the overall wetland ecosystem.

Temperature Rise

Aquatic plants, especially fully submerged plants, are highly vulnerable to **temperature rises**. Therefore, there may be changes in species compositions and decline in species richness. Changes in water temperature affects the plants physiological processes, growth rates, and reproductive patterns.

Eutrophication

Eutrophication (excessive runoff of nutrients from the land) is a huge problem for aquatic plants because there is a change to the overall chemical balance of the ecosystem. Too much of one chemical, such as nitrogen, can stimulate the growth of algae, which deplete oxygen from the water and block sunlight.

Flooding

Flooding events can bring impurities into the water ecosystems. This leads to decreased water clarity, which can negatively affect photosynthesis rates.

Wetlands Can Also Mitigate Climate Change Impacts

Wetlands slow the flow of water, reducing flood damage in areas downstream and around them. **[28]**

Additionally, **wetlands have erosion control capabilities**, allowing the wetlands to absorb energy and store water during storms which reduces downstream flood damage and the risk of flash floods.

While aquatic plants are not immune to the impacts of climate change, the wetland ecosystem of which they are a part of has natural defenses to combat some of its negative impacts.

Terrestrial Plants

Overview

While land plants may look very different from one another, they all contain the same basic characteristics.

Plants differ on a variety of characteristics based on their evolutionary time scale, geographic location, and adaptation capabilities. Examples of major plant characteristic differences include vascular vs nonvascular. **[30]**

Stomata

A stoma or many stomata that allows for the exchange of gases between the plant and its environment

Waxy Cuticle

A waxy cuticle on the outside of the plant to protect it from water loss and UV radiation

Anchored Roots

Roots that anchor the plant to the soil and aid in the water exchange process

Alternate Generations

The alternation of generations life cycle, through which generations of individual plants alternate between haploid and diploid organisms.

The diploid plant (sporophyte) produces spores through mitosis. The haploid plant (gametophyte) is produced from the aforementioned spores and produces haploid gametes.

Tall Goldenrod

Solidago altissima

Cardinal Flower

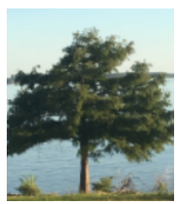
Lobelia cardinalis

Cinnamon Fern

Osmunda cinnamomea

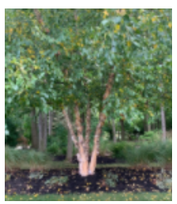
Herbaceous

Herbaceous plants are classified into three categories: annuals, biennials, and perennials. They are vascular plants, which means that they have tissue throughout the plant to exchange water and minerals. They do not have woody stems above the ground, and the top growth of the plant typically dies in the winter. **[31]**



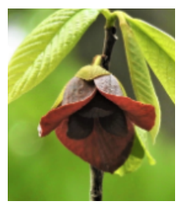
Bald Cypress

Taxodium distichum



River Birch

Betula nigra



Paw Paw

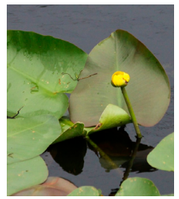
Asimina triloba

Woody

Woody Plants are plants that have hard woody stems above the ground. The vascular system of the woody plants move water and nutrients from roots to leaves and sugars from the leaves to the roots.

Woody plants are typically perennials and are much larger than herbaceous plants. Also unlike herbaceous plants, the top growth of the plant does not die back in the winter. The most easily recognized examples of woody plants include trees and shrubs. **[32]**

Terrestrial Plants



Spatterdock

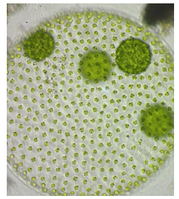
Nuphar advena

Buttonbush

Cephalanthus occidentalis

Common Haircap Moss

Polytrichum commune



Globe Algae

Volvox

Vascular Plants

Trees, shrubs, grasses, flowering plants, and ferns are all vascular plants; just about everything that is not a moss, algae, lichen, or fungus (nonvascular plants) is vascular. These plants have systems of veins (xylem and phloem) that conduct water and nutrient fluids throughout the plant. **[33]**

Non-Vascular Plants

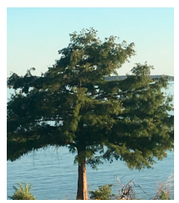
Non-vascular plants lack the conductive tissue, xylem and phloem, most plants use to transport water and nutrients. Instead, moisture is absorbed directly into cells by osmosis via membranes rather than roots. Mosses and liverworts are two common examples. **[34]**

Queen Anne's Lace

Daucus carota

Tulip Poplar

Liriodendron tulipifera



Bald Cypress

Taxodium distichum

Virginia Pine

Pinus virginiana

Angiosperm Plants

Referred to as "flowering plants", Angiosperms produce seeds within an enclosure such as a fruit. Even though they developed after gymnosperms, they are the most diverse group of land plants. Over time, insects began to use the pollen of flowering plants; the angiosperms, in turn, evolved bright petals and nectar that exploited visiting insects for the plants' own reproductive purposes. This partnership allowed insects to diversify rapidly, evolving new, specialized forms such as bees, moths, and butterflies. **[35]**

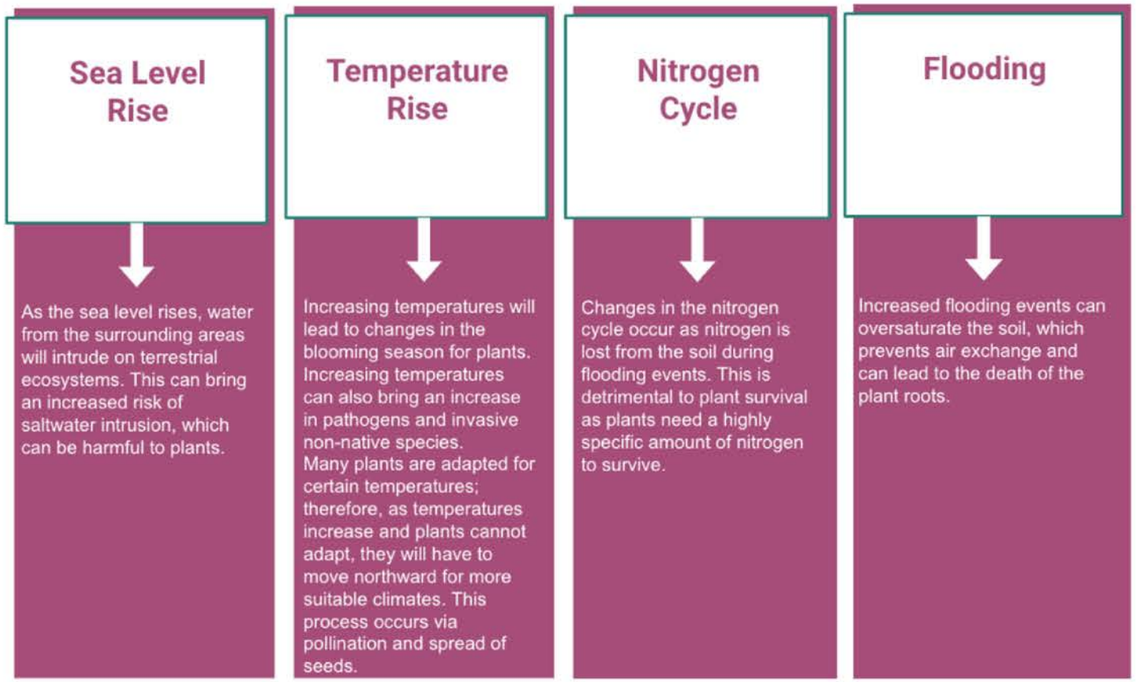
Gymnosperm Plants

Referred to as "seed plants", the seeds of gymnosperms develop on the surface of scales, leaves or cones rather than inside of a fruit. Gymnosperms, which means "naked seed", refers to the fact that the seeds of these plants are not enclosed in the ovary, as they are with Angiosperms, and these plants lack flowers. Conifers (which includes pines and cypresses) are the most well known type of gymnosperm. **[36]**

Climate Change Impacts on Terrestrial Plants

Vegetation is the biological foundation of terrestrial ecosystems and is highly influenced by environmental factors, such as soil texture, depth, and landform type. **[37]**

Climate change threatens not just the physiology of the plant, but also impacts the environmental factors that plants depend on.



Adaptation

Like aquatic plants, terrestrial plants have their own ways to adapt to a changing climate.

Seasonal plants can adapt much more quickly to a changing climate versus plants that have longer lifespans.

Some plants, including oak trees, are more tolerant to climate related stressors and are capable of keeping their stomata open to absorb more carbon dioxide than other tree species.

More Impacts of Climate Change

In the next few sections, climate change will be further discussed in the context of impacts that affect the D.C. area, health impacts, as well as answers to frequently asked questions, and tips on how to engage with visitors about climate change.

While climate change can at times seem like a 'doom and gloom' situation, it is important to note that there is still so much we can do as individuals and as collective groups to decrease the impacts of climate change.

We can still take steps to help decrease our contribution to carbon emissions and greenhouse gases to lessen the impacts that climate change will have not just on our cities and state, but also on the entire planet.

What Are Some Ways to Help Reduce Climate Change?

Rethink Your Carbon Heavy Commute

Look into alternative methods of transportation beyond just your car—walking and biking are great modes of transportation. Check out your area's public transportation options, such as a subway system, public buses, etc. If you have to use your car, consider carpooling with others!

Having Conversations with Visitors, Friends, and Family

In the next few sections, climate change will be further discussed in the context of impacts that affect the D.C. area, health impacts, as well as answers to frequently asked questions, and tips on how to engage with visitors about climate change.

Adopt a Plant Based Diet

Meat production is a known contributor to climate change, with beef production emitting four to eight times the amount of greenhouse gases than chicken or pork. **[39]**

If every American substituted vegetarian food for chicken for just one meal per week, the carbon dioxide savings would be equivalent to taking more than half a million cars off of U.S. roads. **[40]**

Plant based diets have a low carbon footprint, especially if those plants are locally grown. Make sure to check out a local farmers market, or even consider growing your own vegetable garden in your home!

Be Mindful of Your Energy Consumption

An easy way to save energy? Make sure to unplug your chargers from the electrical source when not in use. Additional ways to save on energy include checking with your energy provider and setting your thermostat to its energy saving settings (typically 75 cool in the summer, 68 heat in the winter). Switching your home to solar energy is another way to save on energy consumption.

Decrease Food Waste

In the United States, roughly 40% of food is wasted rather than consumed. **[38]** Not only is methane (a potent greenhouse gas) released when food rots in landfills, but all the emissions that go into producing food is wasted when it is thrown away.

That includes all the energy going into growing, manufacturing, transporting, and selling the food. Studies show that eliminating food waste could reduce global emissions by 11%. To reduce food waste, store food correctly and pay attention to what you throw away each week so that you can make more thoughtful purchases.

Changes in Sea Level Rise

Sea level rise is occurring on a global scale as the result of many climate change-induced factors, including glacial melt resulting from increasing temperatures, especially during the summer periods.

The melting of glaciers causes increases in sea level because the fresh water that was previously frozen and stored on a land mass melts and drains into the ocean, adding to its total volume.

Relative Sea Level Trend
8594900 Washington, District of Columbia

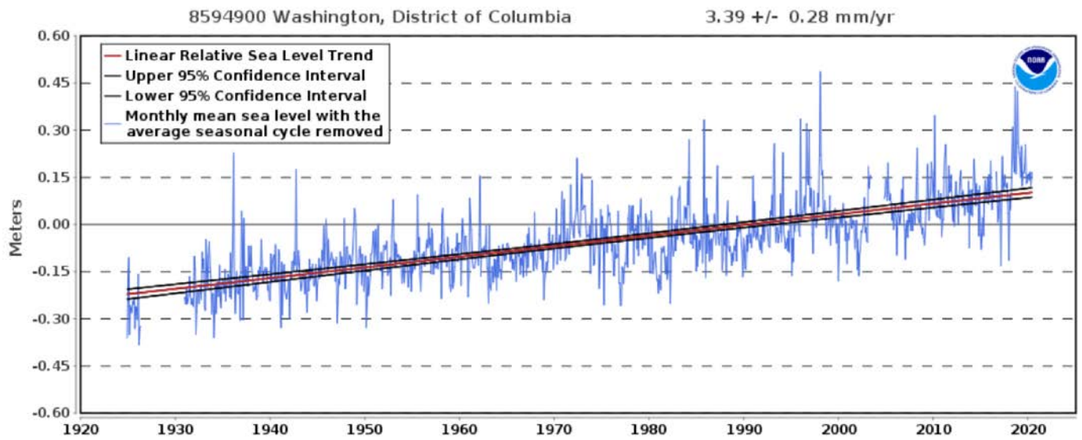


Fig 1: The relative sea level trend is 3.39 millimeters/year with a 95% confidence interval of +/- 0.28 mm/yr based on monthly mean sea level data from 1924 to 2019 which is equivalent to a change of 1.11 feet in 100 years. [41]

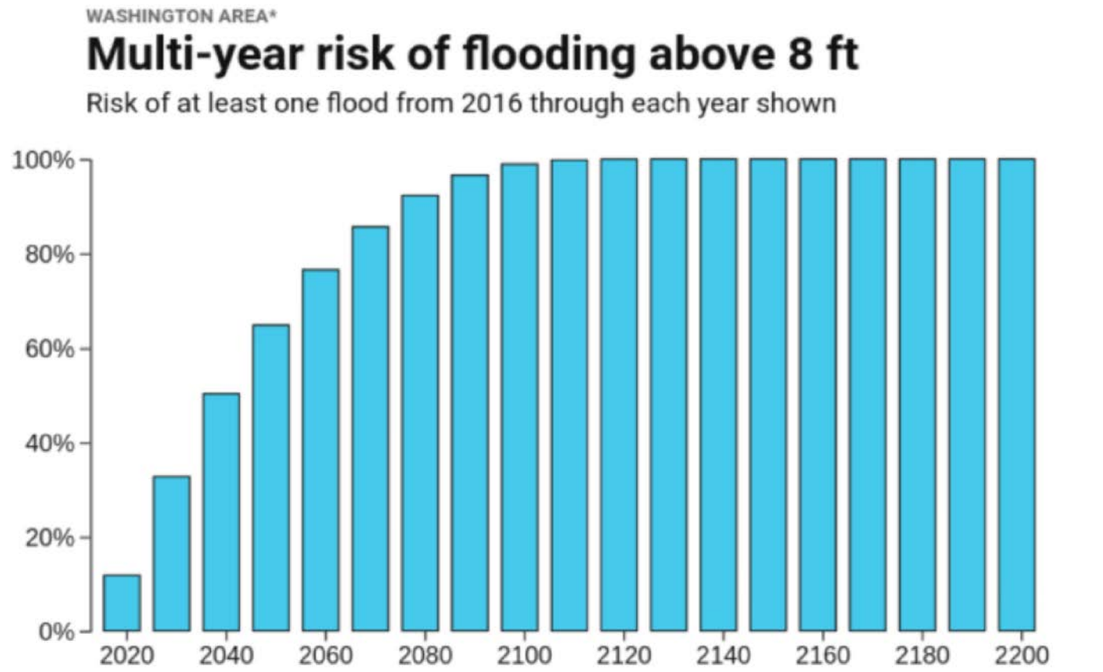
As of December 2019, the sea level in D.C. was increasing by 3.16 mm per year and is projected to increase by 1.9 -6.4 feet by the end of the century. Sea level rise is occurring at a particularly rapid rate in this region because the land bordering the Potomac and Anacostia rivers is sinking simultaneously.

Flooding

Flooding is a direct result of increased precipitation and can also be caused by storm surges. Climate change causes precipitation events to occur more frequently and with stronger intensity.

This occurs because as temperatures increase so does evaporation from the world's oceans. Additionally, a warmer atmosphere can hold more moisture.

Warming temperatures can exacerbate storms such as hurricanes. Riverine flooding is a huge risk in this area because it is surrounded by major waterways (i.e., the Potomac and Anacostia Rivers). Increases in flood events can cause pollution from stormwater runoff and soil erosion, which causes soils to lose essential nutrients. **[42]**



**At Washington water level station, 2 miles from Washington*

Analysis uses median local sea level projections based on the intermediate scenario from NOAA Technical Report NOS CO-OPS 083 (2017), intended for the 2018 U.S. National Climate Assessment. Source: Climate Central Risk Finder, 2020. http://www.riskfinder.org/

For more information about ways to decrease your carbon footprint, visit **https://climate.gov/** for the most up-to-date information.

CLIMATE CENTRAL

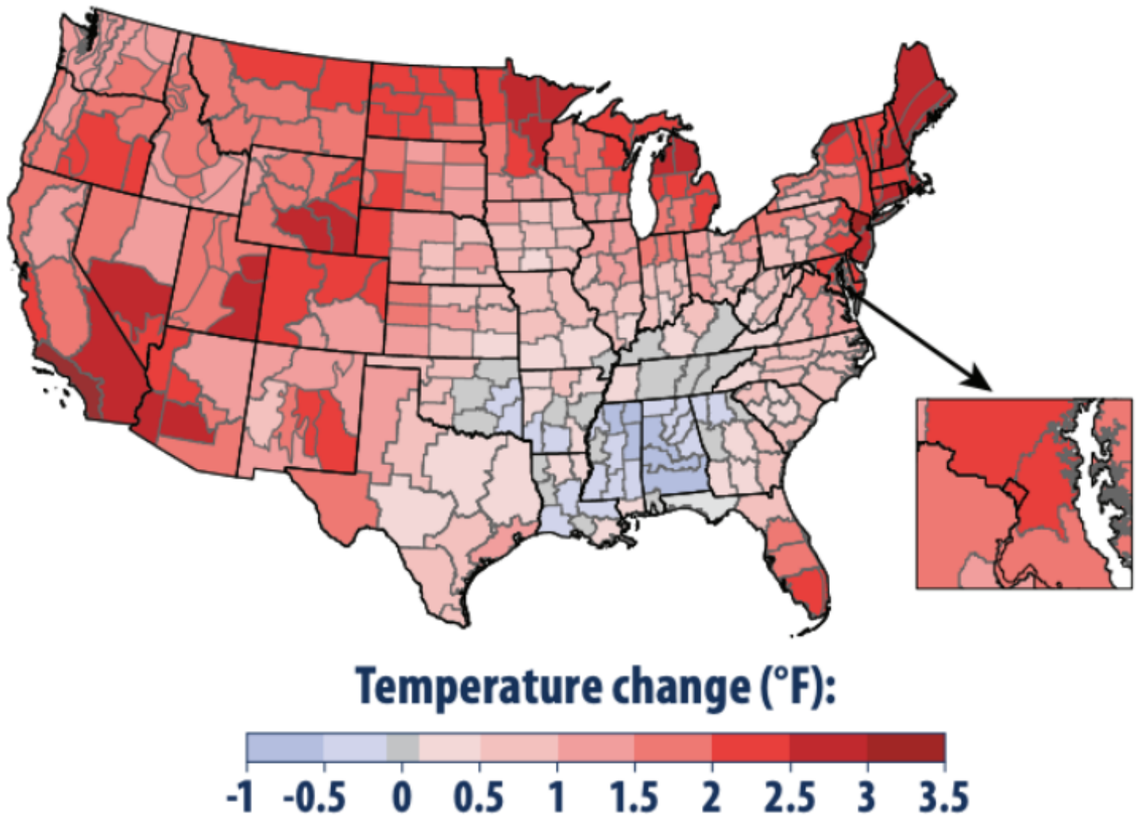
Increasing Temperatures

The Washington D.C. region has warmed by more than 2 degrees Farenheit in the last century, and all four seasons have become warmer since the 1940s.

As temperatures rise, extreme heat days (days above 95°F) will be more frequent, and heat waves will last longer.

Additionally, heat emergencies are projected to increase, as the number of days at 95°F or above will go from 18-20 days out of the current year to 40-75 days by 2080. **[43]**

This is a huge cause for concern and puts species that are highly vulnerable to high temperature changes at risk. **[44]**



Temperature Affects Park Visitation

NPS performed a study which found that warming temperatures would likely alter visitation across the National Park System.

Where, when, and how many people visit parks will likely change with continued warming. For example, visitors may avoid extremely warm months in more southern parks and the visitation season may extend across additional weeks to months in more northern parks.

Understanding potential changes in visitation based on historical trends and future patterns of temperature change is a crucial first step for park managers and local communities to anticipate, plan for, and proactively influence future visitation. **[45]**

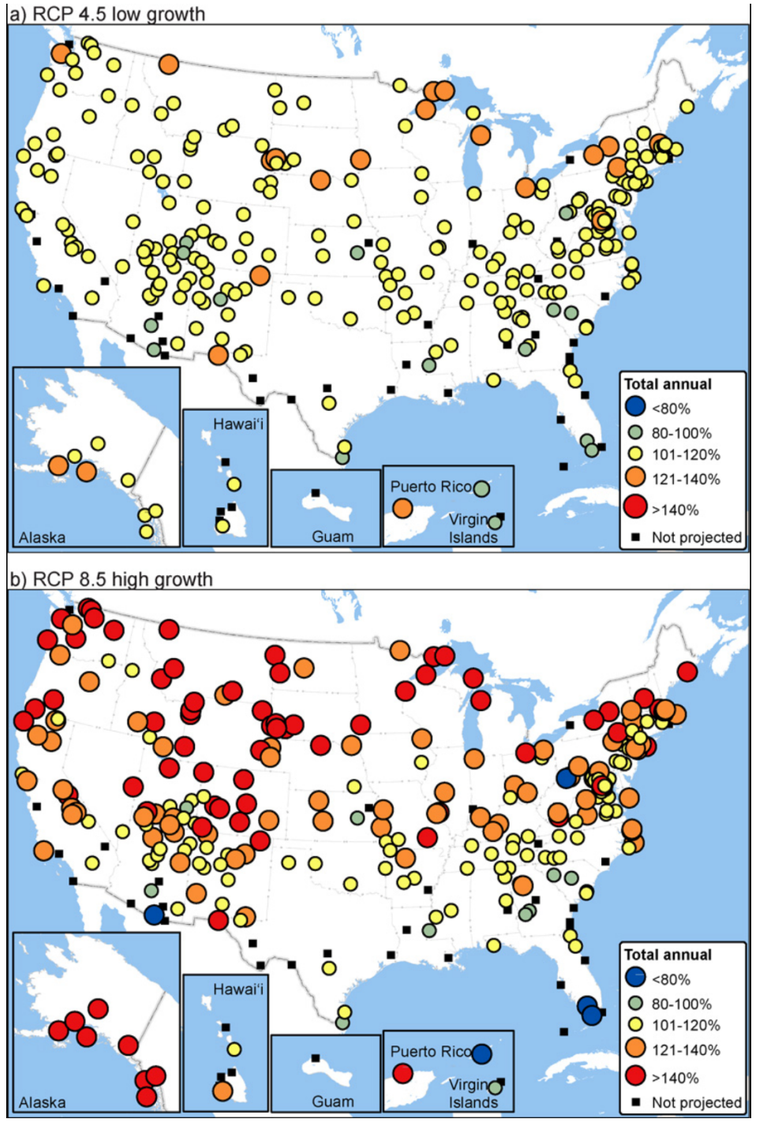


Figure 1. Potential future total annual visitation (2041-2060) expressed as a percentage of historical values (1979-2013) under two futures: a) minor warming and low visitation growth and b) major warming and high visitation growth.

Humans and Climate Change

Major Ways that Climate Change Impacts Human Health

Social Factors of Health

Increases in the frequency and intensity of both storms and flooding can result in many different types of damages, such as property damage and increases in injuries and fatalities, which can all have mental health impacts.

Intensive and frequent heat waves can lead to power outages when too many people in a condensed area like D.C. are overusing energy to combat high temperatures, especially during the night. Major power outages can lead to lessened national security if power is out for lasting periods of time.

Respiratory Illnesses (including allergens and asthma)

Increasing temperatures will also lengthen pollen season as plants bloom earlier, which can increase the frequency and severity of allergic illnesses.

Additionally, increased flooding as a result of increased precipitation events and storm surges will also lead to increases in allergens and asthma, specifically from water damage that can lead to undetected mold.

Health-Related Illness

Increasing temperatures, especially during the summer months and during the night, will lead to an increase in heat-related illnesses such as heat stroke. Those who are most vulnerable to heat related illnesses are children under five, the elderly, and the homeless.

Increases in Vector Borne Diseases

Figure 1. Reported Cases of Lyme Disease in the United States, 1991–2014

Increasing temperatures, more precipitation, and higher humidity leads to a favorable climate for the development and survival of ticks, which carry the bacteria that leads to Lyme disease. Additionally, more mild winters in this region allows for more ticks to survive the winter. **[46]**

Tips to Protect Yourself from Health Impacts

Limit Time Outside on Days over 95° F

There is already a trend of increasing heat, and the number of heat emergency days in D.C. is increasing as well. By 2080, it is predicted that there will be 40-75 days above 95° F. **[43]** 35 Washington D.C. is at additional risk because it is an urban area and is subject to the urban heat island effect.

This occurs because the infrastructure of the city, such as concrete and pavements, absorb more of the sun's energy.

Additionally, large buildings reduce air flow, which further traps the heat. These impacts, coupled with the emissions from vehicles and factories, make the city hotter during both the day and night. High heat, especially when exercising, can have many negative impacts on the body. This includes heat cramps, heat exhaustion, the inability of the body to regulate temperature, and hyperthermia.

In order to protect yourself from risk of heat related illness, know the symptoms of heat related illness. These include:

Heavy sweating

Painful muscle cramps or spasms

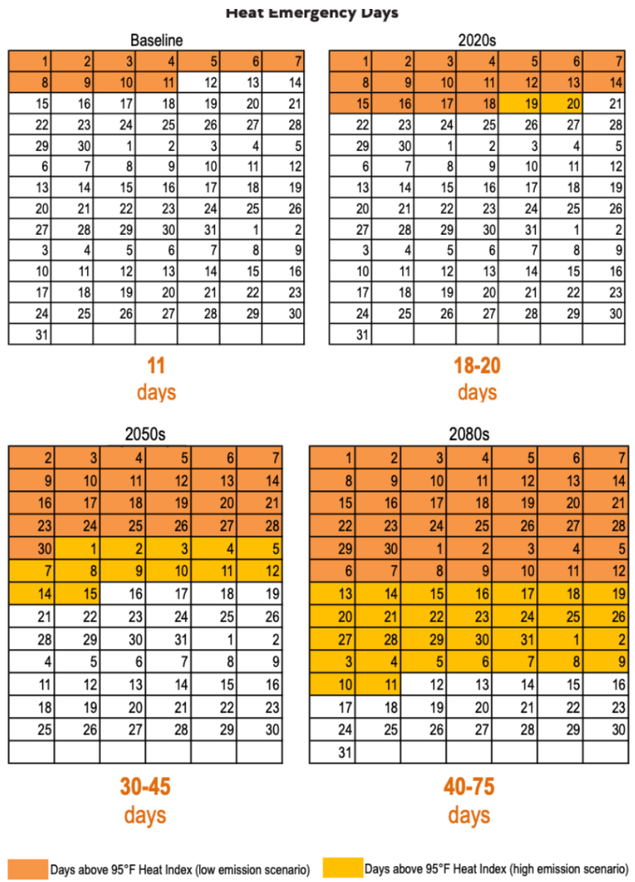
Weakness

Fatigue

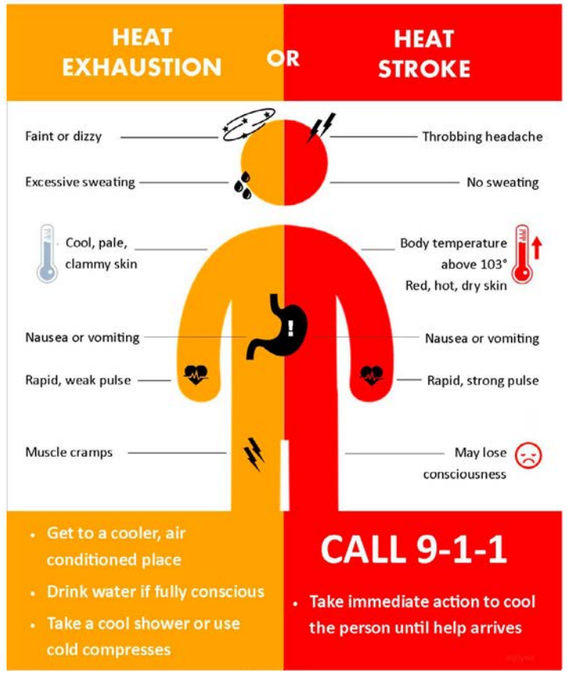
Thirst

Confusion

If you or any visitors are experiencing any of these symptoms, the CDC recommends stopping physical activity, moving to a cooler location, staying hydrated, and seeking medical attention if these symptoms worsen or last longer than an hour. **[47]**



Humans and Climate Change



How Can I Further Reduce my Risk to Heat Related Illness?

Keep hydrated throughout the day

Replace old air conditioners in your home

Consider planting a green roof at your work or at home
Plant trees or build shade areas in locations with large amounts of sunlight

See if your city has a heat emergency response plan and register with them to stay up-to-date on safety tips and heat warnings

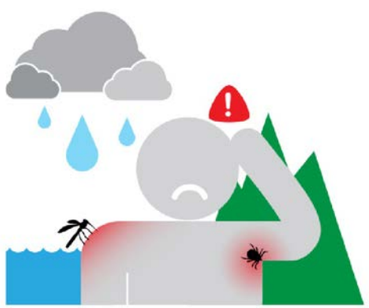
[Source: USDA and US Forest Service]

After Flooding Events, Keep an Eye Out for Possible Mold Growth

Mold growth is a large concern after flooding events, especially in damp dark areas of the home such as basements, walls, and carpets.

Mold can have a variety of color and smells, and can be easily spread. Those most vulnerable to the health effects from mold include children, the elderly, people with compromised immune systems, and pregnant women. **[48]**

It is important to identify mold early in order to prevent the spread of mold spores across the home and to limit human exposure.



[Source: CDC]

Check for Ticks After Spending Time Outside

Avoid ticks and other bites by wearing insect repellent or making sure to cover all exposed skin. Have a friend or family member check your skin for ticks after spending time outside, especially if you were in a wooded area. **[49]**

Frequently Asked Climate Change Questions

Q: What is the difference between weather and climate?

A: Weather is the day to day changes in the atmosphere, which includes temperature, precipitation, humidity, wind, and more.

Climate, on the other hand, is the average weather of a certain geographical area (i.e., local, regional, national, or global) over a period of time (generally 30 years).

Q: My winter is getting colder- how is climate change real?

A: There are some regions of the world where winters are getting colder, but on average global winter temperatures are increasing.

Q: Does the sun cause climate change?

A: While the sun warms the earth through radiation, it is not directly causing climate change.

The Earth goes through periods of warming and cooling in a natural 11 year cycle, but the temperature increases we see today are increasing beyond the natural cycle due to emissions of

Q: What can I do to help combat climate change?

A: There are many different ways an individual can help decrease the impacts of climate change.

Encourage park visitors who ask this question to decrease single plastics use, enjoy more plant based meals, green their commute by walking, biking, or carpooling, decrease food waste, volunteer with local organizations, and plant their own park.

Q: Do scientists agree about climate change?

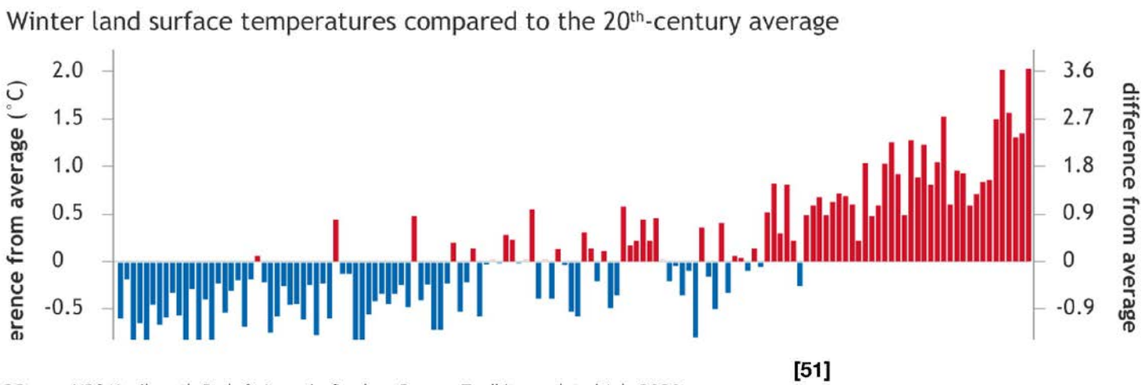
A: Yes, 97% of scientists agree that climate change is occurring and is human-caused. **[50]**

Q: How have humans caused climate change?

A: Since the industrial revolution, humans have been producing greenhouse gases at an alarming rate. Greenhouse gases are compounds that trap heat that should have been re-emitted back into the atmosphere, therefore warming the Earth.

One of the most well known greenhouse gases is CO_2, which is emitted by burning fossil fuels such as coal and wood, solid waste products, and biological products such as trees. **[52]**

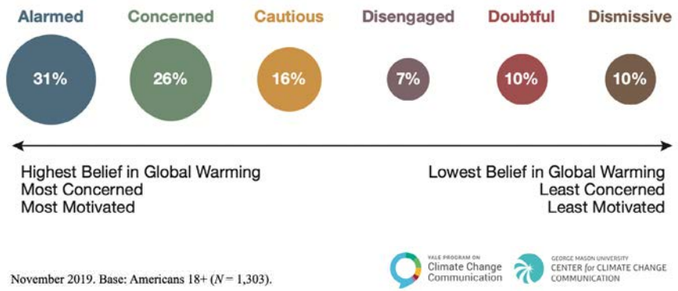
Figure Average Global Land Surface Temperatures from 1680 to 2020. Image Source: NOAA



[51]

Best Practices for Climate Change Communication

Tips For Having Conversations With Park Visitors About Climate Change



[53]

When talking with the **alarmed group**, which is already motivated and worried about climate change, encourage them to take steps in working towards a more sustainable future, such as suggesting things they can do on an individual level to decrease their carbon footprint, but also ways to get involved on a larger scale such as volunteering with organizations.

The **concerned group** knows that climate change is happening, but has less of an urgency to act as compared to the alarmed group. With this group, talk about ways in which KEPA is working towards minimizing its carbon emissions, and also ways in which the ecosystem is able to adapt to a changing climate. Additionally, explain the ways in which the park will be changed due to climate impacts, from the overall landscape, to the plants and pollinators, and all in between.

The **cautious group** believe that climate change is a problem, but are less convinced than the previous two groups that it is human caused, and have less urgency about this issue. With this group, explain that climate change is real, human caused, and happening now. Once again, explain the ways in which the park will be changed due to climate impacts, and how the park is responding to a changing climate.

The disengaged typically have the widest range of questions about climate change- from questions about causes, its effects, and overall evidence of its existence. Show these visitors ways in which the park is being impacted already by climate change, such as explaining major decreases in the Monarch butterfly populations due to climate impacts. Further explain what the NPS stance on climate change is (found at the beginning of this guide), and why they are working to reduce their carbon footprint.

When talking with the d**oubtful group**, establish consensus about climate change (97% of climate scientists agree that human caused climate change is occuring). Additionally, an effective way to communicate with this group is to emphasize that energy conservation is an effective way to save money.

The **dismissive group** are highly convinced that climate change is a hoax, and feel as though they are very well informed on this subject. It is important to remain polite with this group, and maintain a positive message. Explain to them the concrete examples of climate change impacts happening in the park so they can see the changes for themselves. **[54]**

Best Practices for Climate Change Communication

Additional Tips For Conversation For All Audience Members

Use Place-Based Education

Connect the large scale impacts of climate change with observable changes to the local environment. KEPA is a great site to take advantage of place-based education because it is already experiencing the impacts of climate change and is a beautiful natural environment that visitors will experience and be compelled to protect. **[55]**

Use the Inoculation Theory Approach

When visitors present you with a false claim about climate change, first start the discussion by explaining how and why their information is false. People are more likely to listen and change their opinion if they know exactly how their previous information was incorrect through providing counterarguments which bring up the flaws of a specific argument. **[56]** Check out the "FAQs About Climate Change" section of this tool-kit for some of the most talked about climate myths.

Strike When the Iron is Hot

If park visitors mention interest or alarm about climate change, mention some of the tips provided in this tool-kit for mitigation and adaptation techniques. Giving people the tools and information on how to make change will help keep them activated and motivated.

Conversation Starter

Start conversations with the phrase "I didn't know this until just recently, but___" when presenting new climate information to visitors. This way, the park visitor does not feel ignorant for not knowing this information.

Collaboration is Key

Encourage people in groups to work together and do not underestimate the importance of peer power! **[58]** When many people work together, small actions take on a larger significance.

Simple, clear messages repeated often from a variety of trusted sources

Climate change can be a very complex topic, but by explaining concepts in a simple and clear way, park visitors are more likely to understand the message, and therefore, have a better chance of having a lasting impact on them. **[57]**

For example, many sources describe climate change as "warmer, wetter, and weirder". It is a simple and clear message that allows the audience to remember and understand that climate change is making the Earth warmer, wetter, and the planet is changing.

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