Environmental Issues in Yellowstone National Park

Elijah Scott
Macey Dvorak
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Introduction

The purpose of this analysis is to look at two different environmental issue currently present in Yellowstone National Park, as well as to provide recommendations based on a resilience analysis for each issue, those issues being aquatic invasive species and air pollution. As the first national park established in the United States in 1872, the complex and rich history of Yellowstone serves as an example for hundreds of other units of the NPS across the country. By focusing on their environmental issues, the work in Yellowstone can serve as framework for numerous other parks on how to approach such issues, especially in light of climate change. Similarly to the nationwide influence of their fire management policy, which is still a sociopolitical issue continuing today, as well as they face increasing overtourism, another issue, Yellowstone has the ability to act in the face of uncertainty. In doing so, change to protect biodiversity, as well as promoting broad sustainability, can occur.

Recommendations

In order to best approach these environmental issues, Yellowstone can begin by continuing the work by their Invasive Plants Management Team to work towards preventative measures towards the impacts of invasive plants on soils. Along with this, educational programs should increase in order for tourists to approach the park in a way which does not further spread invasive species. Finally, further research can be done to map out where exactly many invasive plants reside within the park, as currently knowledge in this realm is still currently lacking. In relation to air quality, Promote Sustainable Transportation Options for Visitors: To reduce vehicle emissions, encourage the use of electric shuttles, carpooling, and biking within the park. Installing more electric vehicle (EV) charging stations at popular visitor centers and campgrounds can incentivize visitors to choose lower-emission transportation options. Other parks, like Zion National Park, have implemented shuttle systems with great success, reducing emissions and traffic congestion (National Park Service [NPS], 2023). Implement Visitor Education and Awareness Programs: Educate visitors on how their actions impact air quality and encourage eco-friendly behavior. Interactive exhibits, signage, and online resources could highlight the benefits of reducing vehicle use and the importance of preserving air quality for both visitor health and ecosystem sustainability. Research shows that visitors who understand their environmental impact are more likely to make sustainable choices (Environmental Defense Fund [EDF], 2022). Continuous Monitoring and Adaptive Management: Expand the current air quality monitoring network to gather more comprehensive data on emissions sources and pollution levels throughout Yellowstone. This data is essential for tracking the success of interventions and adapting strategies as tourism patterns change. By maintaining a robust monitoring program, Yellowstone can respond to emerging challenges quickly, ensuring the protection of its air quality over the long term (United States Geological Survey [USGS], 2022).

Issue #1 - Invasive Species

Overview

A number of terrestrial and aquatic species threaten the biodiversity of Yellowstone, as well as the existence of their native species (NPS, n.d.). Along with this, tourists have shown interest in mitigating the spread of invasive species, yet also coupled with concern on how this wildlife viewing opportunities may be impacted (Warthin, 2024). Invasive species directly threatens the nature the park hopes to promote care of through tourism, and simultaneously protect.

Terrestrial

- Canada Thistle
- Dalmatian Toadflax
- Houndstongue
- Leafy Spurge
- Ox-eye Daisy
- Spotted Knapweed

Aquatic

- New Zealand Mud Snails
- Red-rimmed Melania
- Zebra mussels
- Lake Trout
- Smallmouth Bass
- Asian Carp
- Asian Clam
- Eurasian Watermilfoil

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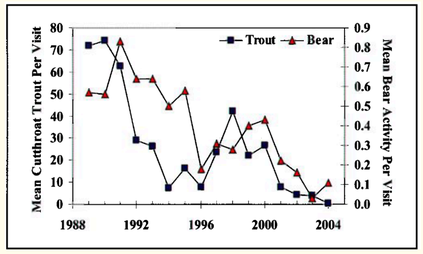
Relevant Data



Koel et al., 2005

Lake trout, an invasive species in the lakes of Yellowstone, have not just an impact on the native cutthroat trout but as well as impacts on consumers. With 1/3 of anglers who visit Yellowstone fishing in Yellowstone lake, and the average number of cutthroat trout caught decreasing from 2.0 to 0.1 over a time period of just 6 years (1998-2004) impacts on tourists are significant as well (Koel et al., 2005)

Resilience Analysis

Vulnerabilities

- The historical context of the park introduced a large amount of aquatic and terrestrial invasive species, starting in the 1800s (NPS, n.d.). This allows the park to have this issue at all, and creates further vulnerabilities for its native species.
- More recently in the park, zebra mussels have been introduced as well as soil erosion has increased overall due to the impact of invasive species (NPS, n.d.).

Assets

- A mandatory 30 day boat dry period has begun in order to prevent the spread of zebra mussels, showing the quick response reflected in park policy (NPS, n.d.).
- Tourists have showed a positive public perception towards preventative measures which occurred in the park in order to mitigate the spread of invasive species (Warthin, 2024).

Response

- Further research and mapping of terrestrial invasive species can and should occur, allowing the park to better approach issues (Western Geographic Science Center, 2023).
- Educational opportunities for tourists visiting the park, as well as those virtually exploring should be offered to prevent spread.

Relevant SDGs

15 - Life on Land - "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" (UN, n.d.)

- The existence of many aquatic species are directly threatened.

14 - Life Below Water - "Conserve and sustainably use the oceans, seas and marine resources for sustainable development" (UN, n.d.)

- The habitat of many native plants are being influenced by invasive species.

4 - Quality Education - "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all" (UN, n.d.)

- Effective education informed by scientific consensus must occur to mitigate spread of invasive species by tourists, applying to both aquatic and terrestrial species.

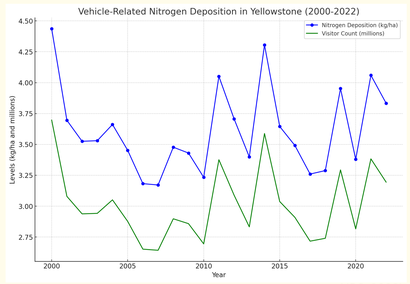
Issue #2 - Air Pollution

Overview

Yellowstone National Park welcomes over four million visitors each year, which brings significant economic benefits but also environmental challenges. Tourism-linked activities, including vehicle emissions, recreational vehicles, campfires, and increased commercial services near park entrances, contribute to air pollution levels within the park (NPS, 2023). With so many visitors, even seemingly minor sources of pollution accumulate and have a large impact. The majority of visitors rely on personal vehicles, RVs, or tour buses to navigate Yellowstone's vast landscapes, resulting in heightened emissions of carbon dioxide (CO_2), nitrogen oxides (NOx), and particulate matter. This consistent influx of vehicles impacts air quality, especially near popular sites like Old Faithful and the Grand Prismatic Spring. Studies have shown that vehicle emissions can directly degrade local air quality, affecting visibility, ecosystem health, and visitor experiences (NPS, 2023).

https://mooseradio.com/yellowstone-national-park-air-quality-still-unhealthy-100/

Relevant Data



NPS, 2023)

This graph shows the nitrogen deposition levels in Yellowstone from 2000 to 2022, reflecting increased nitrogen compounds in the air that correlate with rising visitor numbers and vehicle traffic. Nitrogen oxides (NOx) from vehicle exhaust contribute significantly to nitrogen deposition in the park, which disrupts soil chemistry and harms sensitive plant species (National Park Service [NPS], 2023). Peaks in deposition levels align with years of higher tourism, suggesting a direct link between vehicle emissions and air quality.

Resilience Analysis

Vulnerabilities

- The park's high altitude makes particularly vulnerable to air pollution; pollutants like nitrogen and sulfur are deposited faster at high elevations, harming sensitive ecosystems (NPS, 2023).
- Sensitive alpine ecosystems, already stressed by climate change, are vulnerable to increased air pollution (Copeland et al., 2021).

Assets

- Established monitoring programs track air quality changes over time, an asset for adaptive management (Doe & Brown, 2020).
- Yellowstone's extensive vegetation and unique landscape offer natural carbon sequestration benefits, helping to offset pollutants (Beartooth Capital, 2021).

Response

- Yellowstone's air quality monitoring programs are a key response measure, allowing scientists to track pollution levels, study impacts on flora and fauna, and adapt management strategies (United States Geological survey, 2022).
- Initiatives like monitoring nitrogen deposition levels and vehicle restrictions to control pollution sources (NPS, 2023).
- Visitor education on minimizing pollution during park visits (Doe &Brown, 2020).

Relevant SDGs

13 - Climate Action - "Take urgent action to combat climate change and its impacts" (UN, n.d.).

- Air pollution from greenhouse gases directly affects climate, altering local temperatures, snowpack, and water levels in Yellowstone (Intergovernmental Panel on Climate Change, 2023).

15 - Life on Land - "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" (UN, n.d.).

- Pollution degrades ecosystems, affecting species survival and contributing to biodiversity loss. Yellowstone's sensitive habitats make it a critical area to preserve under SDG 15 (UN Environment Programme, 2023).

3 - "Good Health and Well-being - Ensure healthy lives and promote well-being for all at all ages" (UN, n.d.).

- Visitors and nearby communities are exposed to harmful pollutants, linking air quality with health outcomes (CDC, 2023).