BCS 171 FINAL PROJECT

# Bear Necessities

Huiwen Chen, Jessica Li, Kathy Zhong

## Final

Website: https://jessicazli.github.io/polar-bears/#section1

Data files Google Drive: Data

Data file description:
CS 171 Final Project Data Description

We modified the storyline and completed the final product with fully functional visualizations and styling. To make the storyline more cohesive, we remove the pizzly bear information and tailored our storyline to focus on two subpopulations of polar bears. We first introduced the loss of sea ice in the Arctic due to climate change, and then explore the effect of sea ice loss on polar bears.

## Week 13

**To Do**

- ☑ ~~Migration Viz~~
  - ☑ ~~Figure out direction of bears moving (inland, or other parts of arctic)~~
  - ☑ ~~Clarify map -> what's ice and what's land (color)~~
  - ☑ ~~Add description of which suppopulations of bears this is -> Southern Beaufort and Chukchi Seas~~
  - ☑ ~~Distinguish dots - use purple yellow color~~
  - ☑ ~~Transition~~
  - ☑ ~~Add zoom~~
  - ☑ ~~Experiment with different data~~
  - ☑ ~~Color legend~~
- ☑ ~~Ice Extent, CO2, and Temp Viz~~

- ☑ ~~Get ice projection playable~~
- ☑ ~~Minimize three charts size /height~~
- ☑ ~~Separate ice extent viz from CO2 and temp viz~~
- ☑ ~~Add explanation before or after this visualization~~
- ☑ ~~Interconnected ice map and charts~~
- ☑ ~~Tooltip on the dots when hover~~

☑ ~~Subregions Viz~~

- ☑ ~~Add table with more information~~
- ☑ ~~Project this over map -> make it more clear what it is showing~~
- ☑ ~~Left align and add explanation~~
- ☑ ~~Color legend~~
- ☑ ~~Distinguish colors - use diff color schemes~~
- ☑ ~~Make sure labels are readable on each view~~

☑ ~~Diet Viz~~

- ☑ ~~Stacked bar graph- on the side we have drop down~~
- ☑ ~~Change the total diet %~~
- ☑ ~~Clarify where numbers are from~~
- ☑ ~~Legend for colors~~

☑ ~~Adopt a Bear Viz~~

- ☑ ~~Shows an individual's data in the total dataset~~
- ☑ ~~Lines graph!!!~~

☑ ~~Responsiveness~~

☑ ~~Transitions in Visualization~~

## Week 12: Think-Aloud Study

Tester Name: Clara Chen & Taylor Fang
Tester Email: clara_chen@college.harvard.edu, tfang@college.harvard.edu

General Observations from the think-aloud study:

- The testers thought the visualization designs were pretty with a cohesive color scheme
- The font size was too small and difficult to read, sometimes there was too much text in the paragraph too
- The data story could be clearer and there could be more of a call to action

What does the tester like about your data story?

- The color schemes and tooltips are nice
- First page: very cute, the icon sets the scene, nice font
- The line graphs are redrawn out every time which is cool
- Health visualization bubbles at the beginning are cool

What improvements does the tester point out?

- The title page to “pizzly bears” transition is slightly jarring bc second part is informal
- Break up long paragraphs
- Sliders don’t work
- Would be nice to be able to zoom in on the map
- The line graph changes could be a slower transition to make it more obvious that the axis is changing
- Legend for the second map
- Subpopulation graph is kind of confusing at a first glance
- Adopt a bear buttons don’t quite work

Was the intended key message clear to the tester? Why or why not?

- It was not super clear to the tester, they said that the ordering of the visualizations seemed very random, so there wasn’t a clear storyline throughout - more intentional ordering might have made the message clearer
- Adopt a bear seemed disconnected from the storyline that the other visualizations started and they were confused about where it was going
- The general message of helping polar bears from climate change was clear

Did the tester get your next steps or call to action? Why or why not?

- The tester did not really understand the next steps or call to action, this wasn’t super implemented yet

## Reflections

- Based on the results of your ‘think aloud’ study, what would you improve in your data story?
    - We should have a more cohesive storyline and better transitions between visualizations.

    - We need to decide on the tone of the overall project and whether or not we should adopt a more serious attitude.
- Are there any additional insights and visualizations you would use? Would you amplify or change your message? Did your narrative work? Did the tester get your takeaways?
    - Yes, we want to add a visualization to compare the individual bear to the total bear dataset.
    - We wouldn't necessarily change our message. We do want to amplify it however and make it a bit more clear– as well as add a prominent call to action at the end so that the user is not left with questions and confusion at the end.
    - Our narrative worked but can be improved through a more consistent tone and storyline.
    - They said the general message of helping polar bears from climate change was clear; however, there was not a clear final takeaway or call to action that they understood since we didn't really include this.
- Decide as a team which of these improvements you will implement and write down your decisions and why you made them in your process book as a numbered list.
    - ☑ ~~Make data story clearer~~
    - ☑ ~~Fix text sizing~~
    - ☑ ~~Fix explanations by breaking up longer paragraphs~~
    - ☐ Add zoom to map
    - ☑ ~~Slower transitions~~
    - ☐ Add legends
    - ☐ Add location orienting content to visualizations
    - ☐ Finish visualizations

- Implement the intended changes and check them off your list (e.g., adding "done"). You can distribute the tasks among your team members. If you are unable to implement specific changes, please explain why and describe the expected results in your process book.
    - ☑ ~~Make data story clearer~~
    - ☑ ~~Fix text sizing~~
    - ☑ ~~Fix explanations by breaking up longer paragraphs~~
    - ☐ Add zoom to map → We are still finalizing our map visualization so after doing so, we will try to add the zoom feature to make our visualizations more interactive.
    - ☑ ~~Slower transitions~~

- [ ] Add legends → We were able to add some legends to some of the visualizations, but not all of them yet, and also some look wonky still, so we need to fix it. Hopefully this will make our visualizations clearer to the user as in what different things like size or color for example are conveying.
- [ ] Add location orienting content to visualizations → We are struggling a little to draw our arctic maps over a more detailed map. Once implemented, the user should be better able to orient themselves when looking at our maps.
- [ ] Finish visualizations → We are working on finishing the functionality we hope to have on all visualizations :)

**Meeting Notes**

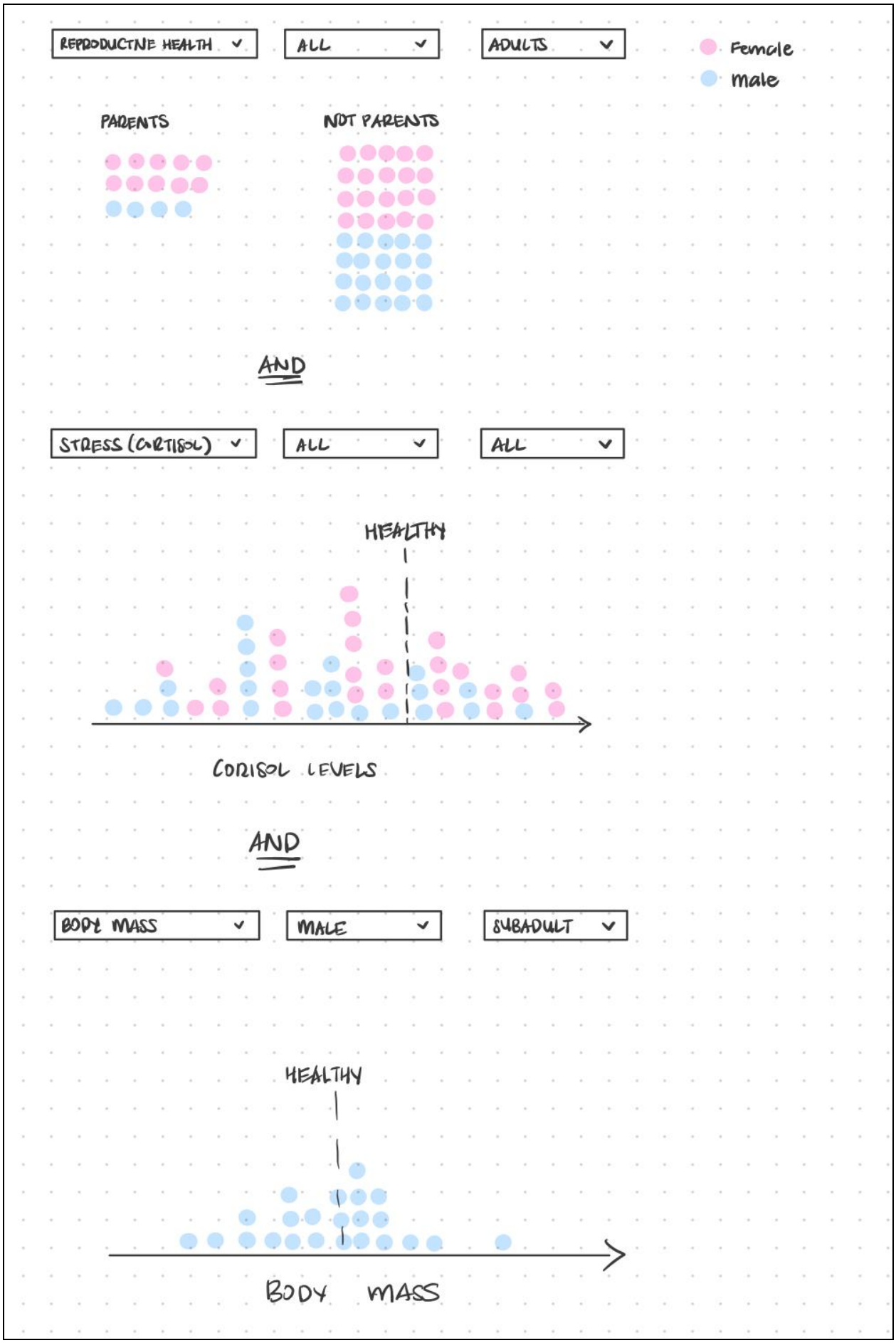
- Force graph
    - Have all viz be force graphs/separate scatterplots into different viz
    - Technical difficulty
        - Maybe integrate/connect with another graph
        - Transitions
- Efficient code
    - Classes
- Ice Mass graph
    - Might not need line graph for ice if we have map
    - A lot of geojsons
        - Every 5 years
    - Add a note about how we manage the data
        - Process book AND WEBSITE
        - “About this data”, “how did we get the data”, “why did we make this vis”
- Region Vis
    - Add table (adds to tech difficulty)
- Diet Vis
    - Easy but bad design: combine line and bar - dual axes - always keep total diet at the forefront
    - Distinguish between percentage and total consumption

    - Maybe separate total consumption and percentages
- Style is good - clean and easy to read
- When voting, they choose a viz that's new/fascinating
- Jpg is good
- Procreate animation

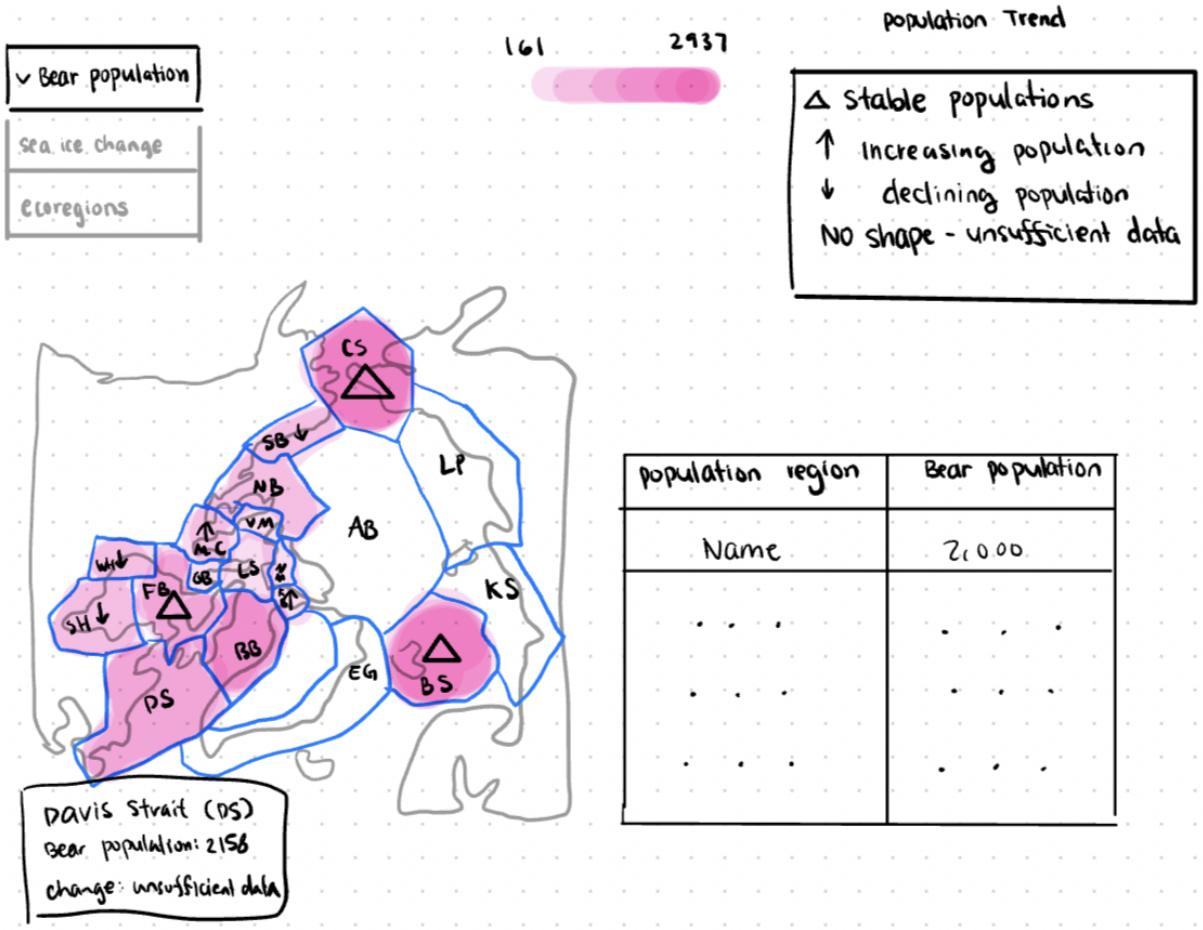
## Week 11

**Programming:**
All 3 members worked on different aspects of the programming.

Detailed visuals
**Visualization: Health of polar bears from 2013-2015.**
This visualization will show the audience the general state of polar bears' health in a period of time that is post major levels of ice loss and global warming. We have data such as weight, BMI, hair weight, hair cortisol, testosterone, and more, which all correspond to characteristics of health such as mood or stress. There will be two colored dots to represent female and male bears, and users will be able to filter based on criteria such as reproductive health, in which we can, for example, separate the major group into two categories such as parents and not parents...stress levels, in which we can display how each of the polar bears falls on a graph with an indicator of where the healthy level falls... and similarly for body mass, and more.


REPRODUCTIVE HEALTH
ALL
ADULTS
Female
male
PARENTS
NOT PARENTS
AND
STRESS (CORTISOL)
ALL
ALL
HEALTHY
CORISOL LEVELS
AND
BODY MASS
MALE
SUBADULT
HEALTHY
BODY MASS

HUIWEN All 19 subpopulations of polar bears have experienced ice loss in 2019 and bear population in some regions changed in 2021

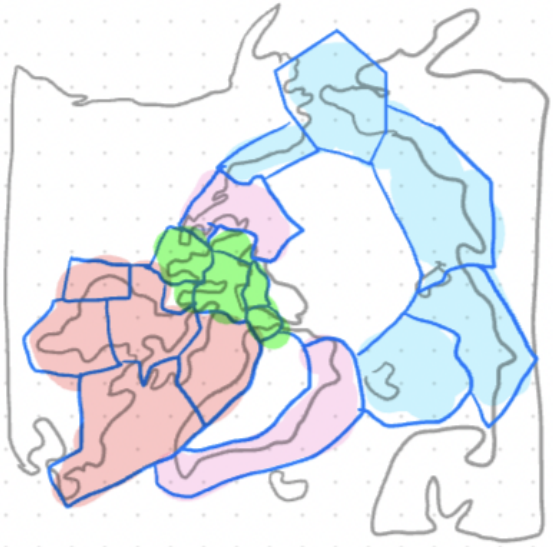



| population region | Bear population |
|---|---|
| Name | 2,000 |
| . . . | . . . |
| . . . | . . . |
| . . . | . . . |

ecorergions

sea ice change

Bear populations



| population region | ecoregions |
| --- | --- |
| Name | data |
| . . . | . . . |
| . . . | . . . |
| . . . | . . . |

sea ice change

ecoregions

Bear populations

| population region | sea ice change |
| --- | --- |
| Name | data |
| . . . | . . . |
| . . . | . . . |
| . . . | . . . |

*This visualization will show viewers where the 19 subgroups of polar bears live and their population change at the end of summer in 2021. In addition, it will provide information on the ecoregions and each region's sea ice change. Through the visualization, viewers can learn about the current state of polar bear living conditions and sea ice change in their habitats.*
*Details: The color on the map, table, and legend update when you click on the dropdown filter. It will show data that corresponds to the selected type. The visualization shows a tooltip on hover.*

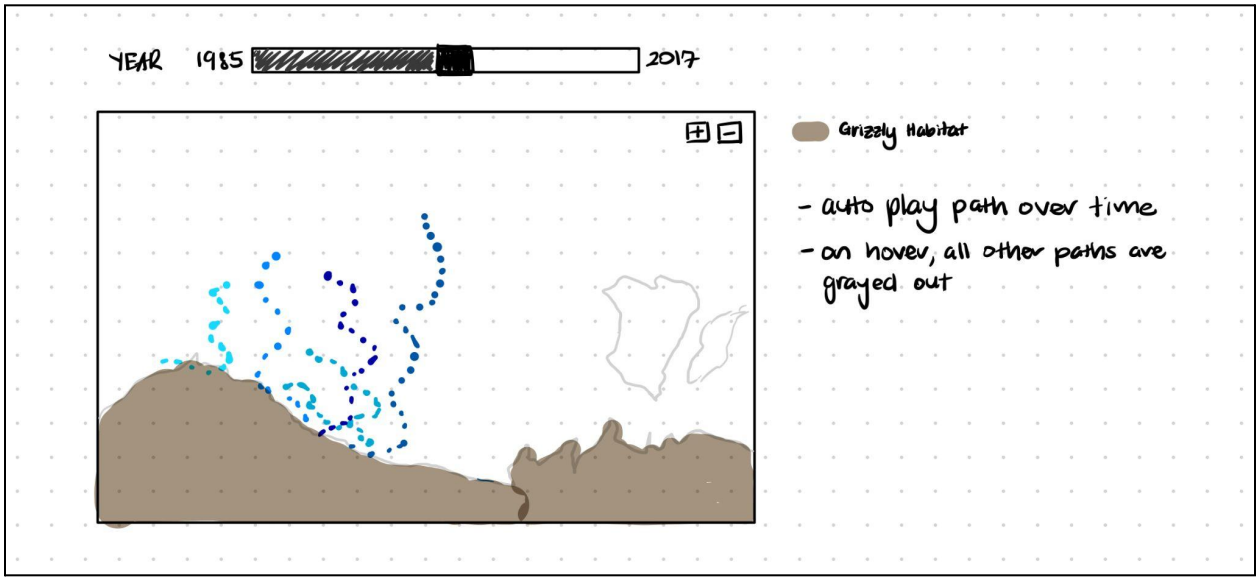
## Week 10

### Data

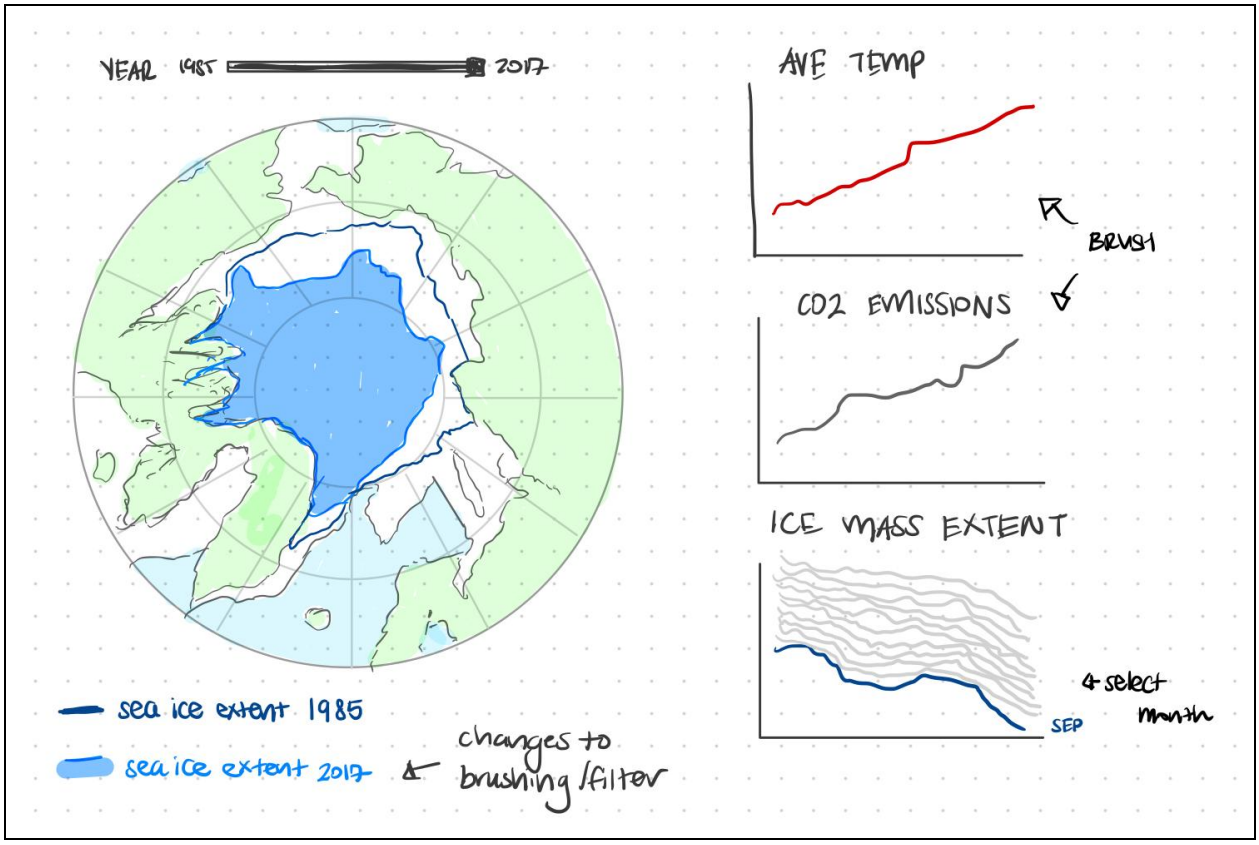
- Data

### Jessica's Sketches

#1
**Question:** How have habitats of polar bears and grizzly bears converged over time?

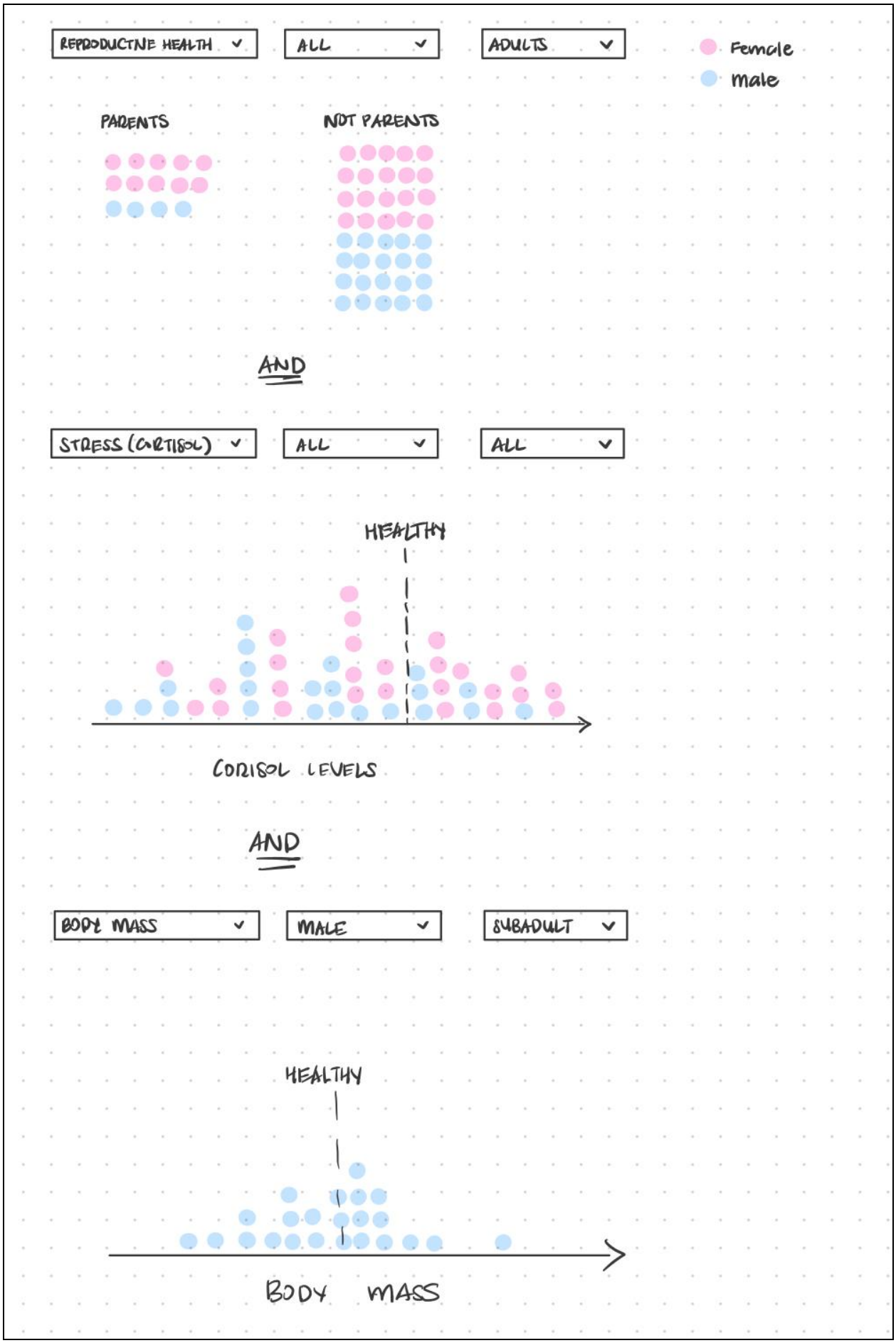



#2
**Question**: How has ice mass changed overtime due to climate change?




#3

**Question**: What are some insights into the health of polar bears (2013-2015)?


REPRODUCTIVE HEALTH
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ALL
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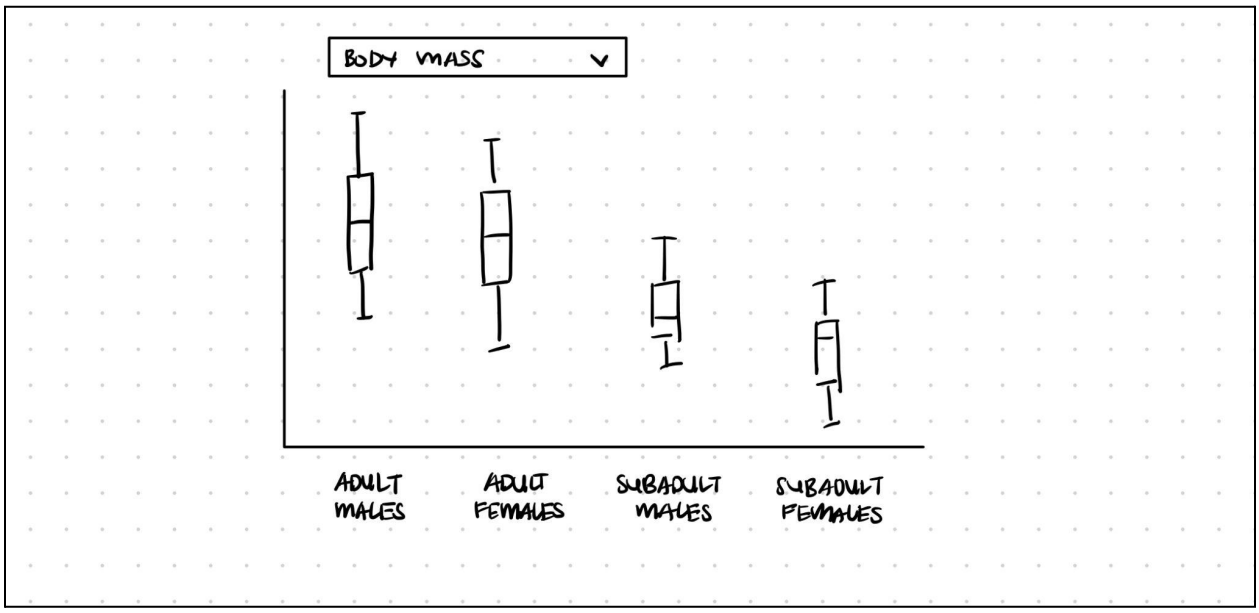
CORISOL LEVELS
AND
BODY MASS
MALE
SUBADULT
HEALTHY
BODY MASS

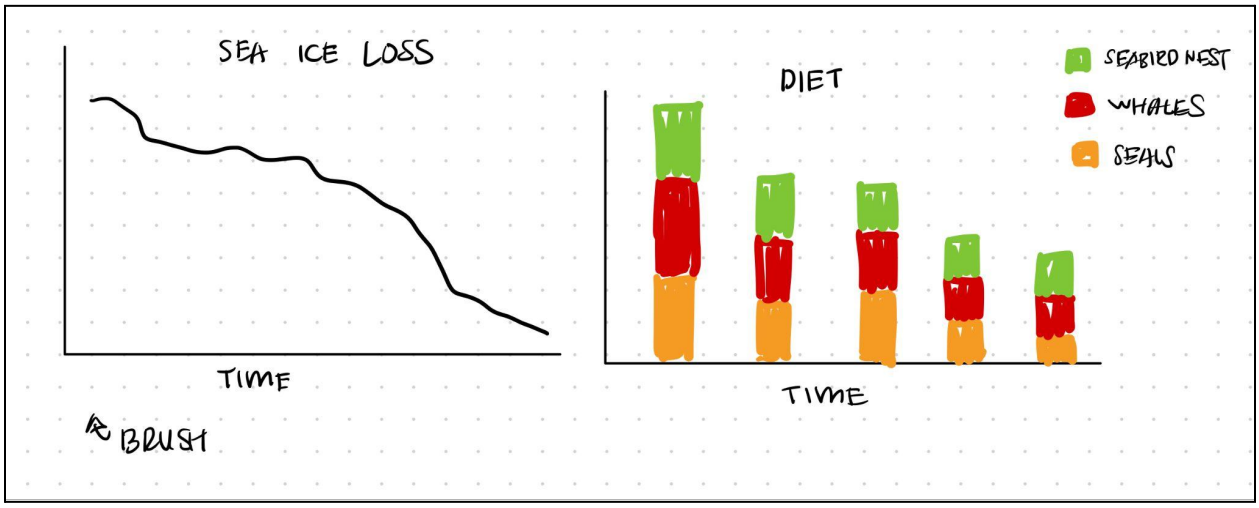
#4

**Question**: What are some insights into the health of polar bears (2013-2015)?




#5

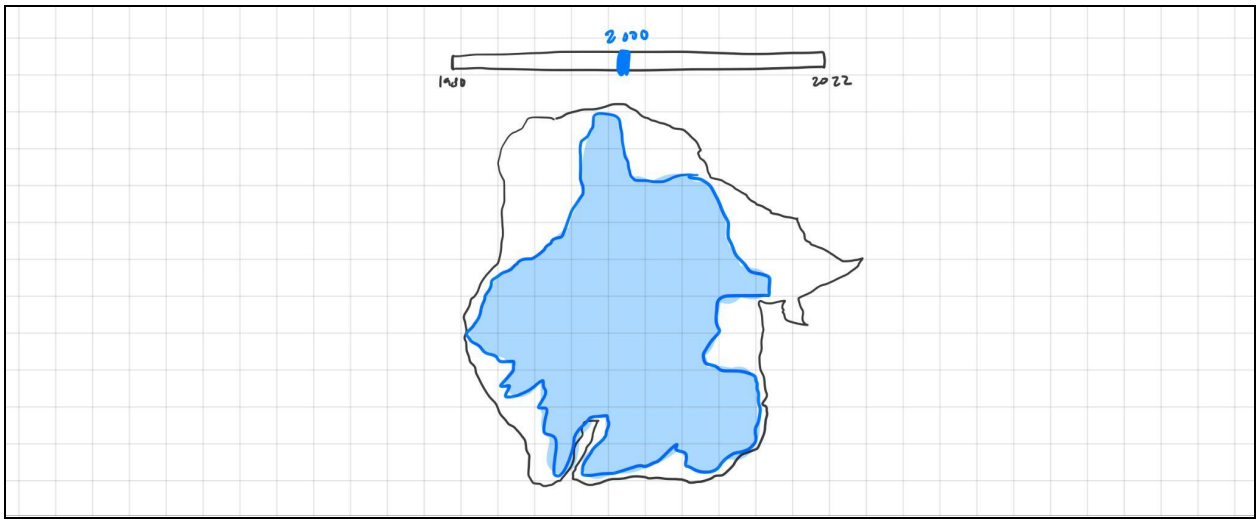
**Question:** How has ice mass loss affected polar bear diets?




## Kathy's Sketches

#6

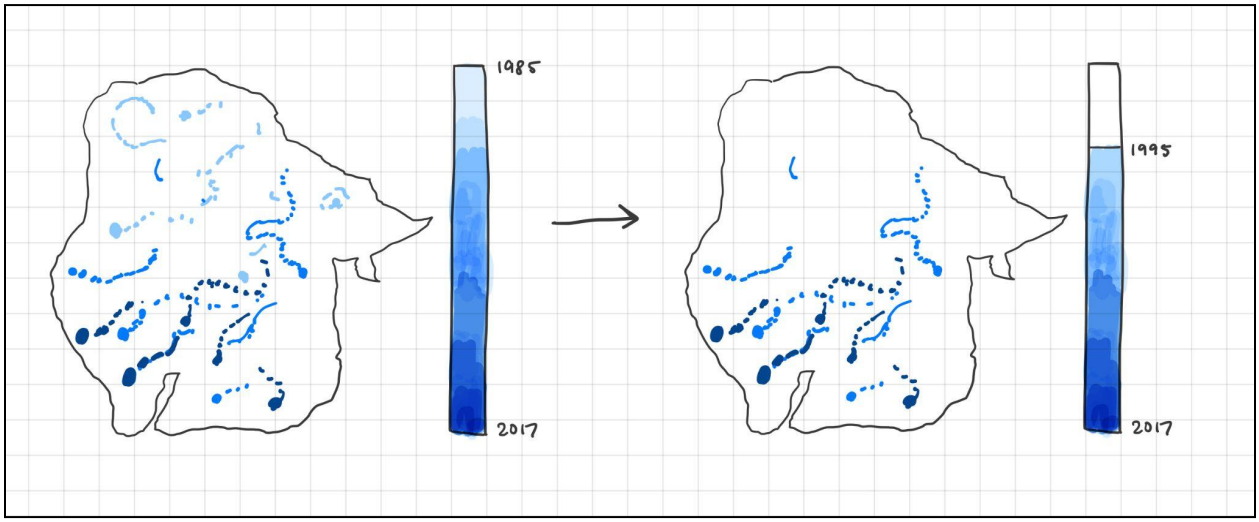
**Question**: How has arctic ice levels changed in the past few decades?




*Details: Slider bar for users to slide to what year they would like to observe. The outline is of the greatest ice extent and the blue is of the ice extent of that year.*

#7

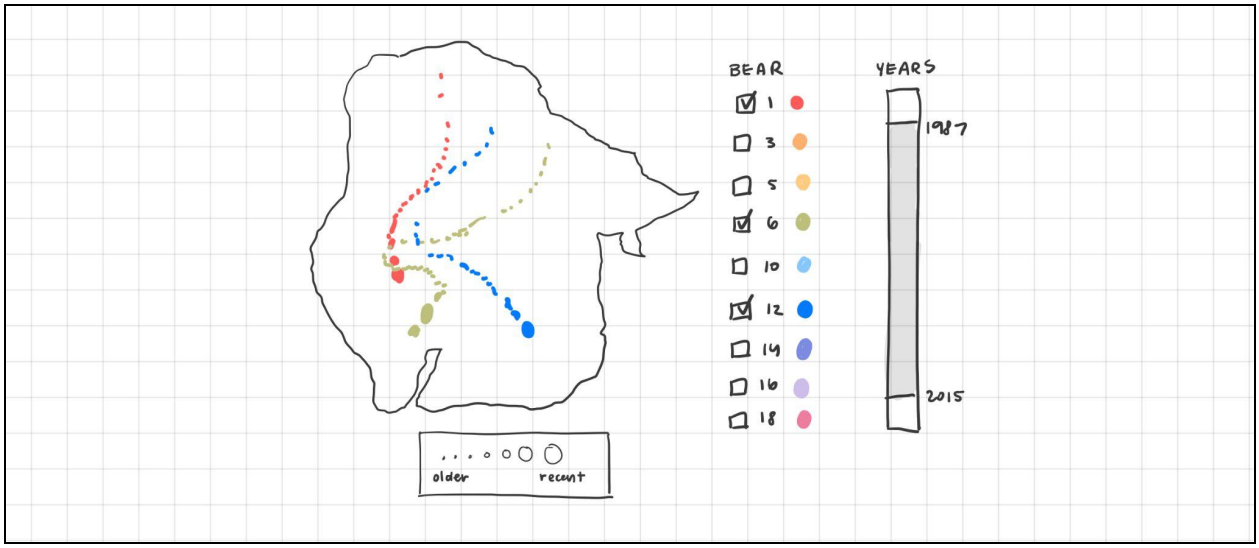
**Question**: How have polar bears' migration patterns changed?




*Details: Brush effect. Choose what years you would like to observe. Only migrations from that year are observed. The larger the dot and deeper the blue, the more recent the movement.*

#8

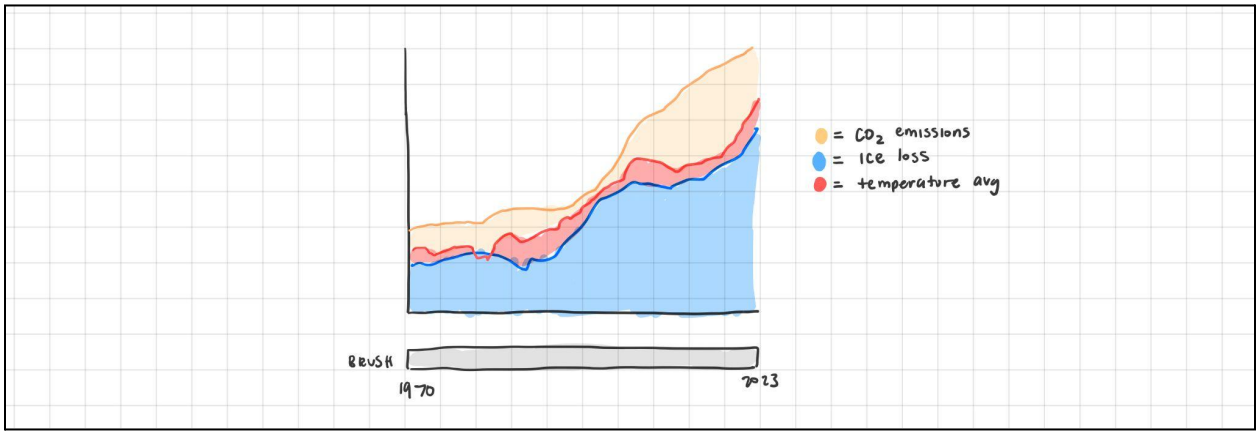
**Question**: How have polar bears' migration patterns changed?




*Details: Brush effect. Choose what years you would like to observe. Only migrations from that year are observed. Select which specific bear's path you would like to observe, and only that bear's path will be displayed. The larger the dot, the more recent the movement.*

#9

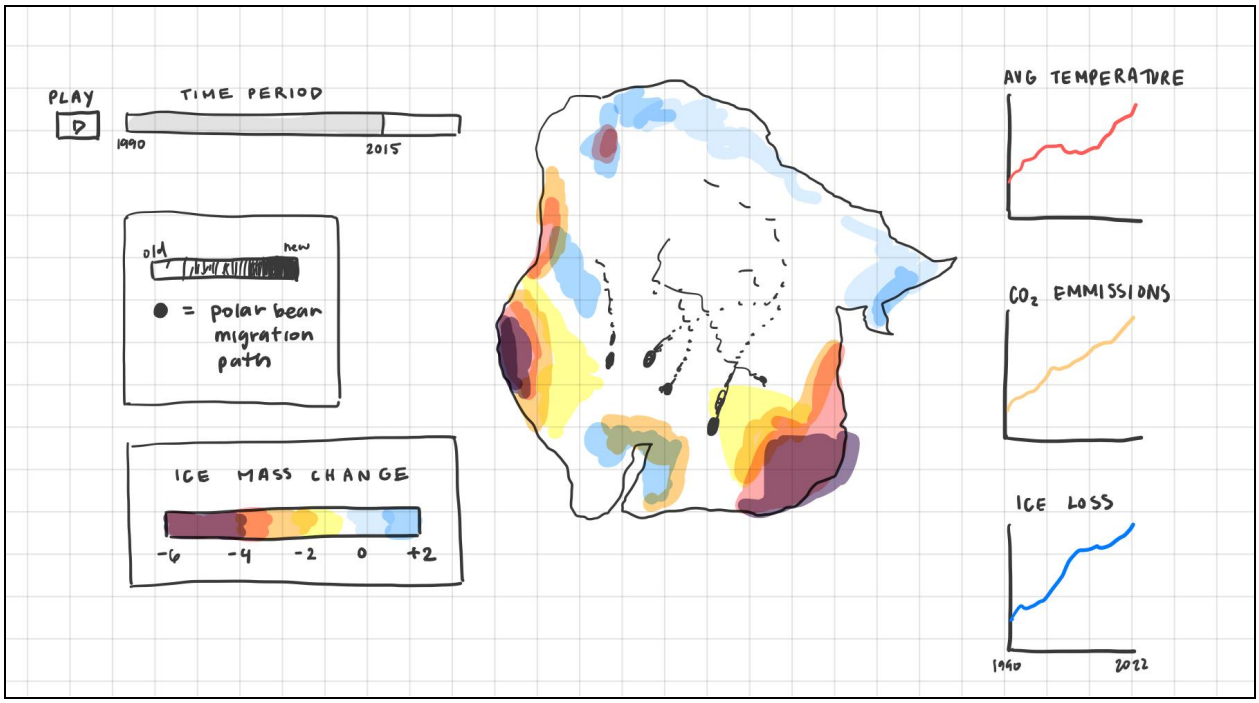
**Question**: How do CO2 emissions from human activities contribute to climate change, and what is their impact on the Arctic environment?




*Details: Brush effect. Choose what years you would like to observe. Only CO2 emissions, ice loss, and temperature averages from those time ranges will be shown.*

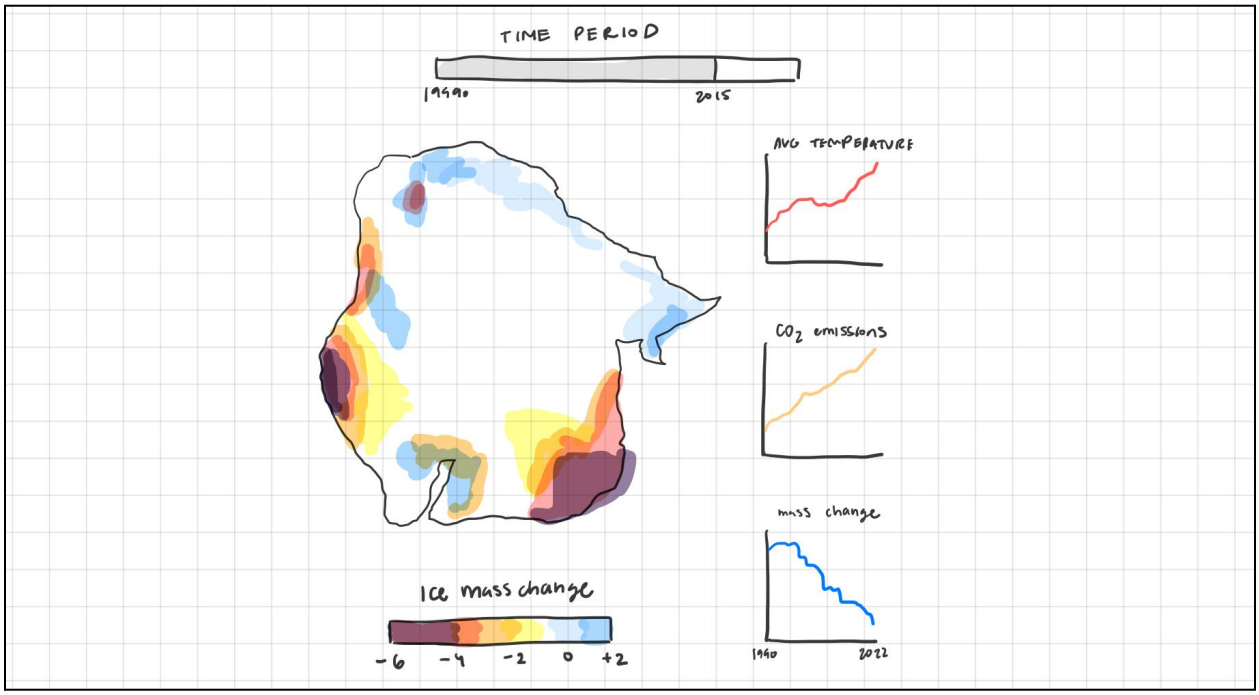
#10

**Questions:** How has sea ice levels changed in the past few decades? / How has temperature changed in the past few years? / How has climate change impacted the habitat and behavior of polar bears in the Arctic? / How do CO2 emissions from human activities contribute to climate change, and what is their impact on the Arctic environment? How have polar bears' migration patterns changed?




*Details: Select time period. Ice map will update, as will the three graphs. You can press play to view an animation from the start of your time period to the end and see how ice has changed on the map, as well as watch the lines on the line graphs be drawn. Migration paths will also be animated.*

Alternate version w/o polar bear migration:

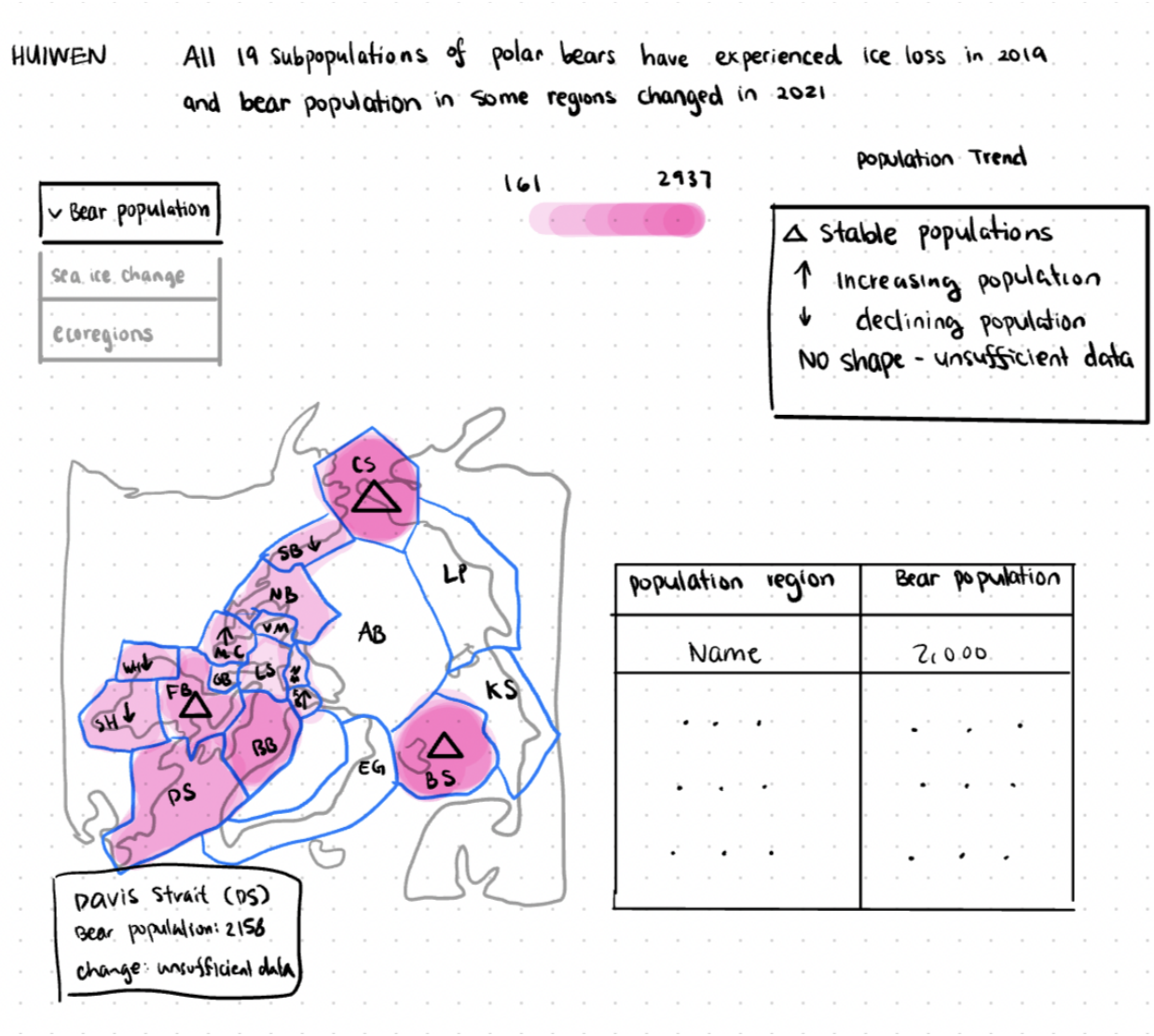


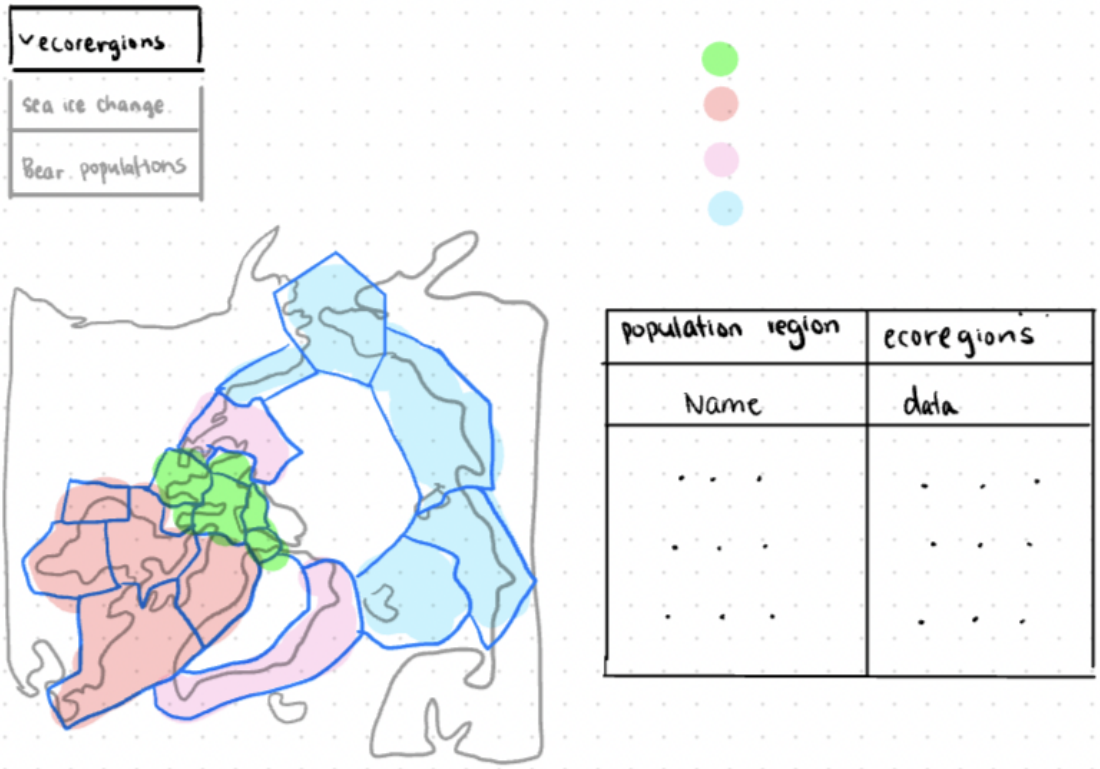

*Details: Same as previous without polar bear migration.*

## Huiwen's Sketches

#11

**Question:** How did ice loss and bear population vary in the 19 polar bear subregions in 2021?

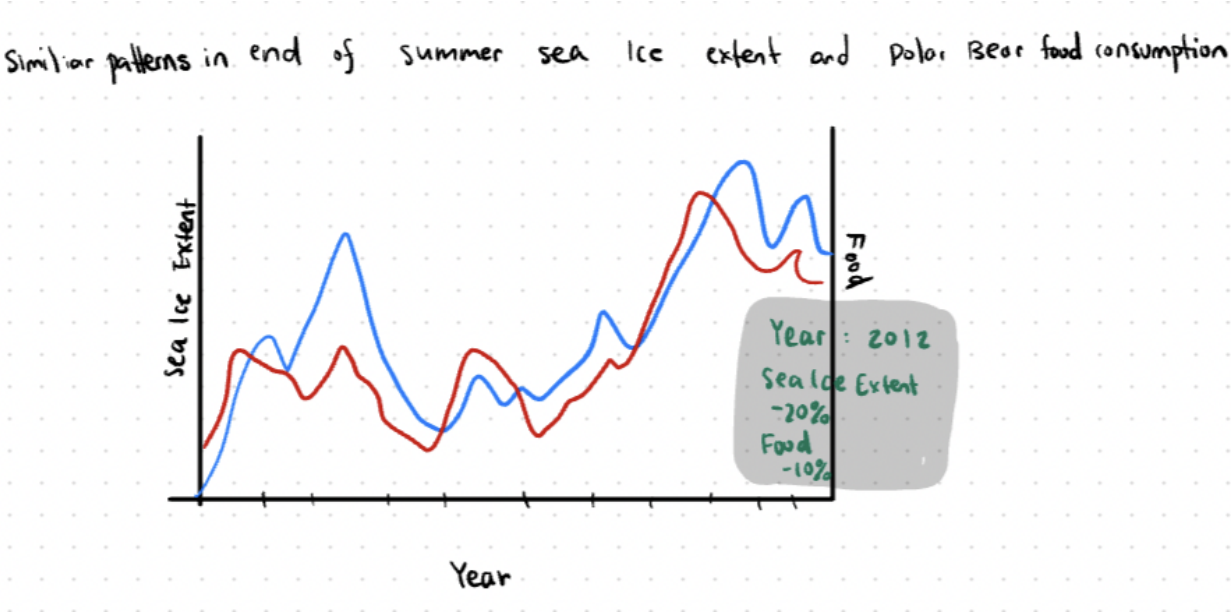



ecoregions
sea ice change
Bear populations
population region
ecoregions
Name
data
sea ice change
ecoregions
Bear populations
population region
sea ice change
Name
data

*Details: The color on the map, table, and legend update when you click on the dropdown filter. It will show data that corresponds to the selected type. The visualization shows a tooltip on hover.*

#12

**Question:** How does end of summer sea ice extent and polar bear food consumption compare?




*Details: Tooltip displays the data of selected year.*

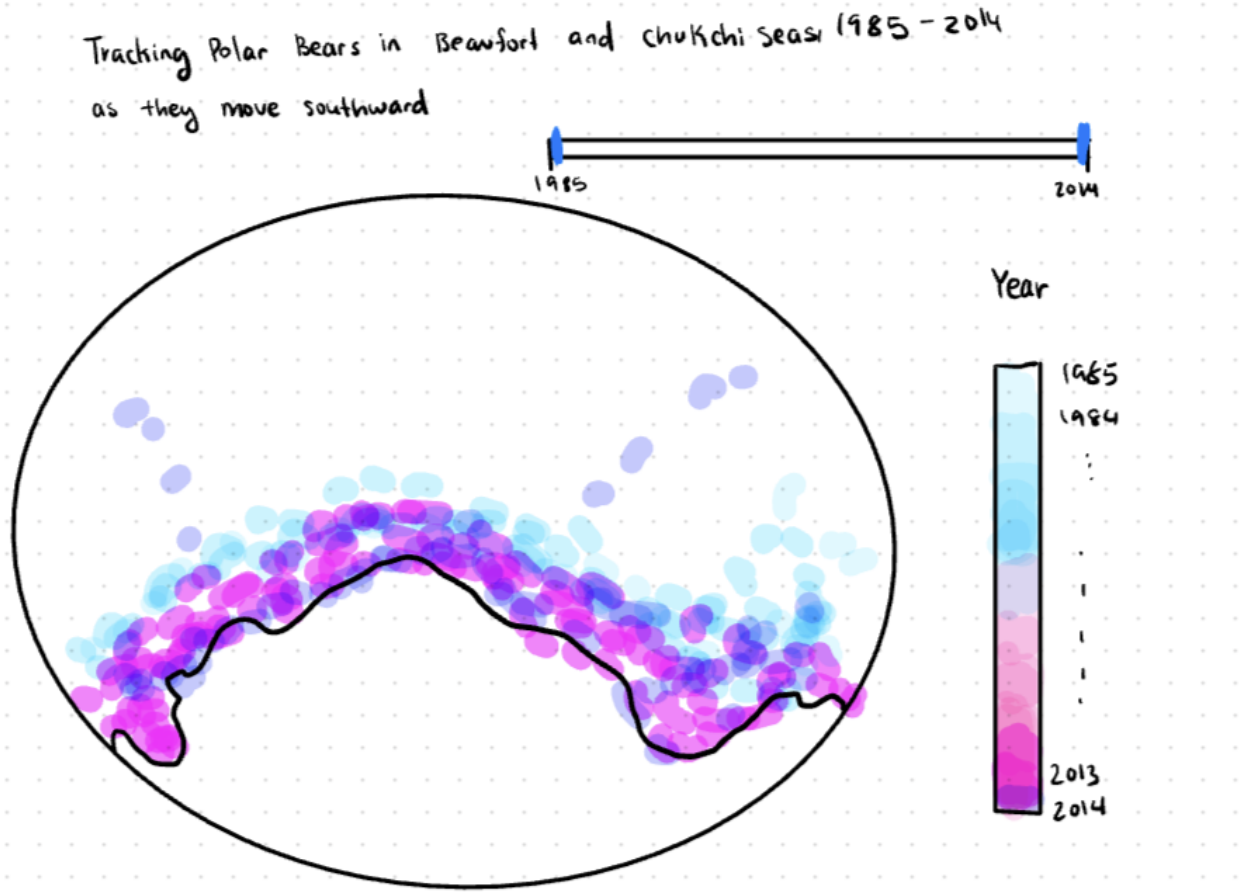
#13

**Question:** What are the diet and health indicators of individual polar bear?


*Details: The polar bear ID, diet chart, and health circles will update when the adopt me button is clicked to randomly select a polar bear from the dataset that matches the sex and age preferences.*

#14

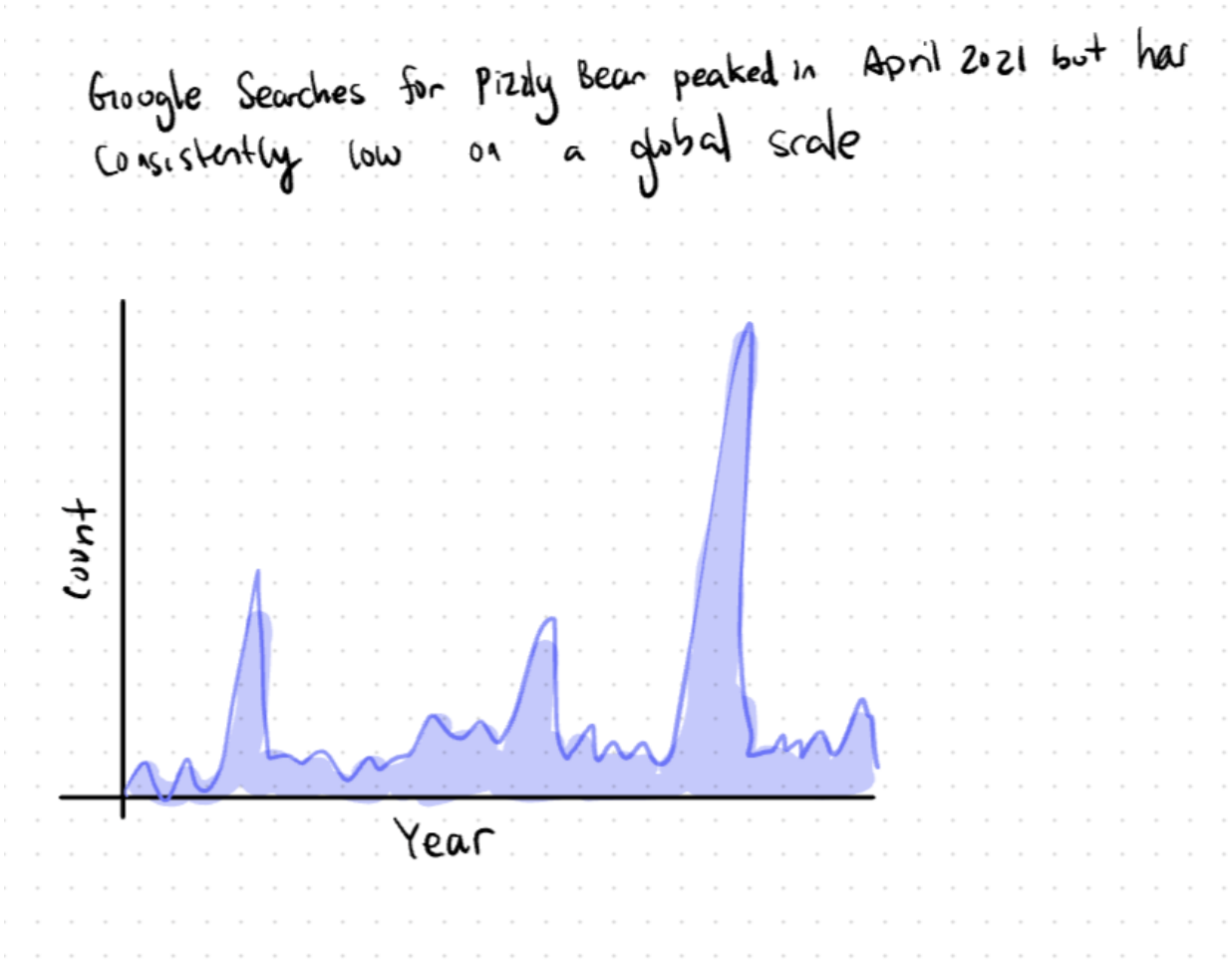
**Question**: How has climate change affect polar bear migration in  Beaufort and Chukchi Seas? Are there any patterns in polar bear migration?




*Detail: Each dot represents on polar bear satellite data from a particular year. Brush effect can filter the data points by year.*

#15

**Question:** Are people familiar with the new species of pizzly bear? What is the worldwide popularity of pizzly bear?




*Detail: On hover, the tooltip will show breakdown of searches by pizzly bear and related key terms such as grolar bear.*

## Affinity Diagramming

**Questions**

**#1 How have habitats of polar bears and grizzly bears converged over time?**

**#2 How has ice mass changed overtime due to climate change?**

#3 What are some insights into the health of polar bears (2013-2015)?

#4 How has ice mass loss affected polar bear diets?

#5 How has arctic ice levels changed in the past few decades?

**#6 How have polar bears' migration patterns changed?**

**#7 How do CO2 emissions from human activities contribute to climate change, and what is their impact on the Arctic environment?**

#8 How did ice loss and bear population vary in the 19 polar bear subregions in 2021?

#9 What are the diet and health indicators of individual polar bear?
#10 Are people familiar with the new species of pizzly bear?

| Sketch ID | Question | Author |
|---|---|---|
| 1 | 1 | JL |
| 2, 10 | 2 | JL, KZ |
| 3, 4 | 3 | JL, JL |
| 5, 12 | 4 | KZ, HC |
| 6 | 5 | KZ |
| 7, 8, 14 | 6 | KZ, KZ, HC |
| 9 | 7 | KZ |
| 11 | 8 | HC |
| 13 | 9 | HC |
| 15 | 10 | HC |

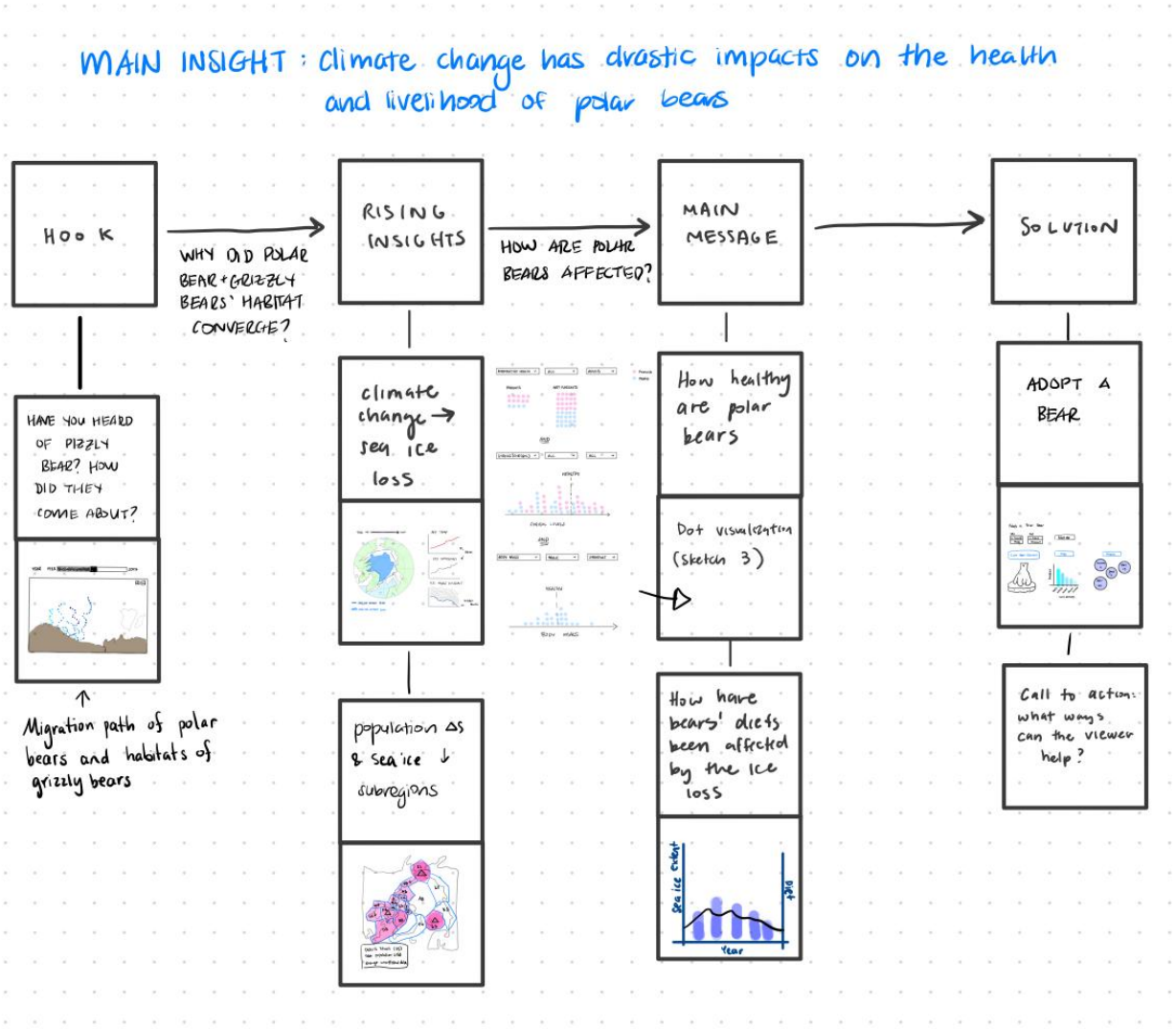
We prioritized visualizations that are core to the storyline and convey the message in a clear way. In addition, we chose visualizations that would be feasible to implement. Many of our visualizations had similar themes or features across the same questions, which is why we decided to combine most of the sketches that corresponded to a specific question we thought would be important to address.

1) Sketches from questions 1+ 6 (ID: 1, 7, 8, 14)- migration path + grizzly habitat
   - Color Dots represent polar bear migration path (from 1985 to 2014)
   - Shaded regions represent grizzly bear habitats (present vs historical)
   - Look like a combination of all of our visualizations, with the map like Jessica's but use color legend similar to Huiwen and Kathy's
2) Sketches from question 2 (ID: 2) - climate change and sea ice loss
   - Minimum viable product: line charts
3) Sketches from question 3 (ID: 3) - health status
4) Sketches from question 4 (ID: 5, 12) - diet and sea ice loss

- Combine the bar chart and the line chart together from ID 5 but we have the double y-axis and tooltip from ID 12 to show the relationship between the two

5) Sketches from question 8 (ID: 11) - 19 subpopulations change, sea ice, and ecoregion
6) Sketches for question 9 (ID: 13) - adopt a bear

## Storyboard



**Meeting Notes**

Pizzly bear as a hook

To show why polar bear are becoming like pizzly

Migration path

- Integrate climate, sea level stuff here

Polar bear by region and decline status

Diet and health changes

- Integrate climate, sea level stuff here

Adopt a bear

People's awareness

Call to action

- Scrollable js - fullpage.js
- At least 3 viz

- Start with pizzly bears
    - Have you heard of pizzly bears
    - search graph
- Climate + CO2 + ice mass loss (by month) chart w/ year filter/brush connected to sea ice Kathy
    - Min: line graph
    - Max: map
- Polar bear population by region + decline status: map with info on side + filters Huiwen
- Migration path Kathy
- Relationship between diet + sea ice loss Huiwen
    - Min: positively correlated
- Health Jessica
    - Force directed graph on reproductive health
    - Only females
    - Amount of adults who have children
    - Hair cortisol stress
    - Filters for male, female, all
- Adopt a polar bear Jessica
    - Must haves
        - What gender
        - Adult or child
    - Customize
        - Name

## Week 9

Visualization ideas

- Ice melting
- Word cloud of search key terms
- Movement of polar bears
- Line graphs of climate change

What to include in our story:

- Graph of pizzly bear searches
    - Do you know what a pizzly bear is?
- Major causes of climate change
    - Co2 emissions
    - Major sources of it (deforestation)
- (major causes of sea ice melting) eg Temperatures rising
- Sea ice melting
- Movement of polar bears
- Changes in bear population
- Changes in polar bear diet
- Migration south
- Pizzly bears!
- Compare pizzly bears + polar bears
- Pizzly bears - where do they fit in the environment?
    - How are they affecting the environment, food chain, etc.
- Vote on whether they like the name pizzly bear or grolar bear better

Who is your audience? Come up with **at least three** options and pick one target audience.

- Animal activists
- Climate advocates
- Environmental policy makers and researchers
- **Target Audience: Students interested in animal rights or climate issues**

Describe your target audience in more detail. What do they know? What are their interests? What visualization literacy do they have? At what level of detail will you present information to them?

- **What they know:**
    - Might have heard about pizzly/grolar bears briefly

    - May be familiar with the basics of climate change and its negative effects

- **What they are interested in:**
    - How climate change has affected polar bears/grizzly bears in the past 2 decades
    - Why it is important to take action
    - Action and resources
    - Understanding of how climate change affects Arctic ecosystems

- **Visualization literacy:**
    - Reasonable level of visualization literacy, as they often encounter scientific data in their studies. They are comfortable with moderately complex visualizations.
    - Level of Detail: Information should be presented at a detailed and scientific level, including precise terminology and data. Visualizations can be moderately complex, aiming to provide educational value and support academic learning.

What questions about your data will be interesting for your audience? Come up with a list of interesting questions that your audience may have about your data. The more, the better, but your team should come up with **at least ten questions**.

1. How has sea ice levels changed in the past few decades?
2. How has temperature changed in the past few years?
3. How have polar bears' migration patterns changed?
4. How have grizzly bears' migration patterns changed?
5. How has climate change impacted the habitat and behavior of polar bears in the Arctic?
6. What are the specific challenges polar bears face due to the melting of sea ice, and how does this relate to climate change?
7. Can you explain the process of polar bears migrating south and encountering grizzly bears? How does this relate to climate change and their search for food?
8. How does hybridization between polar bears and grizzly bears affect the genetic diversity of these species?
9. What are the major causes of climate change, and how do they lead to temperature rise and sea ice melting in the Arctic?
10. How do CO2 emissions from human activities contribute to climate change, and what is their impact on the Arctic environment?

11. What are the implications of climate change and the emergence of pizzly bears on the broader food chain and ecosystem in the Arctic?
12. What are the environmental consequences of the emergence of pizzly bears in the Arctic ecosystem?
13. What are the differences and similarities between polar bears and pizzly bears in terms of things like behavior, diet, physical characteristics, habitat preferences, and more?
14. Are there conservation efforts in place to protect polar bears, grizzly bears, and pizzly bears in the face of climate change, and how effective have these initiatives been?
15. What are some potential solutions to combat climate change and reduce its impact on Arctic ecosystems and wildlife?
16. How can students and young activists get involved in advocating for the protection of Arctic wildlife and addressing climate change?
17. What are some facts about pizzly bears?

**What data do you have? Briefly describe each attribute and its data type.**

- Bear population and sea ice change 2021
    - Region: It is categorical data, as it identifies different geographical areas.
    - Bear Population: It is quantitative discrete data since it consists of numerical values, and it represents the count of bears in each region.
    - Sea Ice Change: This attribute indicates the change in sea ice in each region. It is also quantitative data, as it consists of numerical continuous values.
    - Population Change: This attribute describes the likely change in the bear population in each region. It is a categorical or ordinal data type, as it provides qualitative information about the trend in bear populations, such as "Likely stable," "Likely increased," "Likely decreased," or an empty field for regions with no information provided.
    - Path_data: path shows the shape of the arctic subregion that each subpopulation lives in

- polarBear_dietSealce_southernBeaufort_atwood_2004-2016.csv
    - BearID: This attribute represents a unique identifier for each bear. It is categorical data since it serves as an identifier, and it doesn't have any inherent numerical meaning.

    - Year: This attribute indicates the year when the data was recorded. It is quantitative data since it consists of numerical values representing years.
    - Capture date: This attribute represents the date when the bear was captured, and it is a date value. Date value like this can be categorical or quantitative, depending on how we want to use it.
    - Ageclass: This attribute categorizes bears into age classes such as "Adult" or "Subadult." It is a categorical data type.
    - Sex: This attribute indicates the gender of the bear, such as "Male" or "Female." It is categorical data.
    - OW_50prct: This attribute appears to represent some measurement, possibly related to size or weight. It is quantitative data.
    - OW_15prct: This attribute may also represent a measurement related to size or weight. It is quantitative data.
    - Meltseason: This attribute is quantitative data.
    - Bearded_seal, Ringed_seal, Beluga_whale, Bowhead_whale, Seabird_nestling: These attributes appear to represent various measurements or characteristics related to the presence or abundance of different species (seals, whales, and seabirds) in the bear's diet or habitat. They are quantitative data.

- multiTimeline_of_google_searches
    - Month: This attribute represents the month and year for which the bear counts are recorded. It is quantitative.
    - Grolar bear (Worldwide): This attribute represents the count of grolar bears worldwide for each corresponding month. It is quantitative data as it consists of numerical values, indicating the number of grolar bears.
    - Pizzly bear (Worldwide): This attribute represents the count of pizzly bears worldwide for each corresponding month. It is also quantitative data, indicating the number of pizzly bears.
    - Combined (Worldwide): This attribute represents the combined count of both grolar and pizzly bears worldwide for each corresponding month. It is quantitative data, indicating the total number of these two bear types combined.

- temperature-anomaly.csv
    - Entity: This attribute represents the geographical entity for which the temperature data is recorded. In this dataset, it is always "Global," indicating that the data pertains to global temperature anomalies.
        - Data Type: Categorical

    - Code: N/A
    - Year: This attribute represents the year for which the temperature anomalies are recorded. It is a numerical value indicating the specific year.
        - Data Type: Quantitative
    - Global average temperature anomaly relative to 1961-1990: This attribute represents the global average temperature anomaly for the given year relative to the reference period of 1961-1990. It is a numerical value.
        - Data Type: Quantitative
    - Upper bound of the annual temperature anomaly (95% confidence interval): This attribute represents the upper bound of the annual temperature anomaly for the given year. It provides an upper range estimate of the temperature anomaly and is associated with a 95% confidence interval.
        - Data Type: Quantitative
    - Lower bound of the annual temperature anomaly (95% confidence interval): This attribute represents the lower bound of the annual temperature anomaly for the given year. It provides a lower range estimate of the temperature anomaly and is associated with a 95% confidence interval.
        - Data Type: Quantitative

- Monthly Sea Ice Extent
    - Month: This attribute represents the month for which the ice level values are recorded. It appears to be categorical, with values such as "January," "February," and so on.
        - Data Type: Categorical
    - Year: This attribute represents the year for which the ice level values are recorded. It is a numerical value indicating the specific year.
        - Data Type: Quantitative (Ordinal)
    - Annual Ice Extent: This attribute represents the average annual ice extent value for the corresponding year. It is a numerical value indicating the extent of ice coverage for the entire year.
        - Data Type: Quantitative
    - Ice Extent: This attribute represents the ice extent in km^2 for each specific month in the given year.
        - Data Type: Quantitative

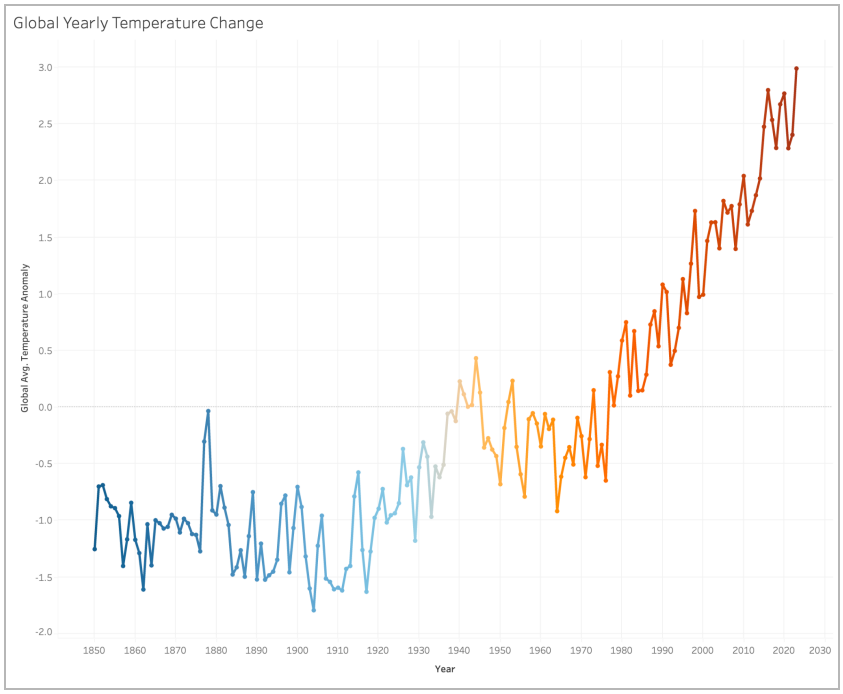
- https://alaska.usgs.gov/products/data.php?dataid=525
    - UniqueAnimalID: This attribute represents a specific polar bear.
        - DataType: Categorical
    - Timestamp: This attribute represents the time and date of an observation.

        - DataType: Quantitative (Ordinal)
    - Mu_lat: This attribute represents the latitude of an observation.
        - DataType: Quantitative
    - Mu_lon: This attribute represents the longitude of an observation.
        - DataType: Quantitative
    - Se_mu_x: This attribute represents the standard error in the x-coordinate of an observation.
        - DataType: Quantitative
    - Se_mu_y: This attribute represents the standard error in the y-coordinate of an observation.
        - DataType: Quantitative

- Grizzly Population
    - Year: This attribute represents the year.
        - Data Type: Quantitative (Ordinal)
    - Minimum Population Estimate: This attribute represents the estimated annual grizzly population size using an equation with unduplicated females with cubs of the year (COY); this estimate is conservative.
        - Data Type: Quantitative
    - Estimated Lambda: This attribute represents the per capita geometric rate of increase of the population; calculated by taking the population size in Year 1 and dividing it by the population size in Year 0. If > 1 population is growing. If < 1 population is declining.
        - Data Type: Quantitative

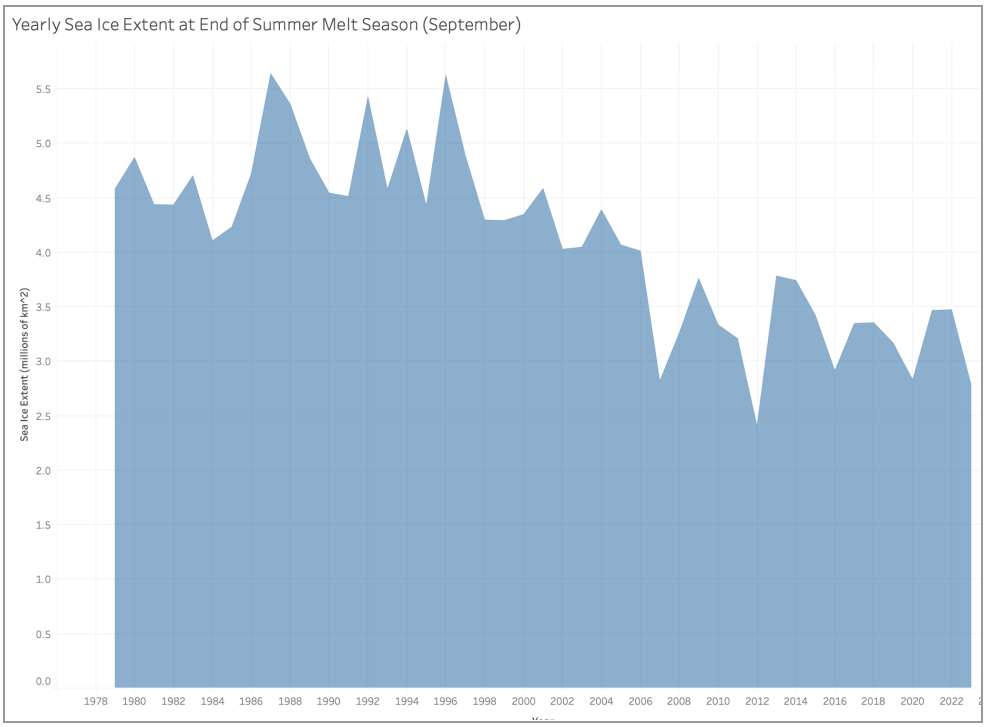
**Visualizations.**

**Kathy**: How has temperature changed in the past few years?



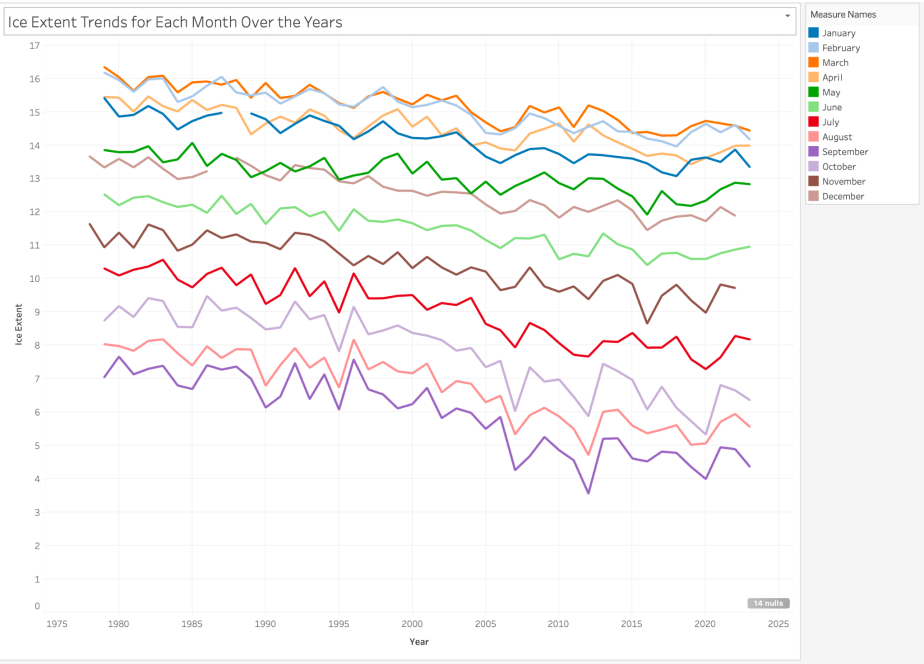

The questions I answered in Tableau, such as "How has temperature changed in the past few years?" align closely with the original questions that my team came up with because they reflect the core objectives and interests of the team. We stuck to the original questions here to maintain alignment with our team's objectives and ensure that the analysis remains focused on addressing the specific issues or topics at hand.

**Kathy**: What has the level of sea ice looked like at the end of each summer melt over the past few years? E.g. what has the minimum extent of ice looked like?



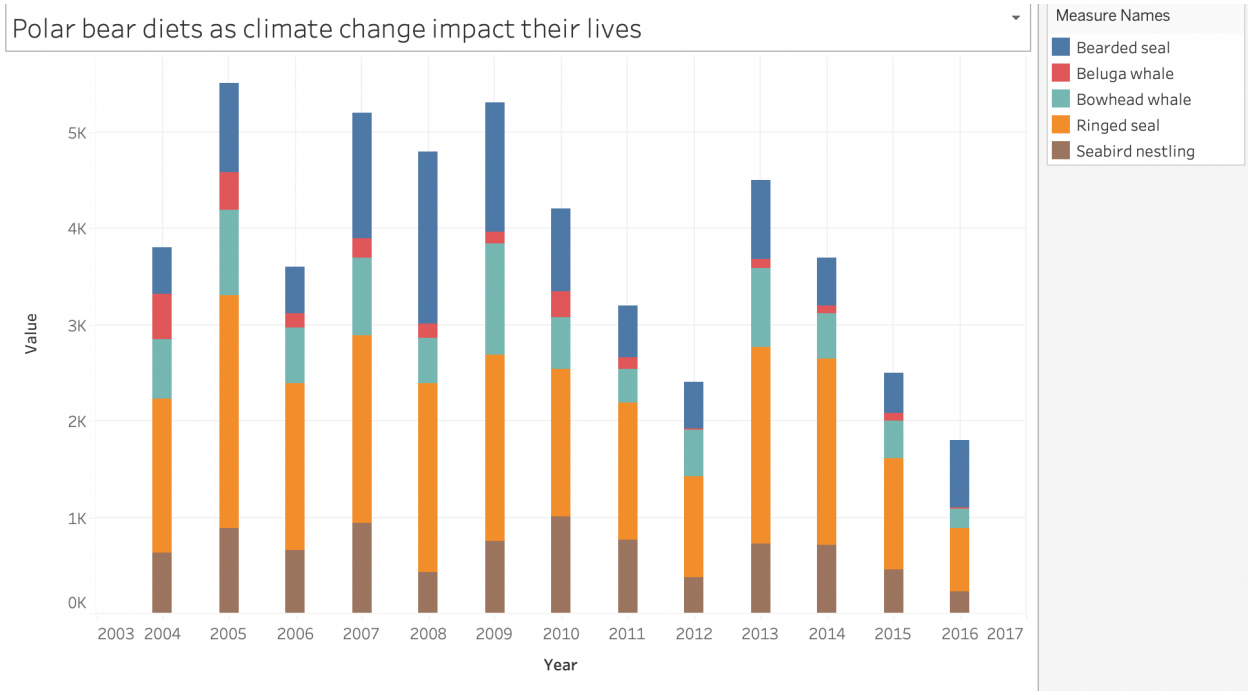

This introduces a nuanced perspective compared to the original question set that broadly asked about changes in sea ice levels. The refined question is more specific and precise, providing a detailed view of the minimum ice extent after the summer melt. This shift in focus can yields insights that are more directly relevant to certain aspects of our team's goals or research objectives. It showcases the importance of adapting and fine-tuning questions as the analysis progresses to ensure that the visualizations and data interpretations align closely with the specific information sought, even if it involves a departure from the original questions. In this case, the updated questions we answer here are likely better suited for addressing specific needs related to sea ice analysis.

**Kathy**: How have sea ice levels changed in the past few decades?



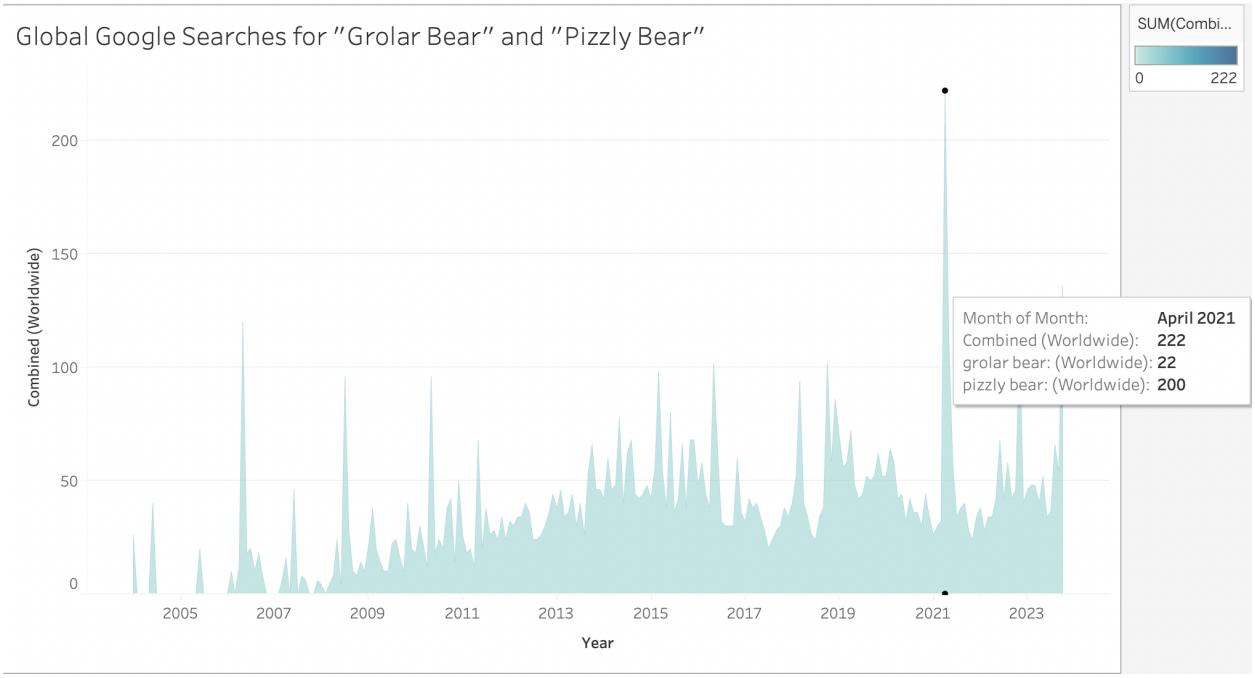

This third question we answer with this visualization, "How have sea ice levels changed in the past few decades?" closely adheres to the original question set, indicating that our team's initial objectives have been maintained in this aspect of the analysis. This alignment is not necessarily a disadvantage; it can provide a consistent and easily comparable basis for tracking changes over time. While more specific or nuanced questions can provide deeper insights, like in the last graph, a broad and consistent question like this one is valuable for establishing a foundational understanding of long-term trends and can serve as a reference point for more detailed analyses.

**Huiwen**: How has polar bear diet changed in the last 2 decades as global temperature continues to rise every year at an accelerated rate?



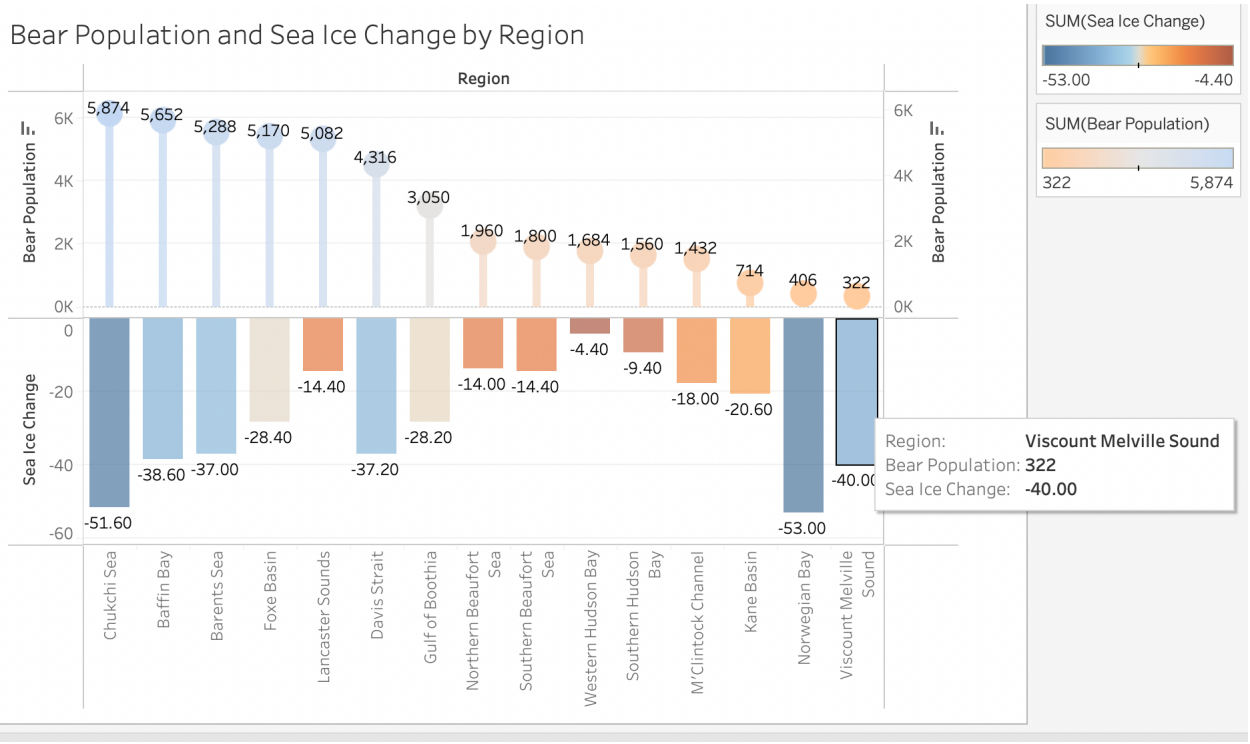

We have one question on “Can you explain the process of polar bears migrating south and encountering grizzly bears? How does this relate to climate change and their search for food?” The first part of the question is difficult to answer with just one visualization, but the second one can be answered using the stacked bar chart above. I explored how the diet of polar bears changed in the last two decades, and this correlates to the visualization that Kathy made about end of summer sea ice extent. We see that as sea ice decreases, the polar bear overall food consumption also declines. This means they have a more difficult time finding food due to melting ice in years with lower sea extent by the end of summer.

**Huiwen**: Are there any trends in global Google Searches for Pizzly Bear and Grolar Bear from 2004 to Present?



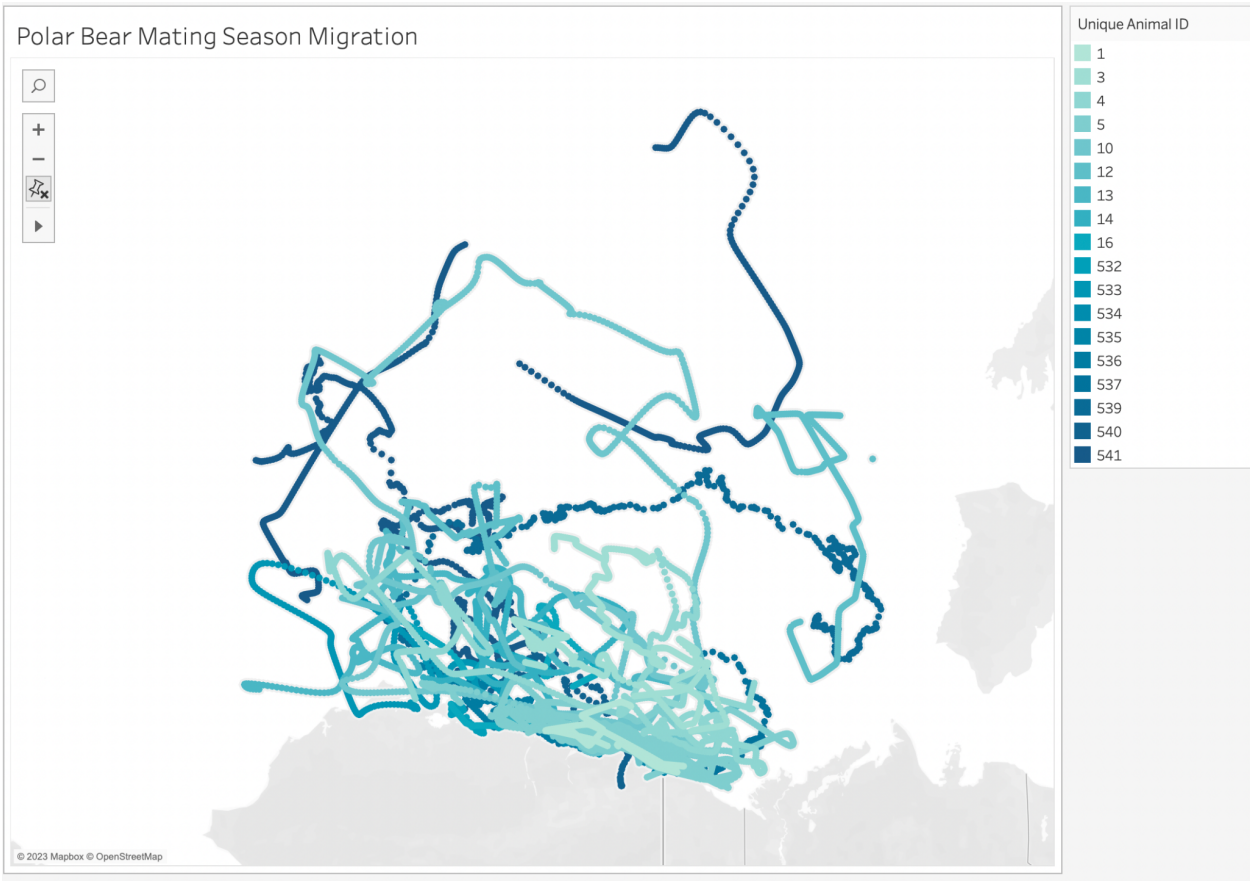

This is a question we did not include as a team, but it provides context on how many people are aware of this new evolutionary phenomenon that is caused by climate change. Interestingly, there are several spikes in the number of searches for grolar bear and pizzly bear in 2021, 2022, and 2023. However, the searches are relatively low considering the global scale of this data, indicating that many people are not educated about these hybrid bears. As such, it supports our motivation to create this project to inspire change and spread awareness.

**Huiwen:** How do bear population and sea ice change vary by region in 2021?



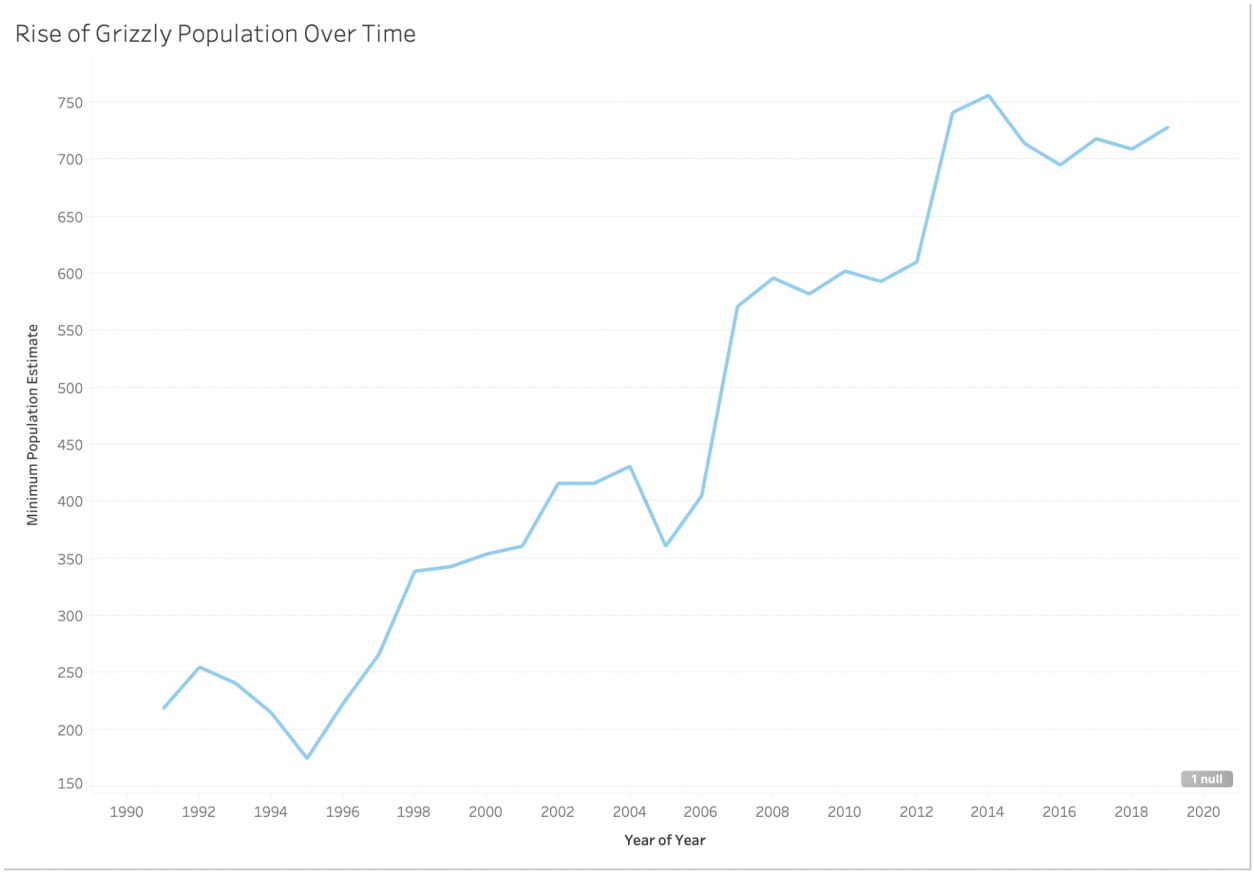

My question here is similar to several of the key questions from the group discussion because having data on how bear population and sea ice change vary by Arctic region is important to our project. There are a total of 19 Arctic regions where polar bears typically live, but there are limited information about 4 of those regions. Across all regions, sea ice change was drastic in 2021 with majority of the areas experiencing more than 25% loss in sea ice. This data will inform audience about the urgent need save polar bears and fight against climate crisis.

**Jessica:** How have migration paths changed over time?



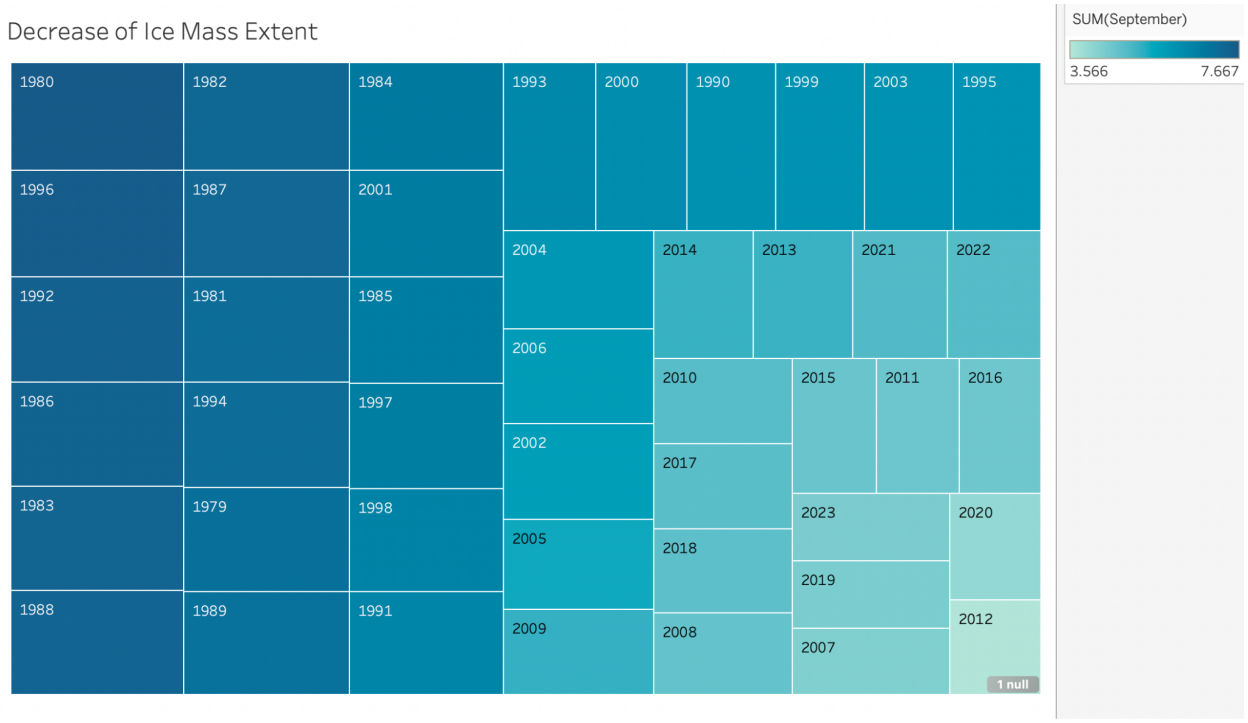

This question relates to the questions we came up with as a team. By looking at the migration paths of polar bears during the summer (mating season), we can analyze what areas they are traveling to and more specifically if these paths have moved south over time.

**Jessica:** How has the grizzly bear population changed over time?




This wasn't a specific question we wanted to answer but after some more research, I found that grizzly bear populations have been increasing while polar bear populations have been decreasing. This is concerning as sea ice mass loss and the interbreeding of the two bears is contributing to the decline of polar bears.

**Jessica:** How has ice mass extent changed due to global warming?




Similarly to the area chart above, this visualization seeks to showcase how ice mass has decreased over time. This answers an important question that explains why polar bears are moving south.

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## Week 8

Team Agreement

- We will communicate by iMessage and meet on a weekly basis on Saturdays at 3PM at Smith Center.
- Meetings are primarily for group discussion and aspects that require synchronous communication. We may also code together in real-time if necessary.
- We plan to use Visual Studio Code and GitHub, which supports collaborative coding and version control, to implement our final project. We will create documentation of all steps from ideation to prototyping to final programming.

- We discuss and draw sketches of the final visualizations together. However, we will break the coding tasks into different visualizations assigned to each person.
- It is expected that each group member will provide others an update of the work each week, and work should be committed through Git push and pull request version control to avoid merge conflicts. After commiting code, each person should also document updates on the work process.

Signatures: Huiwen Chen, Kathy Zhong, Jessica Li
Date: 10/29/2023

Project Title
Names: Huiwen Chen (hchen@college.harvard.edu), Kathy Zhong (kathyzhong@college.harvard.edu) , Jessica Li (jessica_li@college.harvard.edu)
Team Name: Bear Necessities

Basic Information: Climate Change and the Emergence of Pizzly Bears: A Cold Reality

Background and Motivation

Climate change is one of the most pressing issues of our time, impacting ecosystems, humans, and animals worldwide. The Arctic region is particularly sensitive to temperature changes, and as temperatures continue to rise, it has witnessed significant shifts in its environment. Our motivation for this project stems from an advocacy for understanding these changes and their impact on Arctic wildlife.

The emergence of the pizzly bear, a hybrid species resulting from the interbreeding of polar bears and grizzly bears, serves as a compelling case study of the effects of climate change. As the Arctic ice mass dwindles and the habitat of polar bears shrinks, they have been forced to migrate southward in search of food. In their path, they have encountered grizzly bears, leading to hybridization and the birth of the pizzly bear. This phenomenon reflects the profound ecological consequences of climate change on Arctic ecosystems.

Our project aims to shed light on these changes, explore the intricacies of hybridization, and highlight the broader ecological, evolutionary, and conservation implications. By tracking temperature changes, polar bear migration patterns, the rise of the pizzly population, and the impact of new species in the ecosystem, we hope to contribute to the growing body of knowledge surrounding the effects of climate change on biodiversity.

**Related Work.**
Our project has drawn inspiration from a range of scientific research and relevant literature.

- Several news articles discussing this hybrid species of grizzly bears.
    - https://polarbearsinternational.org/news-media/articles/pizzlies-grolars-polar-bear-grizzly-hybrid
    - https://www.sierraclub.org/sierra/meet-polar-bear-tomorrow-2
    - https://www.livescience.com/pizzly-bear-hybrids-created-by-climate-crisis.html
    - https://www.iflscience.com/pizzlies-are-hybrid-bears-that-show-a-worrying-future-for-the-arctic-70930
    - https://interactive.carbonbrief.org/polar-bears-climate-change-what-does-science-say/
    - https://peopleandcarnivores.org/grizzly-bears
    - https://mtpr.org/montana-news/2021-04-02/timeline-a-history-of-grizzly-bear-recovery-in-the-lower-48-states
    - Facts about pizzly bear https://ourplnt.com/pizzly-bear-facts/
    - https://carnegiemnh.org/climate-change-pizzly-bear/

**Data**.

- https://nsidc.org/data/g02135/versions/3
- The "Climate Change Earth Surface Temperature Data" dataset from Berkeley Earth: This comprehensive dataset offers historical records of land and ocean temperatures. https://climatedataguide.ucar.edu/climate-data/global-surface-temperatures-best-berkeley-earth-surface-temperatures
- Data on ice mass loss from GRACE (Gravity Recovery and Climate Experiment) and GRACE-FO (Follow-On) missions: These datasets provide essential insights into the loss of polar land ice mass since 2002, a critical indicator of the impact of climate change on the Arctic region. https://svs.gsfc.nasa.gov/31166
- USGS (United States Geological Survey) records on polar bear migration: USGS provides valuable data on the migration patterns of polar bears, offering a glimpse into how these majestic creatures are adapting to a changing Arctic environment.
    - https://www.usgs.gov/centers/alaska-science-center/science/polar-bear-research#science
    - https://alaska.usgs.gov/products/data.php?dataid=525
- There are 22 datasets on data.gov that relate to polar bear
    - https://catalog.data.gov/dataset?tags=polar-bear

- A simple table of polar bear population and sheet ice information from Statista
    - https://www.statista.com/statistics/1412560/polar-bear-population-and-sea-ice-change-by-region/
    - Sea ice change, bear population change in different regions in 2021
- Grizzly bear
    - https://www.montana.edu/smrc/supercharge_your_classroom/supercharge_datasets/supercharge_grizzlybears/supercharge_grizzlybear.html
- https://catalog.data.gov/dataset?tags=grizzly-bear
- Polar bear tracker
    - https://polarbearsinternational.org/polar-bear-tracker

**Data Cleanup**.
The USGS has been a valuable source of information on the migration patterns of polar bears in response to shifting environmental conditions. This data aids in understanding how polar bears are adapting to a changing Arctic ecosystem. One of the dataset comes in a csv format, so we don't need to do too much data cleaning besides aggregating and grouping data points. This following GitHub contains a cleaned up version of the polar bear ear tag from USGS that another GitHub user has created, and it is publicly available. https://gist.github.com/simonw/9f8bf23b37a42d7628c4dcc4bba10253

The Berkeley Earth dataset on climate change is a comprehensive dataset with many options; for instance,  higher spatial and temporal resolutions are available for certain regions and time periods, so we can take the relevant data entries to construct our visualizations on climate change patterns in the arctic. Additionally, there are some static visualizations on the Berkeley Earth website to illustrate examples of how we can use the data and transform it into an interactive visualization. For instance, we can visualize precipitation and temperature on a sphere using this data.

The statista table will not require any data cleaning and can allow us to model bear population and the change in sheet ice by region.

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## Week 7

Project Title: Climate Change and the Emergence of Pizzly Bears: A Cold Reality

Project Abstract:

For this project, we would like to explore how climate change has affected the Arctic landscape, causing shifts in ecosystems and more specifically, how climate change has led to the rise of a new species – the pizzly bear. We aim to explore the intricacies of this climate-driven hybridization between polar and grizzly bears and shed light on its ecological, evolutionary, and conservation implications. Our key goals are to showcase the change of Arctic ice mass over time, the migration of polar bears south, the rise of the pizzly population, and how the introduction of another species will impact other species in the ecosystem (decline of polar bear population).

Data:

- Global Temperature Change: This data set provides average land and ocean temperatures from 1750 and 850 based on geographic locations, as well as a multitude of other variables. https://www.kaggle.com/datasets/berkeleyearth/climate-change-earth-surface-temperature-data
- Ice Mass Loss: This dataset shows changes in polar land ice mass since 2002 https://grace.jpl.nasa.gov/resources/41/grace-and-grace-fo-polar-ice-mass-loss/
- Polar bear migration: https://alaska.usgs.gov/products/data.php?dataid=525