INFO 247 Information Visualization and Presentation

Final Project: Loop - A closer observation of endangered animals
Final Writeup

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Project Goals

In both the worlds of animals and plants, there are now 41,415 species on the IUCN Red List (endangered species list), and 16,306 of them are endangered species threatened with extinction. This is up from 16,118 last year. We sense the urgency to raise awareness around this issue by engaging viewers to wildlife conversation.

As part of our MIMS Capstone project where we designed an interactive immersive game called "Loop" to teach young children at age 5-10 about concepts of "balance in Nature", and "human's relationship with other living species". After kids play the game, we would like to provide a data visualization platform for parents and people to learn more about wildlife protection.

Our goal is :
1. **To make the data about wildlife preservation easier for parents and the public to grasp**
2. **To provide guidance for parents to open up the conversation with young children about the topic**
3. **An inspiration for parents and children to take action in wildlife conservation.**

To accomplish this goal, we built an interactive website to visualize the data with contents including:
- An interactive world map presenting the most threatened and endangered species by country
- Visualization to closer observe the composition of threatened species in each country
- Visualize the 3 main threats faced by these animal species
    - Habit Loss
    - Poaching
    - Climate change
- Visualization story of 3 represented endangered animals
    - Orangutan
    - Amur Leopard
    - Leatherback Turtle
- Activities and games that encourage parents and children to participate in.
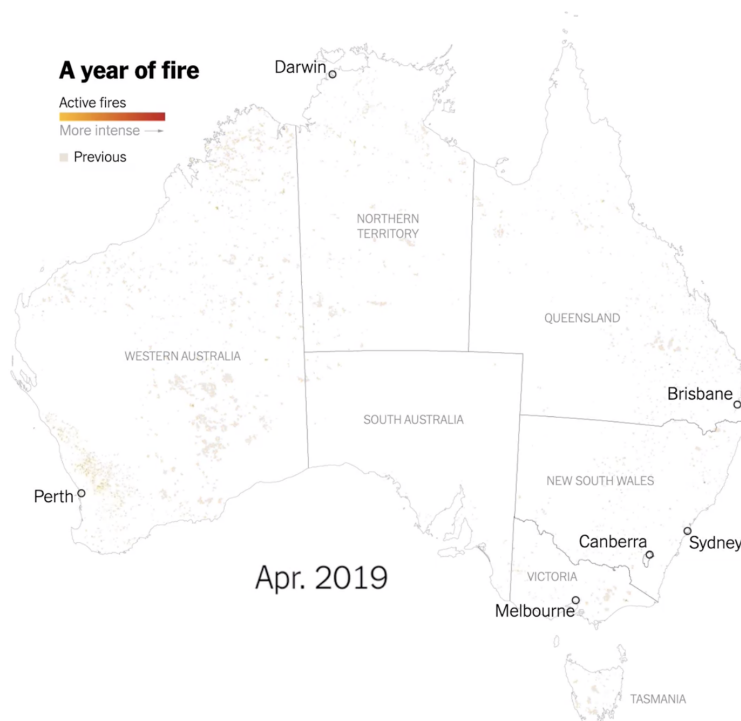
Related Work

1. Esther Jan

   We found several existing websites and resources related to the topic of animal preservation,

   a. [The Year in Climate by New York Times](#)

   I wanted to use a world map view to show how the status of endangered wildlife changed over the years. I found this example about climate change from the New York Times, which is sort of related to our topic.


   Example of map visualization in The Year in Climate

   This visualization used a simple color palette (Yellow to Orange) to indicate the fires that happened in Australia throughout the year. The map kept the information simple by fading the outline of the country to make the highlight of locations more obvious.

   Since the information related to wildlife conservation has more data compared to our example, I also decided to choose a simple color palette

(Orange and red for endangered species) that is consistent with the other
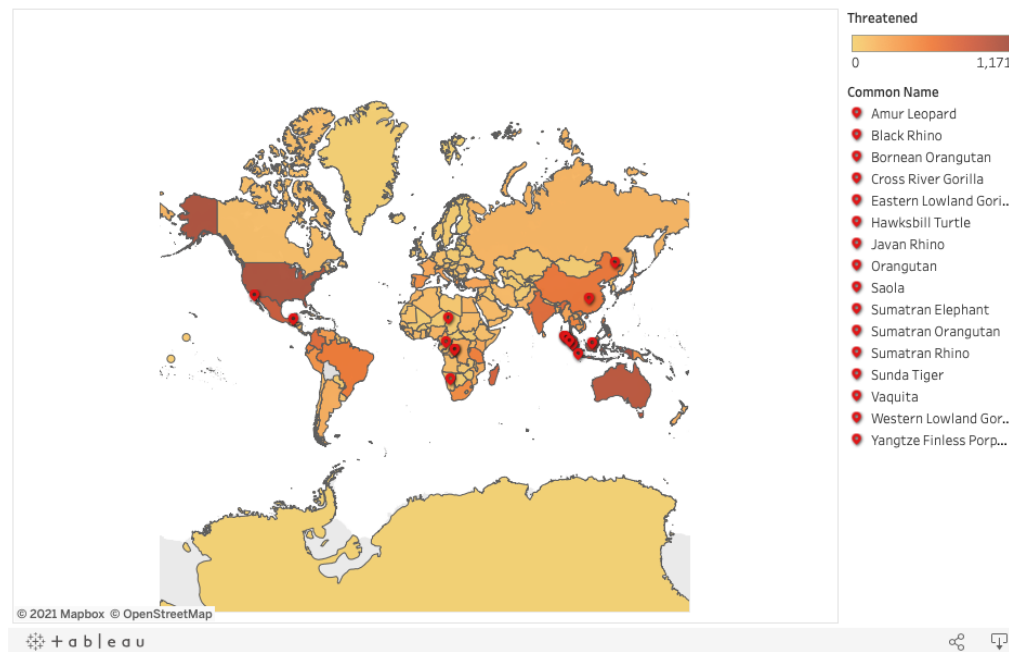
visualizations on our website.

Screenshot of my map design showing the number of endangered animals globally

The legends for this visualization ends up being very similar to the map visualization. By using the dark and bright variations of the color, we can make it easy for the viewers to identify the degree of species endangerment in each country at a glance.

b. Justaxposing and comparing data

On the second visualization, we wanted to use a bar graph to show the ranking of endangered and extinct species in each country. Since it will be a chart that compares two parameters, one the endangered, and the other extinct species, I looked into the visualization of small multiples.

Sorting 4 Variables, Faceting by Origin and Make

Example of faceting and justaxposing multiple variables from class materials (week 7 lecture)

This visualization made every variable easy to compare by placing them next to each other. We tried to achieve a similar result by creating three bar graphs (lower risk, endangered, and extinct) next to each other, but through discussions, we thought the bar graph should be an auxiliary graph to help viewers understand the world map with another perspective. In the end, we decided to take the bar graph of "lower risk" off the visualization. In addition, we thought the total number of animals listed should be something viewers would want to know, so we decided to combine the "endangered" and "extinct" bars together as a stacked bar graph.
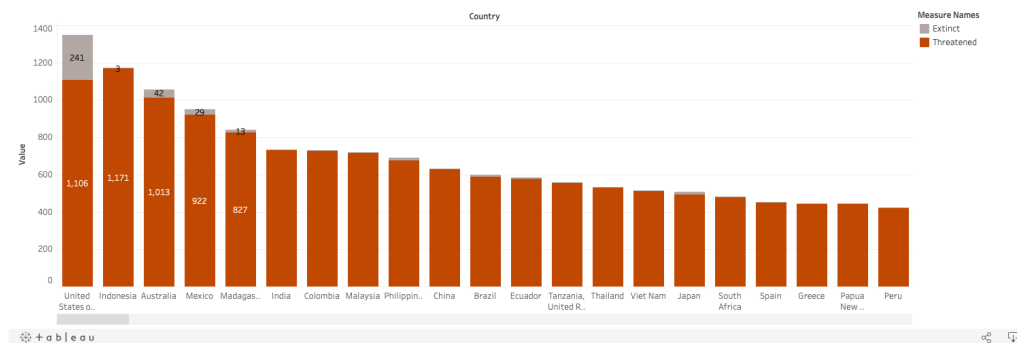

Screenshot of my stacked bar graph with consistent color palette as the map above

c. [The Inside Scoop of Ben & Jerry](#)

When looking into examples that can show ingredients/compositions of a certain topic. I was inspired by this example shared by Michelle in class. By using different colors, this visualization shows the abundance of Ben & Jerry ice cream flavors that can be found in each country.

Example of breakdown of ingredients and flavors
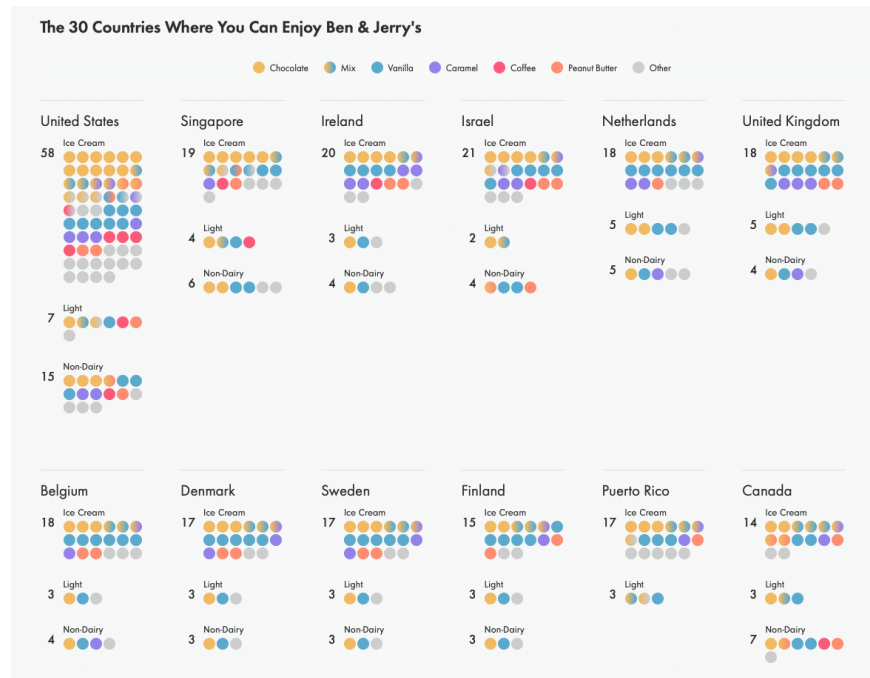
I took this as an inspiration to create the third visualization, the breakdown of the endangered species in the top 5 countries by taxonomic group. I used a consistent color palette that has been used in the previous visualizations, also highlighted two of the taxonomic groups that show information worth more observation and analysis.
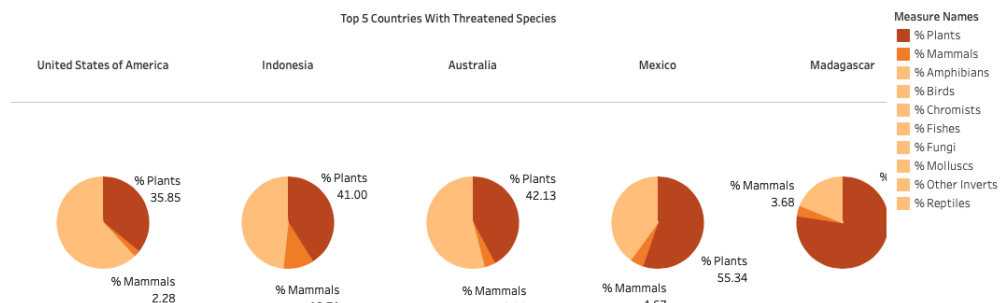

Screenshot of my design to show small multiples in pie charts

5

2. Michelle Hwang

    a. [Exploring Isotype Charts: "Only An Ocean Between"](#)

    In this particular isotype chart, the author decided to have the animals all facing right and moving from left to right in the direction of X-axis, away from the human population, to aid in the viewer's interpretation of these animals as a separate and independent population from the people. I was inspired by the discussion of how "every detail of an isotype chart is considered - even the direction of the icons". When I created my own isotype graphs like orangutan population and penguin population decreases, I kept in mind that the isotypes should be placed meaningfully, hence why I faced the penguins the same direction, to the left. When I added in the secondary color, orange, to indicate the % of penguins that have disappeared, I also made sure that the coloring happens from left to right, top to bottom. It's consistent with how I indicated the disappearing of the % of orangutans in my other isotype graph.

    Inspiration
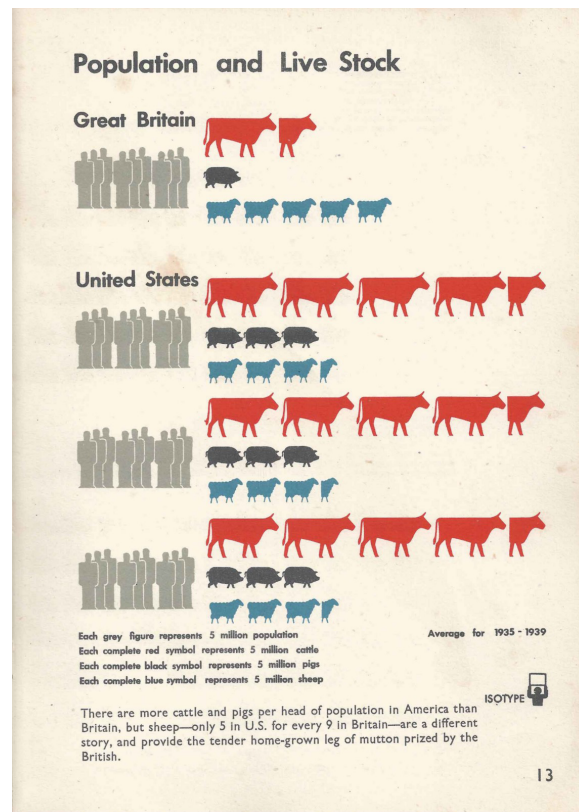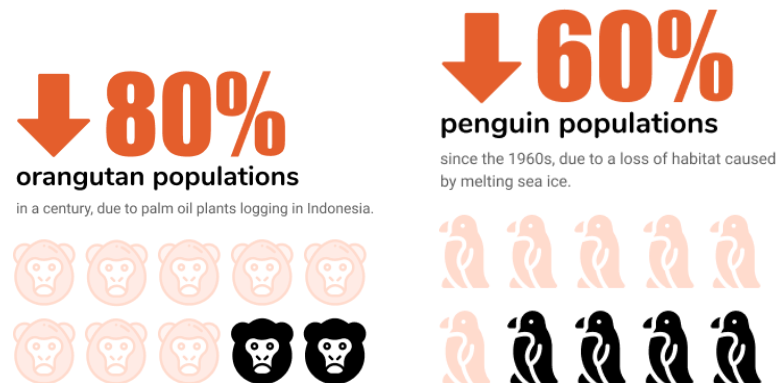
b. Color in Data Visualization: Less How, More Why

The point of this visualization is not to show the viewers the kindergarten vaccination rate of every county in Texas. It is instead to highlight the lowest rate — Terry County. As a result, the navy blue color is used to highlight Terry County. I applied the same idea to my designs for the elephant and wild tiger populations. I used the color orange to highlight the % of decrease in both populations: 50% decrease in elephant population and 97% decrease in wild tiger populations. I also used the same orange color (but in a more faded hue to signal 'disappearing') to highlight the corresponding parts on the two bar graphs.

Inspiration
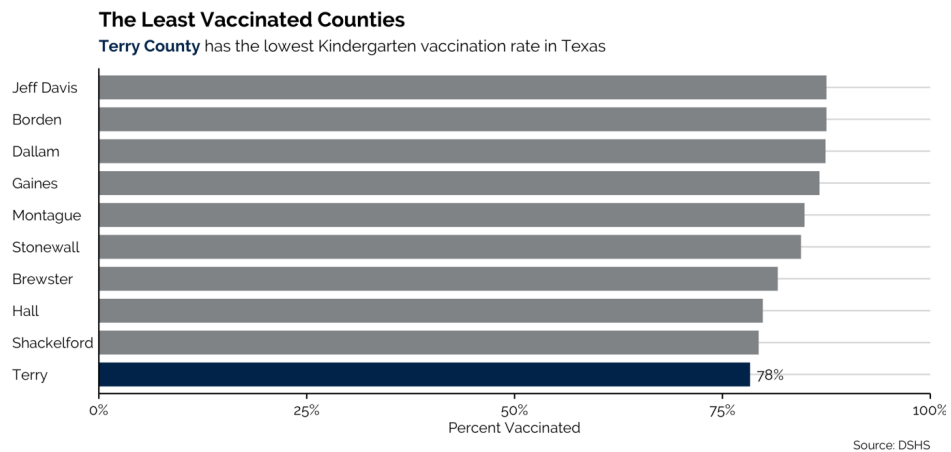
My Designs
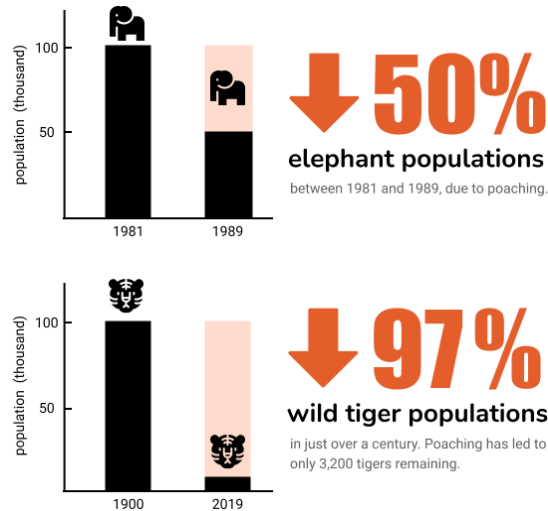
c. [How to Design an Effective Infographic with Icons](#)

I learned from this article that one of the best practices of using icons is to use icons that share a similar line weight or general look and feel to create a consistent style across my designs. I kept this in mind when I was selecting each of the icons for all of my designs.

Inspiration

Don't:
Use icons with vastly different visual styles, or styles that don't match your overall aesthetic.

Do:
Use icons within the same collection so they carry the same style and line weight.

My Designs

caused by temperature changes that affected loggerhead turtles' nesting conditions.

in the wild, due to extensive habitatloss and conflicts with human.

3. Bowen Wei

    a. [Flashcard and Kid's study](#)

    We noticed that flash cards and flip cards are quite commonly used for parents to teach kids about new concepts. It is fun, engaging, and easy to carry. This inspired us to use the same flipping gesture on our website for parents to engage their kids in learning about endangered animals conservation.

We thought by using tools that parents and kids are already familiar with can aid in the storytelling, so I designed the animal stories section to be virtual flip cards that parents can flip over to read and share more about the animals to their kids.
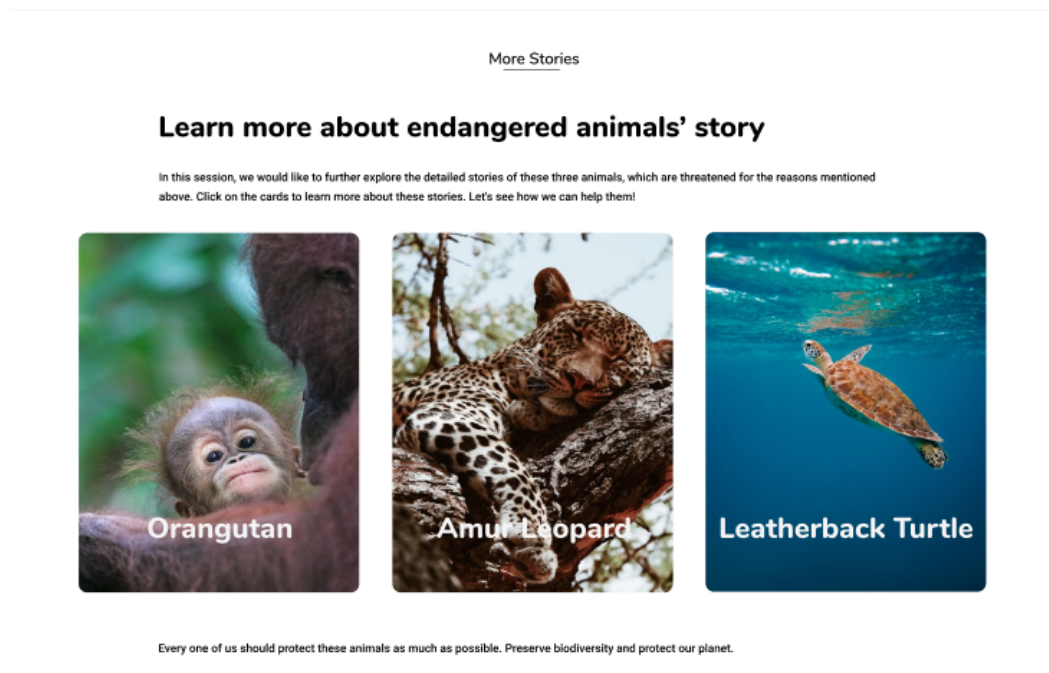
b. [Line graph to show the trend]

From what we learned from the class and readings, line graphs are a great way to represent the changes and trends. For example, in this graph, it shows the bus ridership changes from 2010 to 2020 in different regions. The line graph clearly shows the changes which inspire us to use line graphs
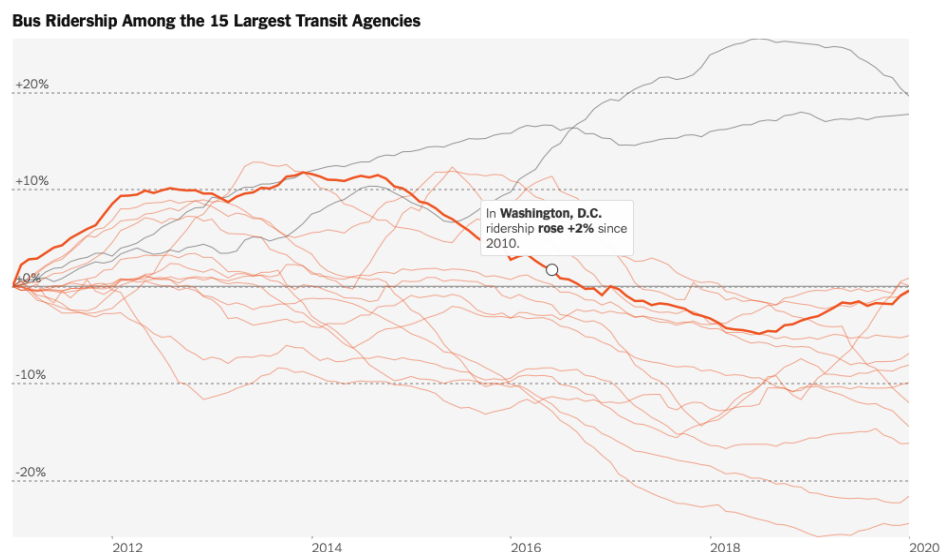
to show the number of endangered wild animals changes throughout the year.

Thus in the flip card design, we use the line graph to indicate the number changes of endangered specials. In addition, we also added explanation and color coded to separate negative and positive trends which applies gestalt principle to help readers understand the graph better.
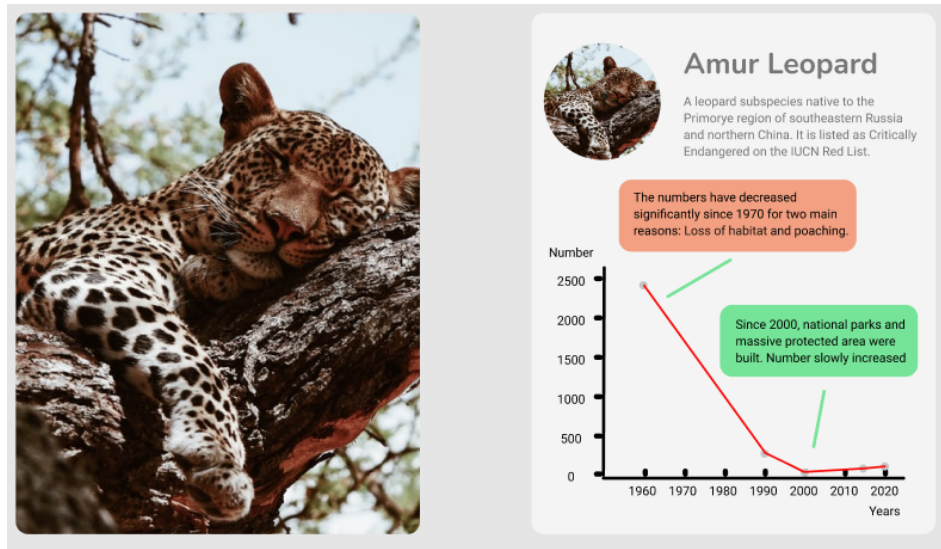
c. [Bar chart to indicate critical state](#)

Bar chart is also a good way to represent critical information, trends or categorization. In this example, it represents different animals' status.

In our design, there is not always continuous number tracking of animal species, therefore for some of our animal stories, we use bar charts to indicate the difference of the number changes of leatherback turtles. In addition, we also include the threats(reasons) of the number changes of leatherback turtles.
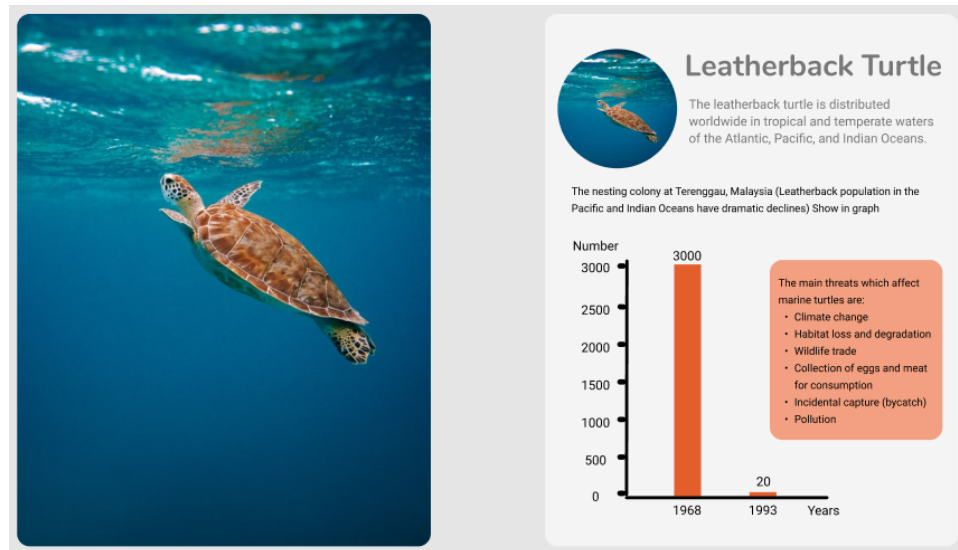
Visualization

To guide the viewers into this topic of endangered species, we divided the website visualization into three main sections: Overview, Main Causes, and Animal Stories. Each section has a header and multiple visualizations to illustrate the story.

Overview

1. Status of endangered species listed on the IUCN Red List

   We began our story with the "Explore" section, which provides an overview of the status of endangered species around the world. Viewers can hover on each country to trigger a tooltip box that shows the total number of species listed in that country, and how many of them are listed as endangered.

   From our usability testing, we learned that instead of just seeing listings of the animal species, viewers are interested to know which species are endangered in which area, and how many of them are left. Responding to that, we added a second

layer of information on top of the world map. The red location icons shown on the map are presenting the animal species that are listed as "critically endangered" on the World Wildlife Fund Species Directory. By hovering on the icons, viewers can see the details of where a certain species is found, and what's the remaining population of it.
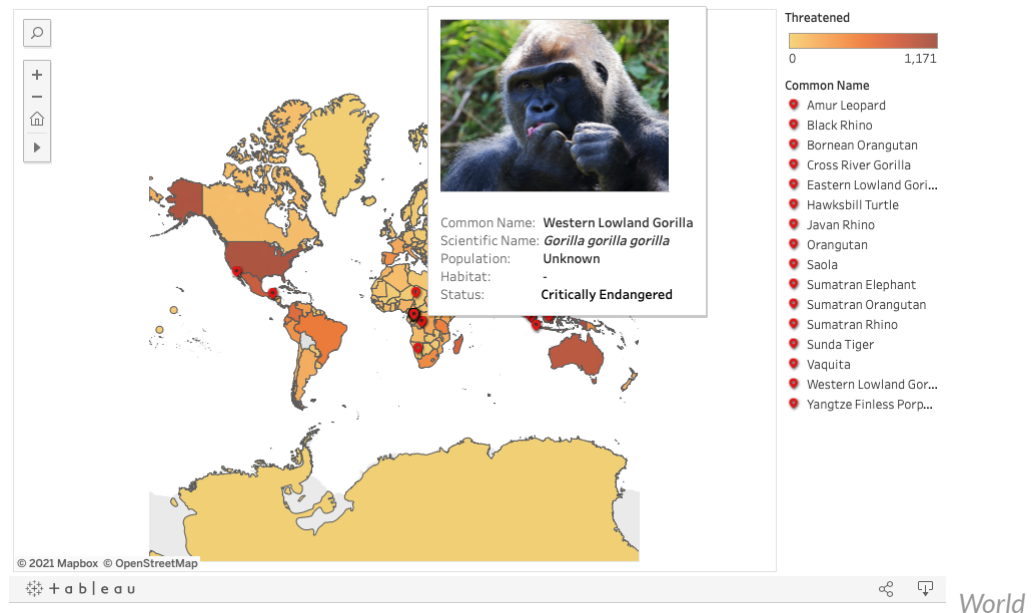
World

Map visualization showing the endangered species around the world

2. Rankings of the countries with the highest number of endangered species listed
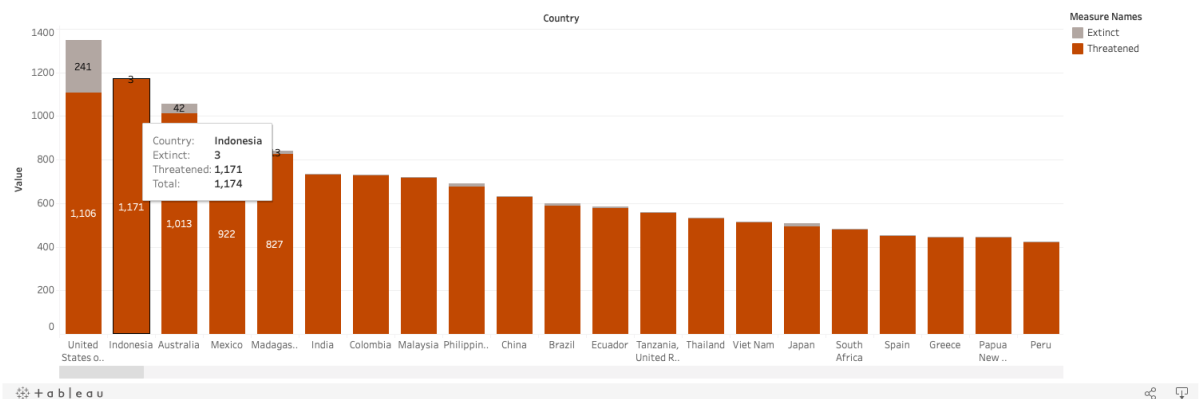
Bar graph showing the ranking of the countries listed with endangered and extinct species from high to low

In the second visualization, we wanted to use a more detailed way to show the viewers what the current status of wildlife preservation is around the world. From the bar graph, it's easier for the viewers to see the top countries listed with the

most number of endangered species, they can scroll through the bar graph to find the data of their own country, and compare among other countries.

3. Composition of the endangered species by taxonomic group

Multiple pie charts showing the composition of the endangered species of the top 5 countries

We learned from the usability test that viewers are not only curious about the number of extinct species in their country, but they also want to know from which species these numbers are counted. To show more details, we use multiple pie charts to visualize the number composition of the top five countries.
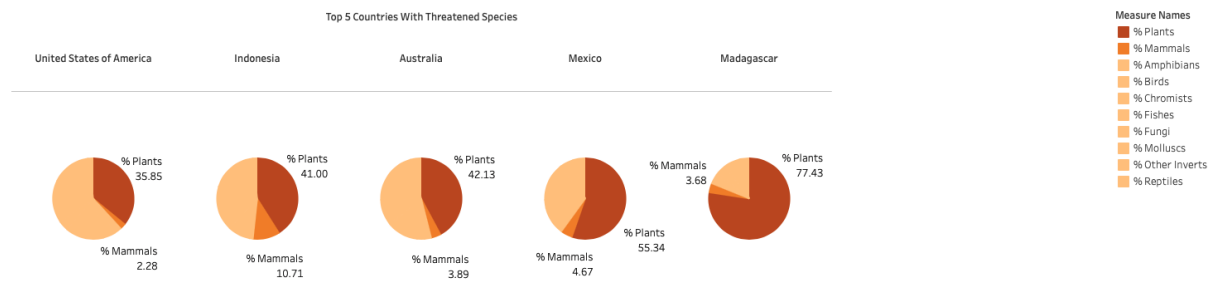
This visualization uses more data calculation. We first change the statistics of the top five countries to percentages and calculate the rate of each species in the selected top five taxonomic groups to the total number of the country.

By showing this visualization, we want to help viewers think outside of the box. So they can understand that even though some commonly known animals are often mentioned when it comes to animal endangerment (such as polar bears and rhinos). However, from the pie chart above, "Plants" actually accounts for the majority of the threatened species, whereas "Mammal" took up about 5% in the top 5 countries listed.

Main Causes

4. Habitat Loss

Most habitat loss is due to intensive harvesting and expansion of agricultural land. The biggest causes include oil exploitation, conflicts with humans, and logging. Some of the better known species under each assault are orangutan, amur leopards, and pandas, respectively.

Habitat Loss
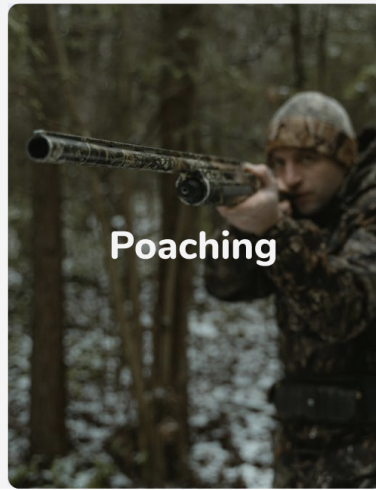
Poaching
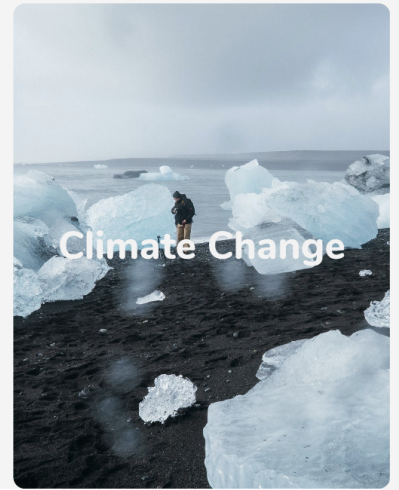
Climate Change

Habitat loss may be the greatest threat to biodiversity on earth, affecting 85% species. Most habitat loss is due to intense harvesting and agricultural expansion by human.

↓**80%**
orangutan populations
in a century, due to palm oil plants logging in Indonesia.

35
amur leopards remain
in the wild, due to extensive habitatloss and conflicts with human.

1600
pandas remain
in the wild, due to sizeable habitatdestroyed by logging.

5. Poaching

While poaching has various effects, its most direct and dramatic impact is extinction, either on a global or local scale. Poaching is a crime fueled by a lucrative black market trade of animal parts. As a result, populations of elephants and wild tigers around the world have been decimated by poachers for their tusks and fur.

Habitat Loss **Poaching** **Climate Change**

Poaching is the illegal hunting, capture or collection of wildlife by human that leads to the maiming of many animals not intended for consumption and in some cases, extinction.

Illegal poaching is the second most lucrative crime globally, with $73–$216B estimated yearly value. The first one is drugs, with $426–$652B estimated yearly value. Human trafficking is third, with an estimated $150B.

↓50%
elephant populations
between 1981 and 1989, due to poaching.

↓97%
wild tiger populations
in just over a century. Poaching has led to only 3,200 tigers remaining.

6. Climate Change

Global climate change threatens to destabilize already stressed ecosystems. In our visualizations, we included data on how animals like penguins, loggerhead turtles, and polar bears are affected by climate change in terms of population decrease, skewed gender ratios, and weight loss.

Habitat Loss

Poaching

Climate Change

Human adds greenhouse gasses to the atmosphere, which arise the planet's temperature, consequently melting ice caps, raising sea levels and warming oceans.

↓60%
penguin populations
since the 1960s, due to a loss of habitat caused by melting sea ice.

9:1 🐢
female-to-male ratio
caused by temperature changes that affected loggerhead turtles' nesting conditions.

↓10%
polar bears' weight
due to melting sea ice, leaving polar bears with less hunt grounds.

Animal Stories

7. Learned more about endangered animals species

    a. Orangutan

        In the orangutan story, we include the basic information about orangutans, in addition, we include the graph of 3 different regions in Asia of the number

change of orangutans. We also include the explanation of threats of orangutan number decrease.
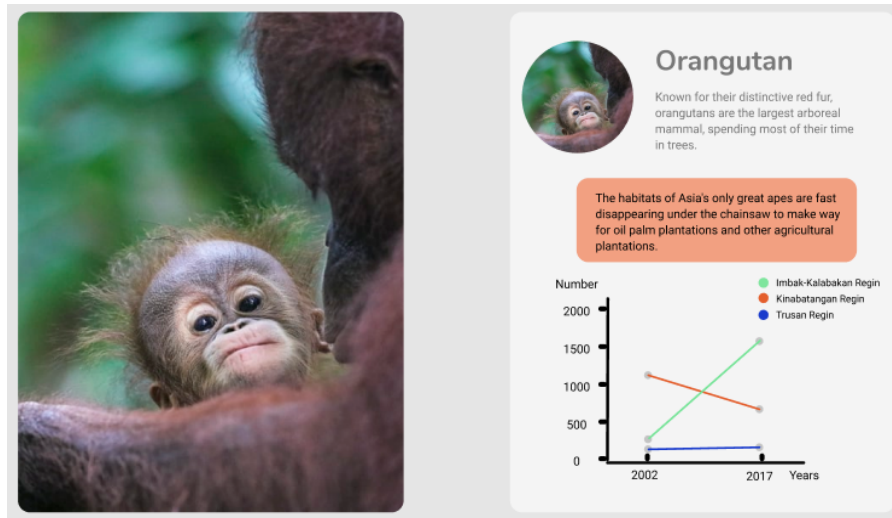
b. Amur Leopard

Similarly, we also include the brief introduction of amur leopard specials, since amur leopard has more data information, we use the line graph to indicate the number changes throughout the years. The large number decrease is due to the loss of habitat and poaching. From the data support, we can also see the number is slowly increasing due to the building of national reserve areas. This helps readers to know the importance of animal preservation.
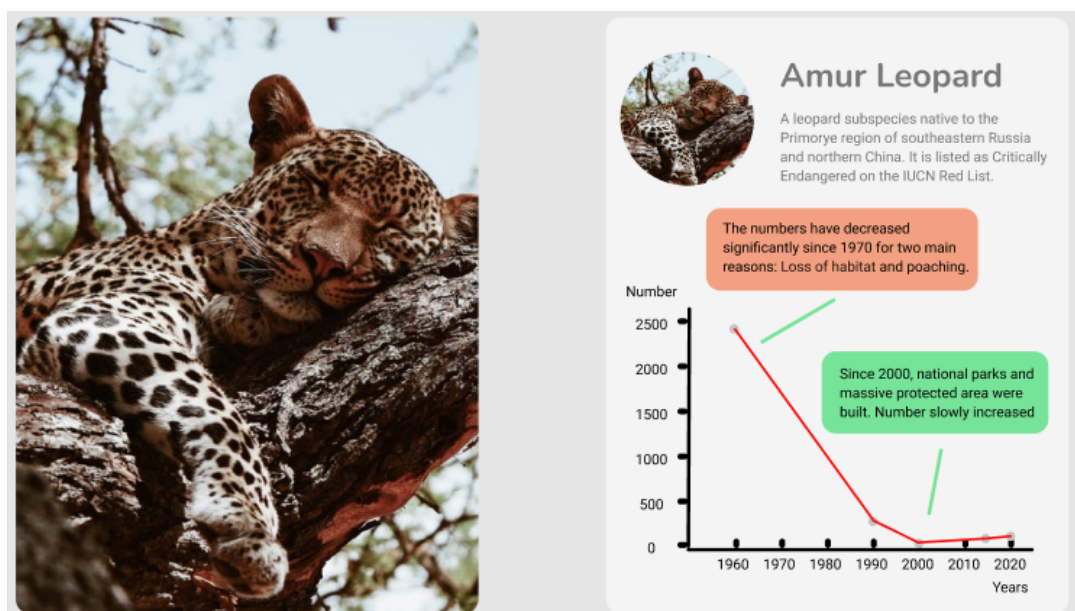
c. Leatherback turtle

Because of lack of continuous data tracking, we only include the number status comparison for leatherback turtles. The extreme decrease tells us the urgency of animal protection. We choose to use a bar graph to represent the extreme status and also include the main threats.
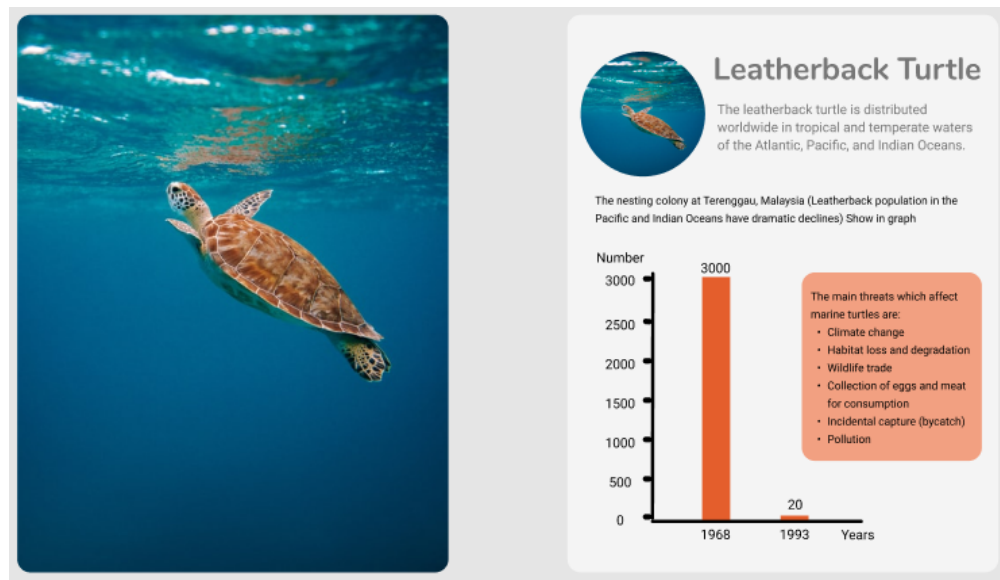
By including different animal species stories, we hope parents can tell kids the importance of animal preservation. We hope the flip card design creates exploration for both parents and children to explore the topics together.

Data

The first section provides an overview of the status of wildlife protection around the world with three visualizations. Three distinct datasets were used for these visualizations:
1. Number of animal species (kingdom: Animalia) listed in each IUCN Red List Category by country.
   a. Source: IUCN Red List of Threatened Species
   b. Date Updated: March 2020
2. Number of threatened species in each major taxonomic group by country.
   a. Source: IUCN Red List of Threatened Species
   b. Date Updated: March 2020

3. Critically Endangered Animals listed on the WWF Species Directory
    a. Source: World Wildlife Fund
    b. Date Updated: Unknown

The second section presents the three main threats endangering animals, the data used in this section are:
1. How We're Endangering Animals Infographic
    a. National Geographic Society Newsroom
    b. Date updated: April 2012

The third section
1. Orangutan data information
    a. Data Source:
       https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0218819
    b. Date Updated: July 2019
2. Amur Leopard
    a. Data Source: The Revelator
       (https://therevelator.org/amur-leopard-triples/); World Wildlife Fund
       (https://www.wwf.org.uk/learn/wildlife/amur-leopards)
    b. Date Updated: The Revelator (April 2018); World Wildlife Fund (Unknown)
3. Leatherback turtle
    a. Data Source: North Florida Ecological Service Office
       (https://www.fws.gov/northflorida/seaturtles/turtle%20factsheets/leatherback-sea-turtle.htm)
    b. Date Updated: April 2015

Tools

We used multiple methods and tools to create the visualizations on our website. For the first three visualizations, where we intend to provide an overview of the status of endangered species around the world, we used Tableau to visualize the data found on the IUCN website. For the various visualizations in the main causes section, we used a combination of illustrator and figma to simplify and illustrate data found on the National Geographic Society Newsroom regarding habitat loss, poaching, and climate change. In the detailed story section, we also use illustrator and figma for graph design and storytelling to encourage parents to share these stories with their children and to protect the animals.

Results & Usability Study

1. ## Overview

   For the usability study, we wanted to evaluate how effective and understandable the six visualizations we've created so far are in storytelling the issue of animal extinctions to our target audience, which are parents with young children. Three of the visualizations (visualization 1-3) we created aimed to paint a holistic picture about the statuses of threatened and extinct animals around the world by country and species. The following two visualizations (visualization 4-5) we created aimed to explain why poaching is one of the main three causes of animal extinctions. The last visualization (visualization 6) included in our pilot study aimed to illustrate the harmful effect poaching has on animals, specifically Amur Leopard, in this case.

2. ## Method

   Quantitative: We designed a questionnaire to collect quantitative data on how many % of our participants understood each of our data visualization designs as well as how they rate the clarity of each visualization.

   Qualitative: We conducted qualitative user interviews over zoom to collect additional insights into what is going through our participants' minds when they perform the pre-assigned tasks on each visualization as well as what was confusing to them.

3. ## Participants

   We selected 3 new parents in their mid-30's as our participants since our data visualization website is designed for parents with young children to view and understand the issues around endangered animals, so they can share this information with their children at home.

4. Scenarios/Tasks

For each visualization, we created a set of questions. Each set has unique questions that ask participants to find answers from the visualizations, and general questions to identify the participants' thoughts about our visualization.

Some task scenarios we created for our users to perform are:

- Visualization 1: we asked our participants to find answers to questions like "what country has the most number of animals listed?" and "can you find the number of animals listed as threatened and extinct in your own country?" by looking at our graph. We also asked them to say out loud what's going on in their mind when they are performing these tasks.
- Visualization 2: we asked our participants to find answers to questions like "What species has the largest percentage of animals listed as Vulnerable (VU)?" and "What species has the largest percentage of animals listed as Data Deficient?" by looking at our graph. We also asked them to describe what were the first things they noticed when they saw the graphs as well as if there was any part of the graph that was confusing to them.
- Visualization 3: we asked our participants to identify the purpose of our visualization design and find answers to questions like "which animal category is ranked the highest score in the US?"
- Visualization 4: we asked our participants to explain what they thought the graph was meant to convey and if there were additional information they wish were included that were missing in the visualization.
- Visualization 5: we asked our participants to share with us what they saw in the animation as well as their thoughts around how effective the animations were in assisting with the storytelling data presented around ivory price increase.
- Visualization 6: When our participants seemed confused about our graphs when performing tasks on "identify the purpose of this visualization design", we asked them to speak out what was going through their mind so we can better understand which parts of the visualization were confusing and could be improved.

5. Screenshots

Visualization 1

Top Countries' Status of Threatened and Extinct Animals (2020 March)
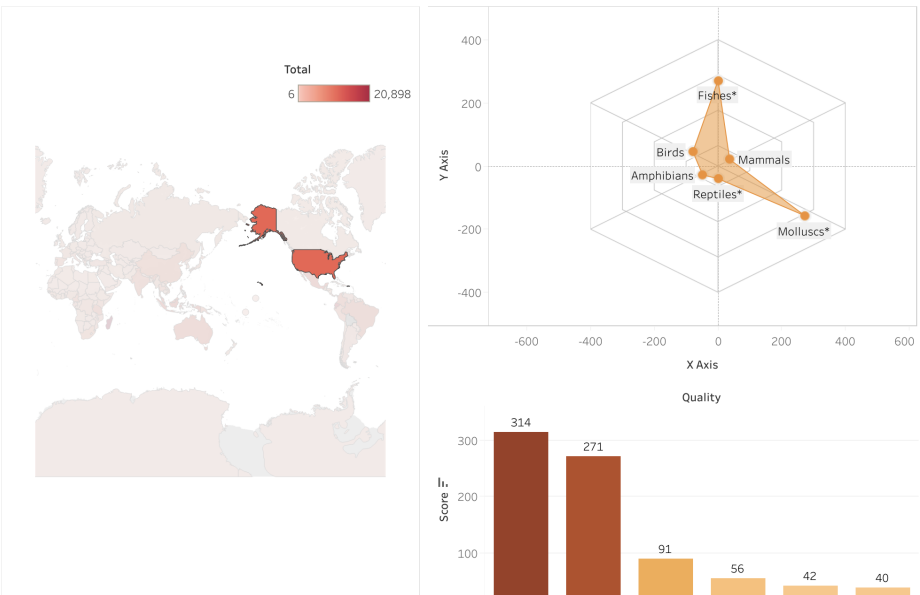Click on the bars or maps to examine the details of threatened and extinct animals in each country.
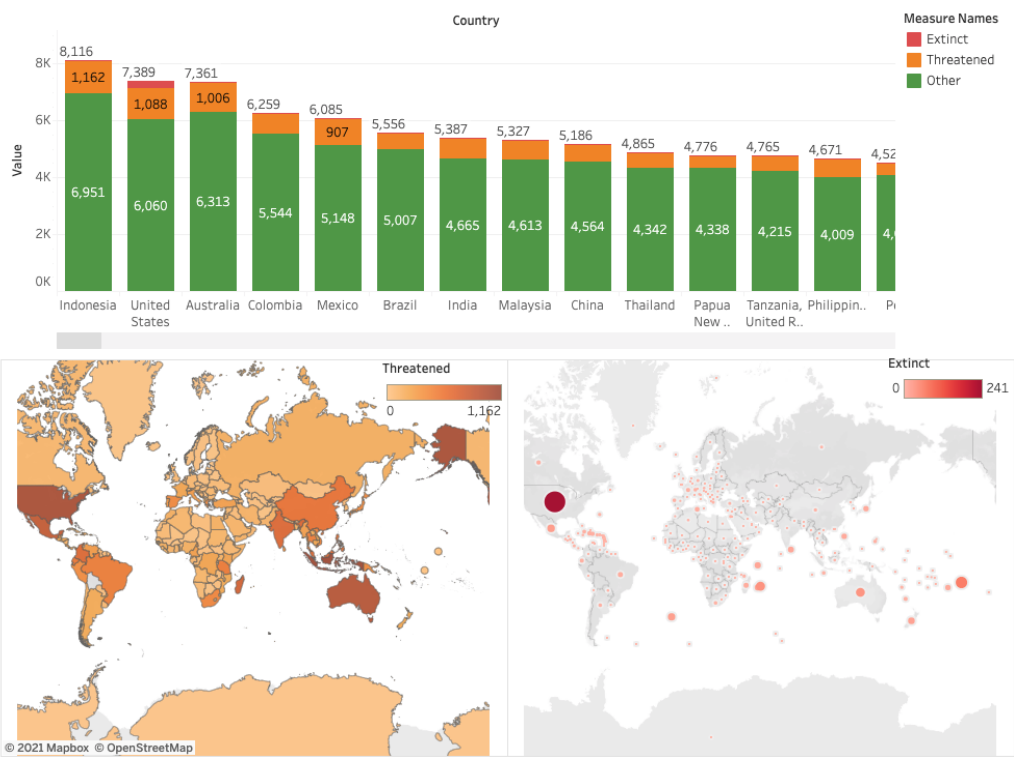
Visualization 2

Composition of Threatened Animal Categories by Country (March 2020)
Click on a country on the map to see the details of threatened animal categories.

Visualization 3

Status of Threatened and Extinct Animals by Groups (March 2020)
The IUCN Red List uses nine categories to classify the state of threatened and extinct animals.
LC - Least Concern | NT - Near Threatened | LR - Lower Risk/Conservation Dependent | DD - Data Deficient
VU - Vulnerable | EN - Endangered | Cr - Critically Endangered | EW - Extinct in the Wild | EX - Extinct
Click on the species in Chart 1 to examine the proportion of threatened degrees, and the detail number of each category.

Chart 1: Proportion of Extant Species
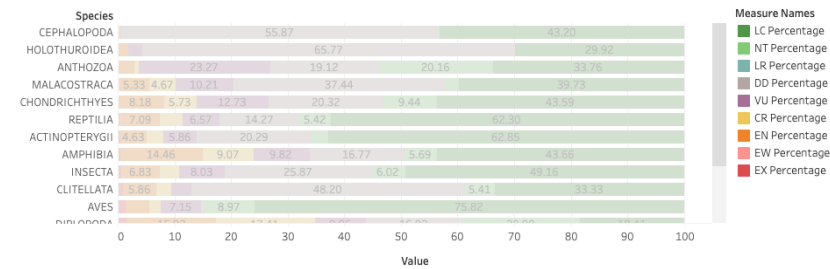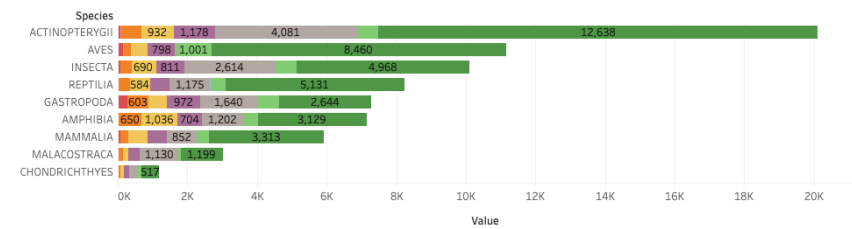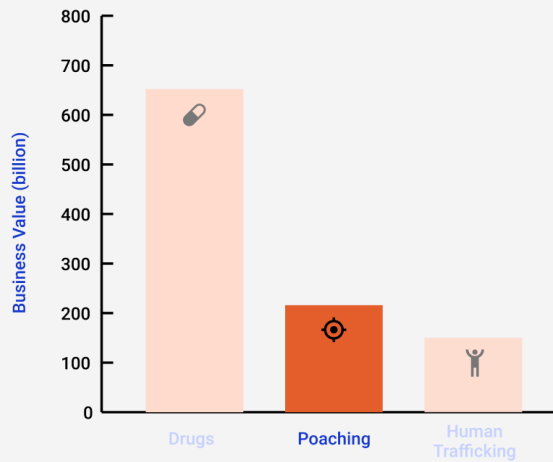
Chart 2: Actual Number of Extant Species
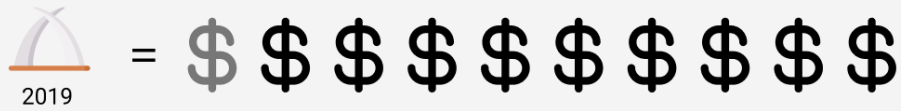
Visualization 4

Top 3 Lucrative Crimes

Illegal wildlife trafficking is the second most lucrative crime globally, with $73–$216 billion estimated yearly value. The first one is drugs, with $426–$652 billion estimated yearly value. Human trafficking is third, with an estimated $150 billion.

Visualization 5

Visualization 6

6. Test Measures

From the unique questions that ask participants to find answers from the visualization, we measure the quantitative results of the correct answer rate to identify which part of the visualization needs more improvement.

We measured the "think out loud process" of how people view the graph, specifically, we asked about what are the first things they noticed, the purpose of design, what are the things they are not clear, and additional information they prefer to include. With this qualitative information, it helps us to identify if our visualization clearly matched our design objective. In addition, we asked users to perform different tasks for each visualization, through measuring the task completion time and how difficult it is for them to figure out the results, it helped us to identify how intuitive and clear our visualizations are.

7. Results

a. Results of the quantitative measures

In the quantitative measures we observe the correctness for the participants to answer unique questions for each visualization.

Overall, the correct rates are high for the questions. Though with some confusion to understand the visualizations at first glance, participants were able to find the correct answers for each question.

	Question	Correct Rate
Viz 1	What country has the most number of animal listed	100%
	Can you find the number of animals listed as threatened and extinct in your own country?	100%
Viz 2	What species has the largest percentage of animals listed as Vulnerable (VU)?	100%
	What species has the largest percentage of animals listed as Data Deficient (DD)?	100%
Viz 3	Which animal category is ranked the highest score in the US?	100%
	Can you identify which animal category ranked the	100%

	highest score in your own country?	
Viz 4	How is poaching ranked among the top 3 lucrative crimes?	100%

We asked participants to rate each visualization, on a scale from 1 (not at all) to 5 (very much), how clearly do they think the visualization represents the data. Overall, people rated higher on the visualizations with less text and images.

Question	Viz 1	Viz 2	Viz 3	Viz 4	Viz 5	Viz 6
How clearly do you think the graph represents the data?	3.33	4	4	3.66	2.66	3

b. Results of the qualitative measures

In addition to survey questions, we also asked the participants general questions about the overall usability of each visualization.

- What was the first thing you noticed?
- Were you able to identify the purpose of the design?
- What are some aspects of the graphs that were confusing to you?
- What information do you wish were included?

In each of the visualizations, we learned that there are parts missing for the participants to understand what the visualization wants to convey. In the first three visualizations, which intended to provide a holistic view of the status of wildlife conservation around the world, x-y axis and graph legends need more specifications for viewers to navigate. In visualization 4-5, which intended to explain the top 3 causes of animal extinction, we learned that participants were confused by seeing the title of "Top 3 Lucrative Crimes", without knowing much about the background information and motivations behind the visualization. Lastly, in visualization 6, which intended to illustrate detailed stories about the extinction of Amur Leopards, participants felt less relatable from the descriptive words and the line chart accompanying it. We learned that we could simplify the text descriptions to a more approachable way for the parents to tell stories to their children.

8. Discussion

In general, we found that by merely showing the data visualizations we created separately and not providing enough context around what each visualization is for can be very confusing to the users. Below are some of our additional learnings on each of our visualizations as well as what we might change to make them more easily understandable for our target audience.

c. Visualization 1:

In General the bar graph shows the overall number of each country's endangered specials. However, the abstract number is hardly to give users the direct idea of how severe the situation is. In addition, the categories are not distinguished clearly at the beginning of the graph, which might cause mis-understanding of the meaning of the graph. "Others" has taken a large amount of the overall bar graph while the extinct and threatened are taken in less amount which doesn't align with our main purpose. In addition, the extinct and threatened country graph used different types of the graph, which may have caused confusion of why we are choosing types of graph to represent the information.

To better address these issues, we plan to

1) Include the background information of the category data.
2) Better represent the data value by providing comparison.
3) Focus on the extinct and threatened categories data.
4) Make sure the graph and design choices are consistent and align with our design objectives.

d. Visualization 2:

Visualization 2 shows the threatened and endangered animals by category, all our users can clearly understand the meaning of the graph. However, these different categories and lots of different types of specials are overwhelming and required users extra time to understand the graph's meaning. Moreover, there is some inconsistency of X-axis labeling.

To better address these issues, we plan to:

1) Include represented animals pictures for the species categories.

2) Better color coded the server level of endangered specials, such as using shades of color to better indicate the server level.

e. Visualization 3:

From our user testing, users can clearly understand the purpose of the graph, which shows the threatherened animals by countries. Some of the confusion points include the legend in the left graph, the color coded of the right 2 graphs, and the labeling and data calculation of the spider graph.

To better address these issues, we plan to:

1. Explain our data calculation
2. Revisit our color encoded categories to make sure it doesn't cause confusion (such as the color used in spider graph may cause users to relate to the quality score in the bottom right graph.

f. Visualization 4:

Visualization 4 shows the top 3 lucrative crimes with the highlight on poaching. Our users can clearly understand the visualization. However, the current information display is very abstract, maybe we can include more narrative ways to tell the information.

To better address these issues, we plan to:

1. Using comparisons such as comparing the poaching business value with the some company's business value to provide a more direct sense for users to understand how severe the problem is.
2. Continued using icons to provide a more visualized representation.

g. Visualization 5:

The animation graph shows the ivory prices changes throughout the year. Users can understand the meaning of the animation, however, the speed of the animation and the information provided caused confusion to our participants. They responded that perhaps a static graph could illustrate the topic more powerful.

To better address these issues, we plan to:

1. Add description to explain representation of the isotype used in the visualization
2. Compare the increasing ivory price with another item that people are more familiar with.

h. Visualization 6:

Visualization 6 is an interactive section where viewers can flip the three cards with animal pictures on it to learn more about the survival stories about each of the endangered animals. Participants find it hard to guess what the images meant, and whether or not it is interactive. Information provided in each card (In this case about the Amur Leopard), the sequence of text descriptions and line graphs seems unrelated to each other.

To better address these issues, we plan to:

1. Add a sentence of description before the viewer scroll to this section, to explain about what they will be seeing, and how to interact with it.
2. Explain the purpose of using these 3 animals, provide story hints for parents to share with kids.

Link

1. Link to our final information visualization website: https://loop2021.github.io/Loopville/explore.html
2. Link to our design prototype
3. Link to our usability test survey

Task Distribution

We basically divided the work evenly within our team. Each team member is responsible for one of the three main sections: Explore, Reasons, and More Stories. The detailed task distribution is listed below.

Project Components	Sub Components	Esther	Michelle	Bowen
Research & Ideation	Researching into topics of endangered animals and brainstorming on topics we want to focus on for our final project. Initial exploration on data source. Identify our target users -- Parents.	33%	33%	33%
Data Preparation	Data collection, cleaning, and processing. Make sure data is aligned with our design objective.	33%	33%	33%
Data Visualization	Creating visualizations for each section of our website: overview, main causes, and animal stories, continue to iterate on the design based on user feedback.	33%	33%	33%
Usability Test	Designing survey questions, initial screening of interview participants, interview participants, debrief survey and interview results.	33%	33%	33%
Website Development	Start with figma website component design, Iterating on our visualizations based on usability testing feedback, designing interactions with the visualizations, developing and organizing website components.	33%	33%	33%
Report Writeup	Writing up usability testing reports and final writeup.	33%	33%	33%