Did We Save Our Tigers?

CPSC 547 Information Visualization Project Proposal

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Abstract

This project proposal presents an explainer article to be implemented as a web page, about tiger conservation efforts in India. The purpose of the article is to provide people with a visualized and interactive approach to wildlife conservation, allowing them to view and analyze trends in tiger population data. This can help in providing a better habitat and effective conservation measures, to help save this endangered species. The data for tiger population is obtained from tiger conservation campaigns run in India and the article provides multiple interactive visualization idioms to analyze this data.
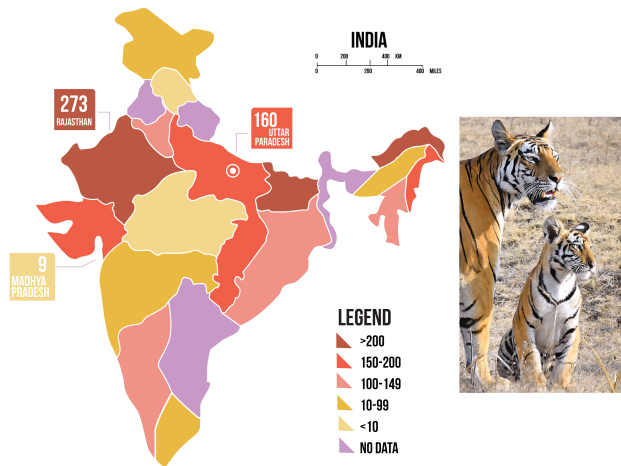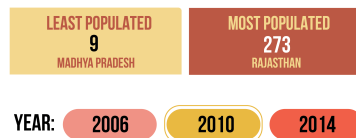
Figure 1: A proposed visualization: Choropleth showing population of tigers for a particular year. 'Tigers' image on the right is sourced from Status of Tigers in India 2018.

1 Introduction

Since the turn of the century, climate change and increasing population have contributed to the endangerment of several wildlife species, but few have been as severely affected as tigers. They have lost over 95% of their historical range, and from over 100000 tigers in the 1900s, we are down to less than 4000 tigers left in the wild presently. That is a 96% drastic decrease. Three subspecies have gone extinct, a fourth mostly extinct in the wild. Although trade in tiger parts is internationally banned, illegal tiger trade still accounts for a big part of a $20 billion/year illegal wildlife market. With their habitat under increasing threat from agricultural developments, deforestation and climate change, it should come as no surprise that confirmed breeding populations exist in only 8 countries worldwide (Panthera.org, World Wildlife Fund). However, after a century of decline, overall wild tiger numbers are starting to tick upward. India, that accounts for over 70% of the tiger population, has had major success with their tiger conservation efforts (World Wildlife Fund).

1

Project Save Our Tigers, a joint initiative between WCT, NDTV, Aircel and Sanctuary Asia, took off in 2008, and has implemented multiple stages of their conservation program in collaboration with governmental and non-governmental organizations to bring the tiger population in India back from the brink of extinction (Aircel). This has been just one of several tiger conservation efforts implemented by the country's central government to save its national animal. The extremely low number of 1411 tigers in 2006 is what spurred the Indian government into action, and based on current data, the tiger population now stands at 2967, more than double of that in 2006 (BBC News). This has been one of India's most successful wildlife conservation projects.

The goal of this project is to visualize the tiger population over the years in India, based on governmental data. These visualizations will include both static and interactive idioms. The end goal is to use these visualizations to help find out the extent to which these efforts were successful and in addition how they can be improved in the future to safeguard the tiger population. As wildlife conservation enthusiasts, we were keen to work on a wildlife visualization project. While we are not wildlife experts, we hope to develop significant insights into this conservation effort and provide possible recommendations for the same.

2   Related Work

There has been significant research into tiger conservation by non-governmental and governmental agencies, as well as international organizations like the World Wildlife Fund (WWF). The Indian government also established the National Tiger Conservation Authority, a governmental body with the sole aim of tracking tiger populations. While there has been much data that has been gathered from the works of these organizations, there is a lack of visualization tools that can effectively communicate this data. None of them have worked on visualizing tiger populations or detecting and predicting trends to aid conservation efforts.

There have also been several publications in the domain of tiger conservation. Conservation priorities for endangered Indian tigers through a genomic lens by Natesh et al. [2] in 2017 aims to identify conservation strategies based on genomic structure. Connectivity of Tiger (Panthera tigris) Populations in the Human-Influenced Forest Mosaic of Central India by Joshi et al. [1] in 2013 analyze and suggest management strategies for tiger corridors. These efforts are guided towards tiger conservation but they do not implement any data visualizations in order to analyze historical population numbers.

3   Data

The tiger population data is obtained from the Indian government website and is available for the years 2006, 2010 and 2014. In addition, we have recently found the data for the year 2018, which will be included in the visualizations (the sample visualizations provided in Section 5, do not have this year included yet). The existing data consists of the following:

- Region and states in India where tiger populations exist and are counted. We are more interested in visualizing the state wise population. The data is available for 23 states in India.
- The number of tigers in each state with an upper and lower bound.

The data is essentially ordered as we have counts for the tiger population which is the main data attribute. The region or states on the other hand are categorical attributes. In addition, derived data such as increase or decrease in tiger population compared to the previous year or percentage increase or decrease per state, will be computed for visualization.

4 Task

The aim is to provide an explainer article which is implemented as a HTML web page. For this, in addition to providing the relevant background and importance of future wildlife conservation practices, several visualizations are designed from the data, to address the following main tasks:

1. Overall analysis: This enables visualizing trends in tiger population over time for all the states. The user can see an overview of the entire data, identify interesting trends and also the maximum and minimum values of tiger population.
2. Comparative analysis: This enables visualizing the comparison of tiger population between multiple states over time.
3. Increase and decrease: Visualizing the relative change in tiger population with respect to the previous year, where the current year can be selected by the user.
4. Spatial data visualization: This enables visualizing tiger population on a geographic map of India.

The above tasks will provide a comprehensive overview of the tiger population data. All of the tasks can be abstracted to the 'analyze' category. Under the analyze category, we want to allow the user to consume information. The tasks can further be categorized into 'discovering', since we are designing for a user who wants to know whether the campaign to save the tigers was successful. Additionally, they can be categorized to 'present' because the visualizations will enable the user to tell a story about the tigers. Overall, this enables the user to study the data effectively, by seeing trends, drastic changes and comparison of conservation efforts between different states and the results which lead to an increase or decrease in tiger population over the years. Analyzing this information from visualizations, provides more insight which helps in improving the decision-making process, for future measures to be taken and implemented to conserve endangered species like tigers.

To achieve the above tasks, both static and interactive visualizations will be designed and plotting categories as described below will be used:

- For spatial visualizations, interactive color-coded choropleth maps will be plotted with data representing either the tiger population count or the increase and decrease in tiger population.
- Interactive scatter plots and line charts also provide a good way to visualize and compare data.
- Bar charts can be used to visualize data statically or as a racing plot where the changes in tiger population over the years for each state is shown with a live animation. These are particularly useful for showing the overall picture of the entire data for multiple years.

The sample sketches for the proposed visualization idioms and their corresponding details like marks, channels and information which is being visualized is provided in the next section.

5 Proposed Solution

We aim to have a total of approximately six interactive visualizations spread out throughout the explainer article, developed using HTML, CSS, Plotly.js and Altair. All code will be shared and updated on a common repository to enable collaboration. Proposed visualization idioms are shown below.

5.1 Idiom 1

We propose a color-encoded choropleth map of India, with the color channel showing the approximate population of tigers in each state, as shown in Figure 1. In this graph, the area mark is used to encode the states. The identity channel color hue is used in combination with the color saturation magnitude channel to encode the states and the tiger populations. Hovering over the state should enable a pop-up that can show the exact number for that year. An interactive button allows users to switch between different years. This allows users to see which regions across the country have the largest populations, thus enabling discussions about conservation efforts in states with lower numbers.
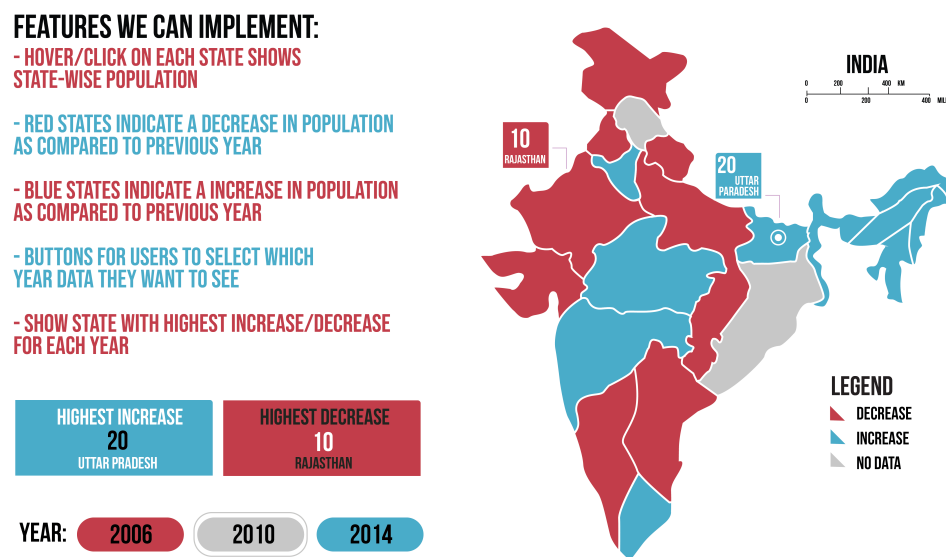
5.2 Idiom 2

Figure 2: Choropleth representation showing increase or decrease compared to previous year.

We propose a color-encoded choropleth map that uses only two colors to show either an increase or a decrease in population compared to the previous year, as shown in Figure 2. In this graph area mark is used to encode the states in combination with color hue identity channel to encode increase/decrease. We intend to use colour-blind inclusive shades to reach a wider audience. Similar to the previous idiom, hovering on the state could show the exact increase or decrease. This allows users to see which regions or states across the country are seeing increase or decrease in populations, thus enabling discussions about conservation efforts in states with declining numbers.
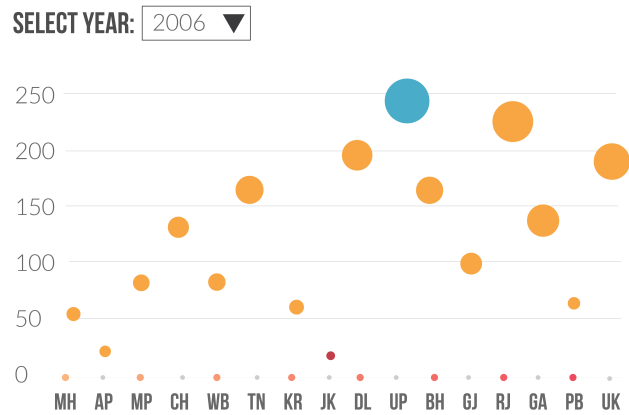
5.3 Idiom 3

Figure 3: Scatter plot showing population for each state for a particular year.

We propose a scatter plot with the X-axis encoding the states of India and the Y-axis encoding the population, as shown in Figure 3. This graph uses point marks and the vertical and horizontal spatial position to encode the tiger population in each state. Another attribute is color to encode the max/min populations and the visual channel of size to redundantly encode the tiger population per state. An interactive drop-down menu would allow users to select which year they want to see the data for. This would allow users to see which states have the largest populations.
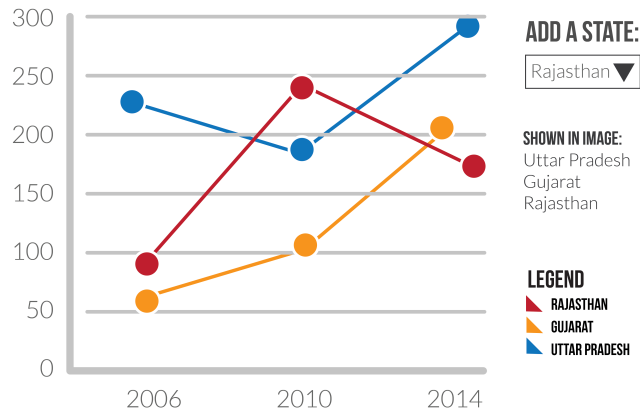
5.4 Idiom 4

Figure 4: Multiple line charts to allow comparison between populations across multiple states.

We propose a line chart that shows the year on the X-axis and the population of tigers on the Y-axis, as shown in Figure 4. This graph uses point marks, connections and the vertical and horizontal spatial position on the common scale. Users can add multiple states for comparison via a drop-down menu, and the color channel would be used to encode the states. This would allow users to view trends across states over time. A limit of maximum 6 states can be viewed at a time.
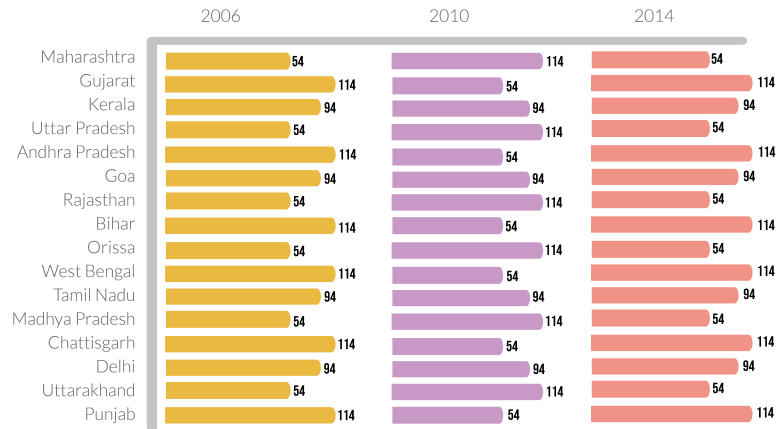
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5.5   Idiom 5

Figure 5: Cumulative bar chart showing entire dataset in one idiom.

We propose a cumulative horizontal bar chart that has the years on the X-axis and the states on the Y-axis and shows the population for each state for each year using a line mark, as shown in Figure 5. This graph uses the vertical and horizontal spatial position on the common scale channel, and the color channel. Additionally, the line mark is used with a length channel to encode the tiger numbers for each sate. The color channel allows for easy differentiation between each year, and can further be used to show states with least and most tiger populations. This presents the user with an overview of the entire dataset in one image. If time permits, we would like to add a hover functionality on each line mark that could show the trend for that state over all the years in a line chart.
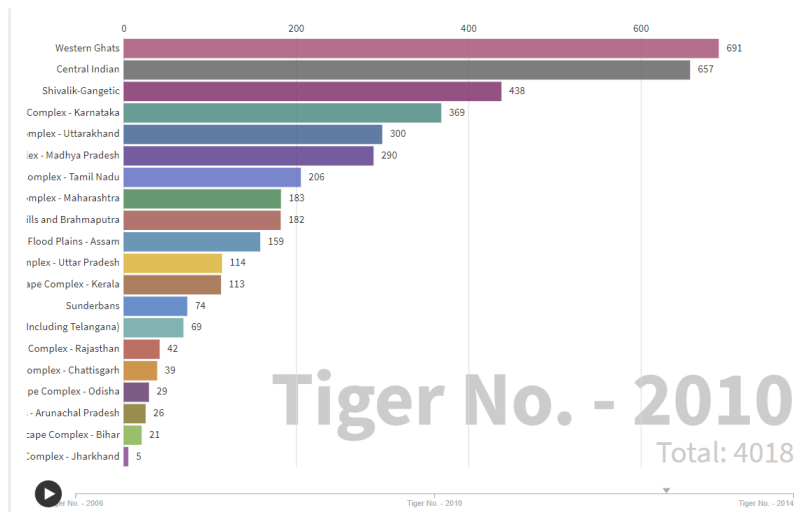
5.6   Idiom 6

Figure 6: Racing bar chart to show cumulative increase of tiger population over time.
Reference: website

We propose a racing bar chart that has the tiger population on the X-axis, and Indian states on the Y-axis, as shown in Figure 6. This graph uses the vertical and horizontal spatial position of the common scale channel, and the color channel. The color channel is used to differentiate between different states. Additionally, the line mark is used with a length channel to encode the tiger numbers for each state. The chart would be in the form of a looping animation that would show the gradual increase/decrease in tiger population for each state over time, as well as the cumulative increase/decrease. The animation would allow states to move up or down, showing the increase or decrease of each state in a more dynamic manner.

6 Usage Scenario

6.1 Task 1: Visualizing trends in tiger population over time

Imagine, as a wildlife conservationist, you want to know whether tiger populations in India have actually increased post the implementation of nation-wide conservation efforts. You would like to know which states have had the most success with such efforts, and which states are still seeing a decline in tiger population. You also want to know if there has been a steady or drastic change over the years, and if there are particular states that need more intensive conservation policies. Hence, you want to see the population changes over time.

Scenario 1: You use Idiom 4 (Figure 4) to visualize data. You select the state you want to see the data for. A line chart is shown with circle marks showing the exact population over the years. Based on the shape of the line, you can analyze whether there has been a steady/drastic increase/decrease in the tiger population. You further want to compare several states in the Northern region of India. You click on the drop-down list and continue to add more states, and see multiple line charts, each colored differently, allowing you to see trends over specific regions as well. You can now analyze which states need better policies, and how effective the campaign has been.

Scenario 2: You use Idiom 6 (Figure 6) to visualize the data. The dynamic bar chart shows the population of tigers across all the years. You can see states sliding up and down depending on the increase/decrease of tiger populations. Based on the arrangement of the states at any given point, you can see which states are faring well or poorly in their conservation efforts.

6.2 Task 2: Visualize the population across the country for a particular year

Imagine, as a wildlife conservationist, you wish to view the tiger population for each state in a particular year. You would like to know which state has the most population, and which state has the least. You can then analyze why in that particular year certain states have seen an increase/decrease in populations, and what measures can be taken for the same.

Scenario 1: You use Idiom 1 (Figure 1) to visualize data. You are presented with a choropleth map that uses the color channel to show approximate populations for each state. You can view the states with most and least populations directly, as well as select the year using buttons. Hovering on each state gives you the exact population for that year. You can further see trends across regions in the country, based on the color encoding. You can thus analyze what changes are needed in existing policies and what events across the year may have caused such changes.

Scenario 2: You use Idiom 3 (Figure 3) to visualize data. You are presented with a scatterplot graph that shows the population of each state in a particular year. You can select the year from a

drop-down list. The color encoding allows you to easily see which states have the most or least populations for that year. You can also analyze correlation between land area of particular states and population in that state. This allows you to view the population per year and analyze which states need improved policies, and reasons of increase/decrease in particular years.

7 Milestones and Schedule

The planned milestones and schedule are given in Table 1.

Deadline	Task to be completed
October 23, 2020	Submit project proposal
October 30, 2020	Have an initial prototype of all visualizations completed
November 10, 2020	Have a second, interactive prototype of all visualizations completed
November 17, 2020	Finalize visualizations and present update
November 24, 2020	Refine visualizations and draft initial report and explainer article
December 1, 2020	Have final explainer article and report ready for peer/instructor review
December 10, 2020	Have final report and explainer article with embedded interactive visualizations ready
December 14, 2020	Submit final report

Table 1: Milestones and Schedule

8 Discussion, Future Work and Conclusions

Our interactive explainer project aims to raise awareness about tiger conservation efforts. By providing multiple interactive visualization idioms, we hope a wide range of users can benefit and enjoy from the variety of options to interact with the data. Further, based on our data, we hope to find trends and analyze how conservation efforts have fared in several states and regions in India over time and where such efforts might need to be improved. We also hope that analysis of such data helps emphasize the need for conservation data to be more easily available on public forums.

For future work, we would like to perform such analysis on a global scale, and for multiple species. We hope such projects raise awareness about wildlife conservation while also helping every wildlife organization and governments, analyze and improve their conservation efforts.

References

[1] Aditya Joshi, Srinivas Vaidyanathan, Samrat Mondol, Advait Edgaonkar, and Uma Ramakrishnan. Connectivity of tiger (panthera tigris) populations in the human-influenced forest mosaic of central india. *PLoS ONE*, 8(11):1–11, 11 2013.

[2] Meghana Natesh, Goutham Atla, Parag Nigam, Yadvendradev V Jhala, Arun Zachariah, Udayan Borthakur, and Uma Ramakrishnan. Conservation priorities for endangered indian tigers through a genomic lens. *Scientific Reports*, 7:9614, 2017.