STATS 401 Project 2 Report - Fauna Loss

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Introduction

This project aims to discover the knowledge of fauna loss, especially among African mammals. It contains a case study to find possible causes of rhino loss and explore people's opinions. We selected this topic due to the severity of animal extinction – numbers have fallen by more than half since 1970, and species are going extinct at an alarming rate (World Wildlife Fund, 2021). Though fauna loss is the disappearance of animals, it is a problem that is closely related to our human life and is happening everywhere around the world. To comprehensively study this global challenge and raise people's awareness of it, we crawled data from multiple sources and visualized them by D3.js and Python.

Method

Table 1 summarizes the data source, the data cleaning and analyzing method, and the visualization tool we adopted for each visualization.

Vis No. #	**Data Description**	**Cleaning/filtering/analysis**	**Vis tool**
1	Source: Our World in Data (https://ourworldindata.org/) • Agricultural land per capita • Proportion of forest area within legally established protected areas • Share of important terrestrial biodiversity sites that are protected • Coverage by protected areas of important sites for mountain biodiversity • Population density • Proportion of important sites for freshwater biodiversity that are covered by protected areas	Filter the data by selecting the year from 2000-2020. Map the name of the country into the longitude and latitude of it to draw the map.	D3.js
2	*Source: Red List (https://www.iucnredlist.org/search/list)* • All African mammals (~1500 entries) with attributes describing the categorical information, endangered level, population information, etc.	We filtered by order name and kept species that were relatively familiar to the public (~500 entries). We kept the following attributes: order name, family name, species name, endangered level, and population trend.	D3.js
3	*Source: Red List (https://www.iucnredlist.org/search/list)* • The species name and endangered level of nine African mammals: wild dog, black rhino, chimpanzee, scimitar-horned oryx, lion, red fox, footed bat, savanna elephant, and jaguar.	We processed the images with pixelate technique. The size of the pixel was decided by the endangered level.	D3.js, Photoshop

4	*Source: International Rhino Foundation (https://rhinos.org/)* • Number of poached rhinos from 2006 to 2017 *Source: Our World in Data (https://ourworldindata.org/deforestation)* • African agricultural land per capita from 2000 to 2018 *Source: National Centers for Environmental Information (https://www.ncdc.noaa.gov/cag/global/time-series)* • African surface temperature anomalies from 1974 to 2017	Found the significant events of rhino worldwide and attached them to the corresponding year.	D3.js, Python
5	*Source: keywords (rhino) crawling from Twitter posts using Python.*	1. Cleaned the non-related posts. 2. Calculated the sentiment score of each post and categorized it into extremely negative/negative/neutral/positive/extremely positive using NLP by Python. 3. Calculated the overall sentiment score for each year based on the categorization (extremely negative:-2. negative:-1; neutral:0; positive:1; extremely positive:2).	D3.js, Python

***Table 1.** Data Table*

Results and Evaluation

1. Geographical Map of Influential Factors

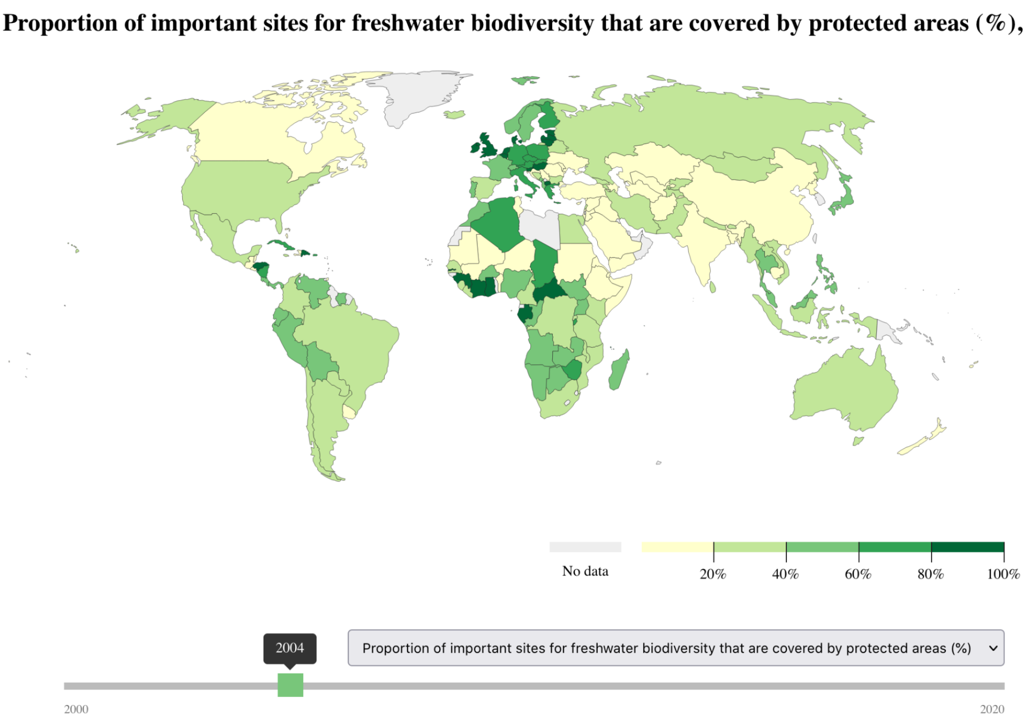

Figure 1. *Visualization 1*

This geographical map illustrates the worldwide geographical distribution and time-series variation of the factors that potentially could influence the animal population. In this way, users could get a basic sense of the background situation of fauna loss and come up with potential causes in mind.

This graph is efficient to achieve its goal and user tasks through proper channels and multiple interactions. The color of countries is a magnitude channel reflecting the value level for each parameter. Users could find the general value distribution, compare between different regions, and find extreme values. They could locate and retrieve specific values to get detailed information about particular countries by covering the mouse. Besides, to discover the time-series variation and trend, users could drag the time bar from 2000 to 2020 to see the map in a particular year, where the title and map would change according to the year they selected. Further, this visualization allows direct parameter change through a drop-down menu. Users could choose among the population, protected areas, agriculture lands, etc. (6 in total) to comprehensively understand the global ecosystem conditions.

This map provides results from worldwide, while we will mainly focus on the results of Africa due to the general goal of this project. Firstly, the population density of Africa continues to increase from 2000 to 2020, which indicates the increased effect of human activities in those areas. However, we are also able to see positive signs that humans are taking action. The agricultural area per capita decreases in many African countries, suggesting that humans' expansion of lands has been mitigated over the years. The proportion of essential sites for freshwater biodiversity covered by protected areas in Namibia, Gabon, Ghana, and many other African countries has increased by about 40% since 2000. Besides, coverage by protected areas of important sites for mountain biodiversity and crucial terrestrial biodiversity sites have increased by about 20% in many African countries (e.g., Zimbabwe, Niger). In the last 20 years, all these changes have shown us that effective regulations and actions are taken in Africa to foster animal protection.

2. Hierarchical Relationship and Endangered Levels

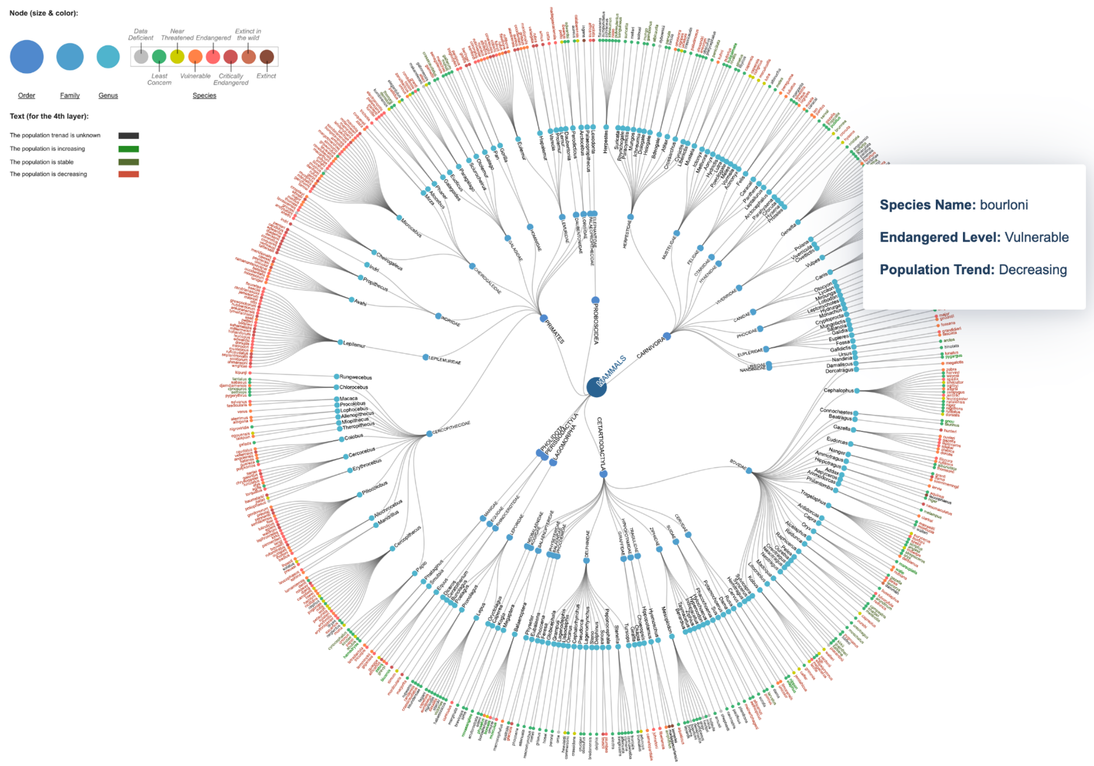

Figure 2. *Visualization 2*

Animals with similar categories are more likely to have similar living conditions and habits. So, their population could change simultaneously when changes happen. Therefore, in this visualization, we aim to explore the hierarchical relationships among endangered animals and discover whether the level of fauna loss is associated with species relationships. We made this network circular because this is a more aesthetic way to visualize many data points in a limited space than the horizontal/vertical structure.

This network can efficiently realize the visualization goal by clearly providing categorical (hierarchical) information and conveying the endangered information. We used a hierarchy tree to classify these endangered animals. From the center of the network to the edge, each layer represents a hierarchy level commonly used to categorize animals: order, family, genus, and species. We used the size channel and color channel to encode data attributes. The higher the hierarchy level is, the larger the node size is. Our color-coding choice is based on common sense that green represents "safe" and red means "dangerous" (see the legend on the top left corner of Figure 2). For example, endangered level "least concern" and an increasing population trend is represented by green and endangered level "extinct", and a decreasing population trend is characterized by red.

Two interactions are added to the network to improve user experience considering that the texts beside the node are relatively small. Firstly, a tooltip will pop up when users hover their mouse on the species node, introducing the detailed information (name, endangered levels, population trend) of that species. Secondly, users can zoom in/out and drag the entire network to obtain different views of this graph.

From this network, we can observe some relationship between the extinction of animals and the genus they are in. For instance, the species under Piliocolobus and Lepilemur are all endangered or critically endangered. Besides, we can also see that the population of most of the endangered animals has been decreasing in recent years. Cheirogaleus, Propithecus, and Avahi, for instance, are suffering a dramatic decrease in the population.

One possible direction for future works is adding species' photos into the tooltip. In this way, users can have a more intuitive understanding of that species.

3. Pixel Photos of African Mammals

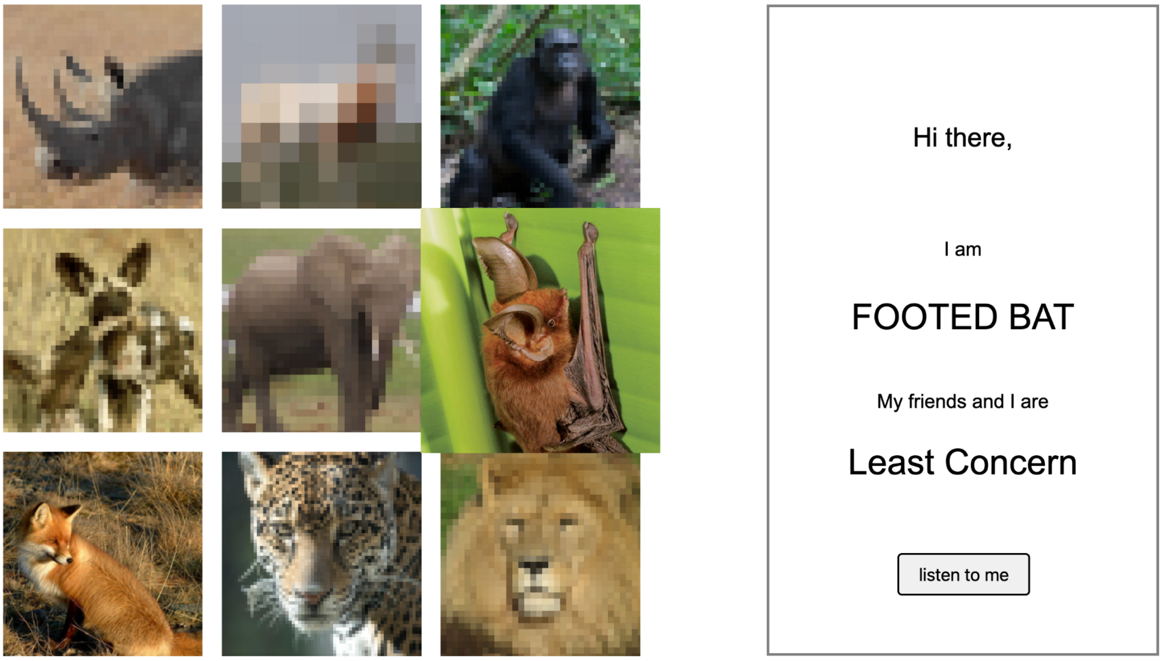

Figure 3. *Visualization 3*

This visualization is designed to discover the different endangered levels of some mammals in Africa intuitively and interestingly and raise people's awareness of fauna loss. It incorporates pixels of 9 endangered mammals in Africa, where the blurrier the picture is, the closer this spice is to extinction.

This visualization is efficient since it allows creative interactions for users. By clicking each blurred image, users could see the original explicit version of that picture and know the name and endangered level of that animal. This visualization incorporates multi-sensory information by returning funny audios for each animal when clicking on the voice button, which provides users with an immersive experience.

These pixels are intuitive and thought-provoking, leaving deep impressions on viewers who are not familiar with the actual situation in the world. Seeing these pictures of animals disappear, ranging from transparent to vague, viewers can know how we destroy the beautiful creatures in the world. Besides these night animals, there are thousands of endangered animals we are not familiar with that are suffering even more than that. These pixels are made to establish empathy between humans and these animals to warn viewers that fauna loss is getting severe.

4. Line Chart of Rhino Population

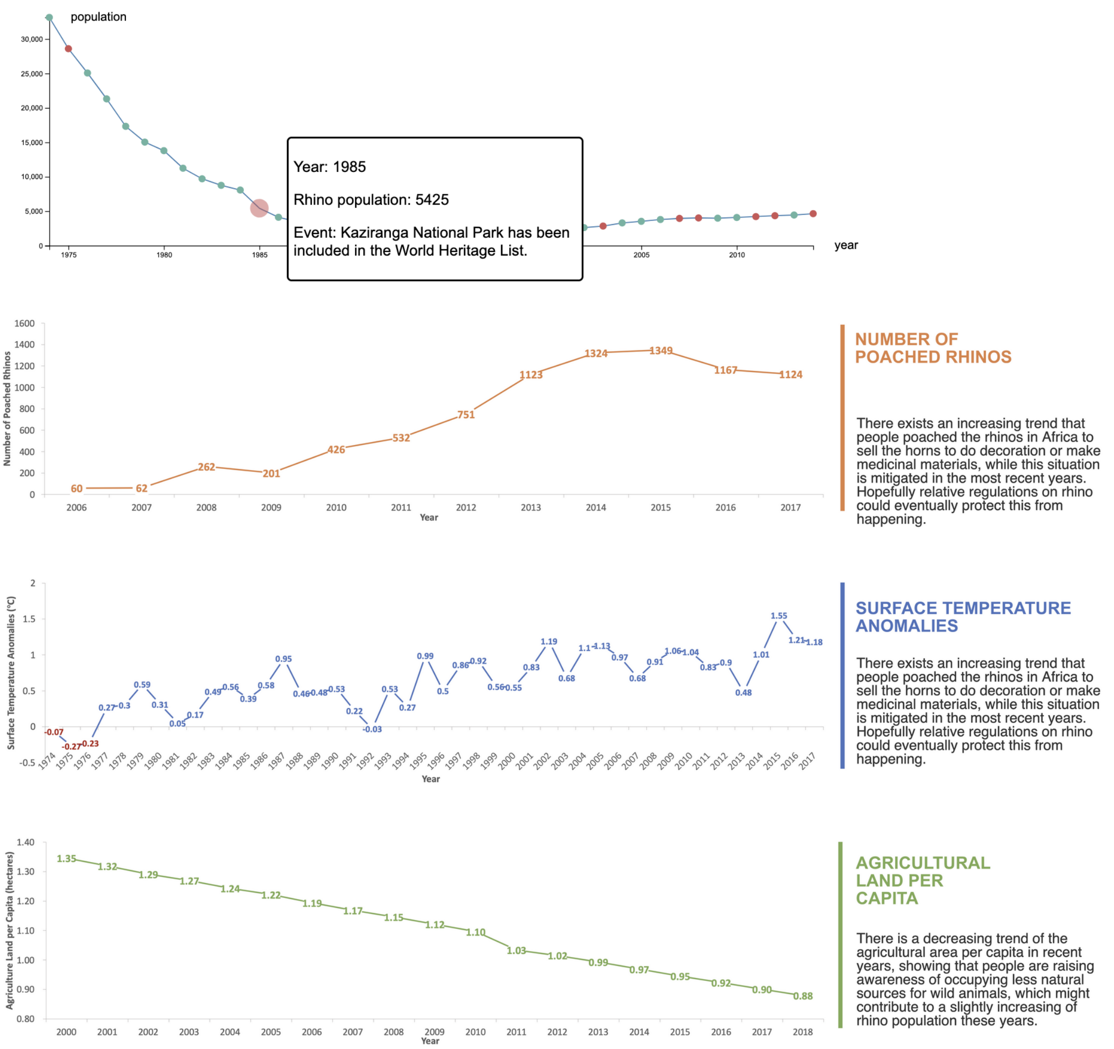

Figure 4. *Visualization 4*

This visualization aims to discover factors that influence the population change of the animal we chose for our case study: rhino. We used line charts to visualize rhino population change over years and factors that could potentially cast influences on the rhino population (e.g., temperature, poaching). We further interactively labeled human activities that related to rhinos with a tooltip. Users could hover on each dot to view detailed information (year, population, events). The hovered dot will become more significant to help highlight. Users can explore factors that significantly affect the rhino population by comparing the line chart of the specific element to the population line chart at the top. Users can zoom in/out and drag the top line chart to other positions to facilitate the comparisons.

Our visualization is efficient from both its content and design idiom. It contains both internal and external factors that potentially impact the rhino population, which provide users with a more rounded understanding. Besides, we labeled data on the node for the last three graphs, which allows users to efficiently perform tasks like retrieving the value, finding extremum, etc. Labeling the years that contain special events with a different color also stimulates users' willingness to explore more.

From this visualization, we could find that the changes in the rhino population are closely connected to human activities and have little relationship with the forest areas or farming area per capita. For example, in 2007, negotiations between three countries for black rhino translocations began. During these years, the population of rhinos has increased from 1536(almost extinct) to 3954. Humans should learn from past protecting processes to save more lives in the world we live in.

5. Twitter Post and Sentiment Analysis

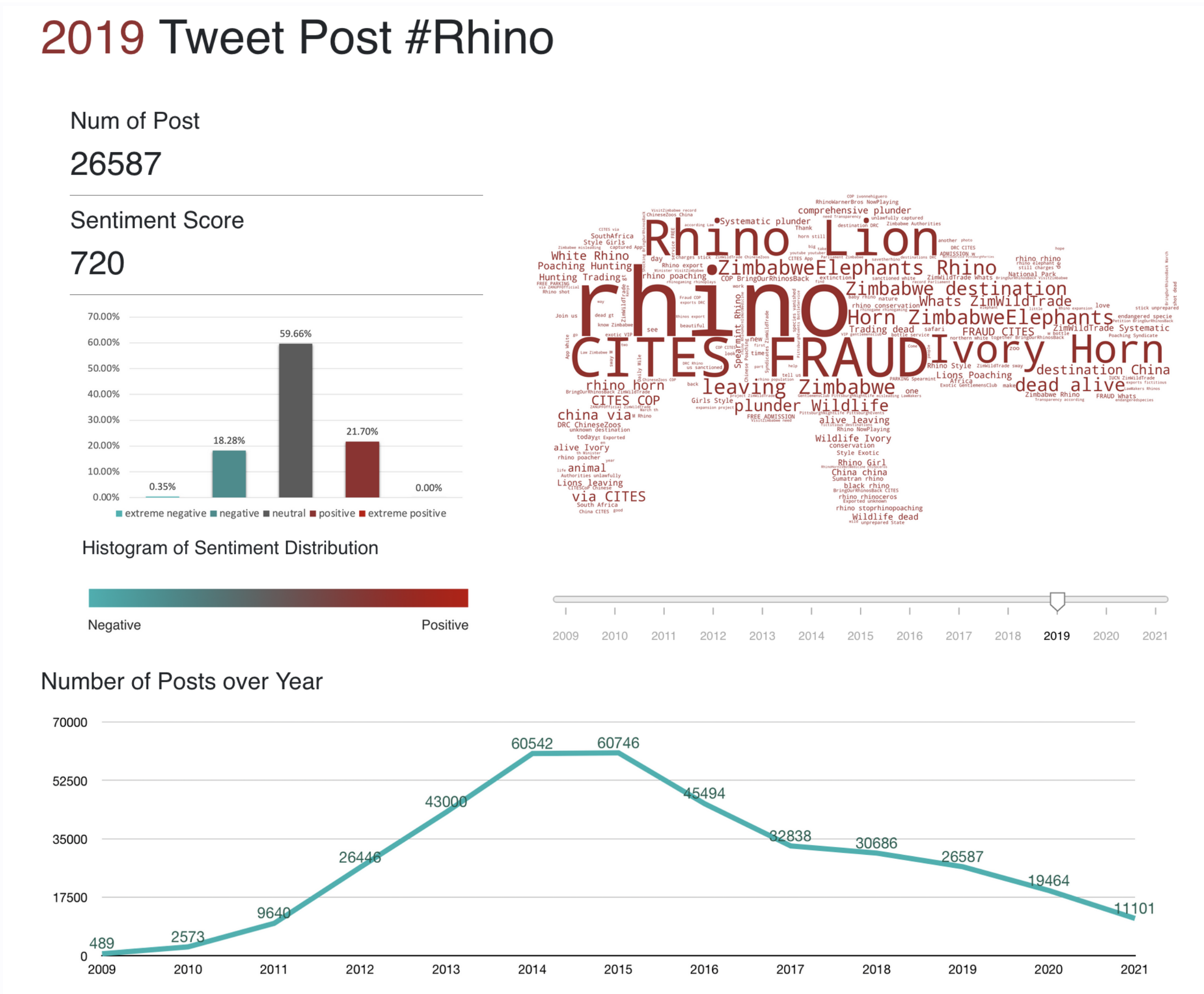

Figure 5. *Visualization 5*

This visualization mainly utilized word clouds, bar charts and a line chart to discover people's opinions towards and significant events related to "rhino" over the years through keywords and sentiment analysis. The word clouds collect the most common words in Tweet posts related to “rhinos” that have been specially made in the shape of a rhino to be more attractive and vivid.

This visualization efficiently achieves its goal and allows multiple explorations for users through different elements in an interactive dashboard. We measured the unquantifiable feelings of the public using NLP. We displayed them using the color channel, with a gradient ramp from green, grey to red, mapping the sentiment from negative, neutral to positive. The size of each word is proportional to the frequency of appearance, through which users could quickly discover the social cognition of rhino in that year. Users could also zoom and drag the word cloud to see some short terms. The number of posts, sentiment score, and sentiment distribution of each year are shown on the left, through which users could get detailed information, retrieve values and discover the distribution for each year more comprehensively and intuitively. Besides, users could compare different years and find the general trend by dragging the time bar. Moreover, a line chart of the number of posts each year is displayed at the bottom to give an intuitive distribution from 2009 to 2021 to users to discover the popularity of the “Rhino” topic among the public.

We could witness a fluctuation of the rhino posts from 2009 to 2021. In 2014 & 2015, the number of posts reached a peak. Through further research, we found that in 2015, 41 years’ old northern white rhino Nola was dead, and there are only three northern white rhinos left in the world. The near-extinction of one widely known species caused a heated discussion in social media. However, public awareness of this topic decreased dramatically in 2 years. Besides, from the color of the word cloud, we could discover that people held negative views of rhino protection from 2009-2012 & 2016-2018. In 2009-2012, the rampant poaching activities in Africa made people desperate for rhino protection. Later, as the government stepped in, people began to hold positive views on the survival of rhino species. However, the death of the last northern white rhino Sudan in 2018 turned the situation severe and made people’s attitudes fall to the bottom.

A limitation of this graph is that some non-related words are still in the word cloud each year, though we have tried our best to clean them. An advanced algorithm is expected to find in the future to look into posts and clean them better.

Conclusion

Our visualizations mainly focus on the topic of fauna loss worldwide, especially in Africa. We approached this topic broadly from the world view and gradually narrowed it down to a case study on rhino, an African mammal. On balance, we have found that animal protection is rugged where the population of many endangered animals is still decreasing. However, people’s awareness of Fauna loss has continued to increase in recent years, and practical actions have been taken. This visualization can not only serve as a useful tool for knowledge exploration but also raise the public’s awareness on this topic and call on immediate steps to prevent animals from extinction.

Word Count: 1950

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