DASHBOARD DESIGN PROCESS BOOK

Conserving New Zealand's Native Freshwater Species

Interaction Design Studio 2
2014/04/06

Amit Agarwal
Angel Yu
Anne-Sophie Kim

Table of Contents

Introduction

The purpose of this project is to create a dashboard that displays climate change and biodiversity information that is relevant to New Zealand. Dashboards capture events as they occur, highlight critical situations, reveal trends, and ultimately help users identify threats and opportunities for action. Our dashboard focuses around New Zealand's native freshwater species and the threats to the country's freshwater biodiversity. It visualizes scientific data and events with the ultimate goal of pushing legislative action in an effort to conserve the country's native species.

Research

Prior to creating sketches and wireframes, we researched New Zealand's biodiversity and factors affecting its climate. We utilized news articles and data provided by the country's government and conservation organizations to identify climate and biodiversity issues in addition to their critical threats.

To begin our research, we started by looking at New Zealand's biodiversity in general and narrowed down our focus based on our findings.

Terminology

/ Biodiversity

The number and variety of all biological life - plants, animals, fungi and microorganisms - the genes they contain and the ecosystems on land or in water where they live.

Elements of Biodiversity

/ Ecological Diversity

The variety of ecosystem types such as forests, wetlands, lakes and oceans and the communities living in them. These communities interact with each other as well as the rest of their environment.

/ Species diversity
The variety of species within a particular geographic area, such as the insects, plants, birds, fish and bacteria living in a wetland.

/ Genetic diversity
The varied genetic make-up of individuals of a single species.

Critical Biodiversity Issues

Around 80 million years ago New Zealand drifted away from the landmass that included the modern continents of Antarctica and Australia. For the plants and animals this separation from other land and from humans meant that New Zealand became an isolated world where species evolved on their own.

Has one of the richest biodiversity but also highest percentages of threatened species in the world.

Arrival of humans impacted many species negatively, even causing some to go extinct. Animal species brought by humans (rats, weasels, possums, feral cats and dogs, wallabies, deer, tahr) detrimentally affected vegetation.

Arrival of Maori around 1300 CE; estimated that Polynesian rats arrived at the same time, which set off first waves of animal extinctions including nesting birds. The second wave of extinctions was set off by Maori and this was by hunting animals for food. The third wave of extinctions set off by European settlers through domesticated animals brought from overseas

Biodiversity on Land

/ Protecting ecosystems and habitats

Many distinctive natural habitats and ecosystems are under-represented in New Zealand's protected area network18, including lowland and coastal forest remnants, dunelands, natural shrublands, wetlands, and lowland tussocklands. Many of these habitats are scarce, located on private land and vulnerable to further loss.

/ Habitat fragmentation

Fragmentation of natural areas through ongoing land use changes has produced many isolated remnants that are important for biodiversity but vulnerable to continuing degradation, including invasion by pests and weeds and loss of indigenous species.

/ Threatened Species

About 1000 indigenous species on land are known to be at risk from insufficient or degraded habitat, plant and animal pests, or the adverse effects of human activities. Many populations of threatened species continue to decline as attention and funds are focused on a small number of highly threatened, and often most visually appealing, native species.

Freshwater Biodiversity

/ Managing freshwater habitats and ecosystems

The threats to freshwater biodiversity are diverse and pervasive. Many land use practices adversely affect freshwater biodiversity, through their effects on freshwater habitats and ecosystems, including underground water systems. These practices include drainage, flood control schemes, removal of riparian vegetation, stock access and the addition of sediment, nutrients and contaminants from agricultural, forestry, industrial, residential and urban runoff. Management responsibilities and accountabilities are often not clearly specified in the freshwater environment.

/ Migration Barrier

Barriers to fish migration in rivers can prevent fish from completing their life cycles; most indigenous fish species are diadromous (meaning that they migrate to and from the sea) and most catchments in New Zealand have some artificial barriers. For some species (such as eels) the effects of the barriers preventing downstream migration to spawning grounds may be the hardest to overcome.

/ Water Quality

Poor water quality in many rivers also frequently limits freshwater biodiversity, and therefore decisions about land use, as well as discharges to water, have significant implications for aquatic biodiversity.

/ Protection of Indigenous Species

Indigenous freshwater species are threatened from a variety of causes, including land use impacts and competition or predation from pest species.

/ Lack of Data

Our knowledge of the distribution and taxonomy of many indigenous freshwater species is limited. Existing survey and monitoring programmes are generally not sufficient to define freshwater biodiversity or to identify changes in freshwater species composition and abundance or habitat condition.

Coastal and Marine Biodiversity

/ Habitats

Although coastal waters and habitats are generally of high quality by international standards they are under stress in some areas - in particular estuaries and the mouths of rivers near urban areas.

/ Species

Some of our coastal and marine species are at risk from human activities, in particular fishing and land-based activities such as sedimentation.

The effects of pollution, particularly persistent organic pollutants, and sediments on species and ecosystems are unknown.
Commercial fishing, although managed through the QMS, has depleted stocks of some target species (for example, snapper, orange roughy and rock lobster) to below levels judged desirable by fisheries scientists and managers.
Management should focus on rebuilding depleted stocks and avoiding, remedying or mitigating any negative effects of fishing on ecosystems.

/ Biosecurity

New Zealand’s coastal and marine environment is vulnerable to the establishment and spread of introduced marine pest species and diseases.

New marine organisms may arrive, and be transferred around New Zealand waters, in ballast water (used to stabilise ships) or attached to the hulls of visiting ships and fishing and recreational vessels.

There is a range of measures under the Fisheries Act which can be used to provide protection for fisheries purposes. These include area closures, seasonal area closures, restrictions on certain fishing techniques, partial closures to certain commercial fishing, taiapure and mataitai.

Climate Change Effects

- Based on the latest climate projections for New Zealand, by the end of this century we are likely to experience:
- Higher temperatures – greater increases in the North Island than the South, with the greatest warming in the northeast (although the amount of warming in New Zealand is likely to be lower than the global average)

- Rising Sea Levels
- Frequent extreme weather events – such as droughts (especially in the east of New Zealand) and floods
- Change in rainfall patterns – with increased summer rainfall in the north and east of the North Island and increased winter rainfall in many parts of the South Island.

Causes for Species Extinction

We also characterised each threat as largely stemming from global human activities, catchment based activities, human activity directly in the sea or stemming from a mixture of two or more of these. We found the two top threats, 83% of the top six threats, 67% of the top twelve threats and over half of the twenty-six top threats fully, or in part, stemmed from human activities external to the marine environment itself.

Table: Causes of extinction for certain species

18	Unknown
20	Habitat destruction
10	Predation by rats (brown rat, Norwegian rat, Polynesian rat)
14	Predation by other introduced carnivores (stoat, cat, dog)
3	Predation by/ competition with introduced trout
1	Human interference
2	Human food
2	Feral browsing introduced species (deer)
3	Collecting
3	Fire/tree felling
3	Always been rare

Threat Classification System categories

NZTCS categories for native species

Lamprey Research for Dashboard

Nowadays, large accumulations of adults are occasionally found where their upstream migration is blocked by obstructions (e.g. dams and waterfalls). Additionally, large numbers of ammocoetes may be found if one looks in the right habitat.

Given the probable location of spawning (small, cobbled, bush clad streams), it is hard to imagine that the conversion of most of New Zealand's lowland forest to farmland has not had a profound effect on the distribution and abundance of lamprey as it has on other species

Adults must surely now have to travel further upstream in many parts of the country to find suitable spawning grounds. Additionally, the overall area of suitable spawning habitat has decreased. To ensure the maintenance of lamprey populations, we must ensure both the preservation of spawning and ammocoetes habitat and the free passage between such habitat and the ocean.

Another potential threat to lamprey is the fact that since the development of commercial fishing in New Zealand waters, there are less potential prey fish in the sea. The effect of this on adult survival, growth and fecundity is unlikely to ever be known.

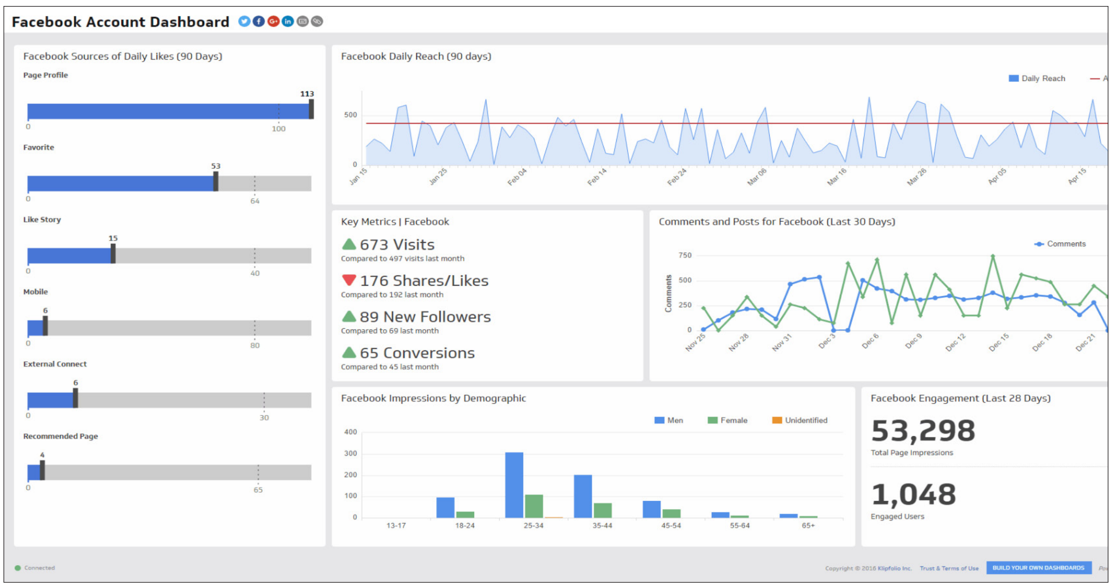
The installation of hydro dams on many major rivers has probably affected the abundance and distribution of this species through preventing access to large parts of its former upstream range (James 2008). Given that spawning is most likely to occur in small, boulder forest streams, it is expected that the conversion of most of the lowland forest to farmland in New Zealand has had a profound effect on the distribution and abundance of this species here, as it has on other freshwater fish species. Adults probably now have to travel further upstream to find suitable spawning habitat (which may negatively impact the condition of the adults) and the overall area of suitable spawning habitat has decreased (James 2008). This is confounded by the recently (2011) discovered Lamprey Reddening Syndrome (LRS), which is killing large numbers of pre-reproductive adults during their upstream migration. The cause of this syndrome is yet to be discovered, but LRS may pose a real threat to declining lamprey populations in New Zealand as it occurs across Southland, which is where adult lamprey are thought to be in the highest abundance. It is possible that trout predation on juveniles is also a threat (David pers. obs. 2011). Threats to the adult marine stage are unknown but may include alterations of prey and accumulation of contaminants.

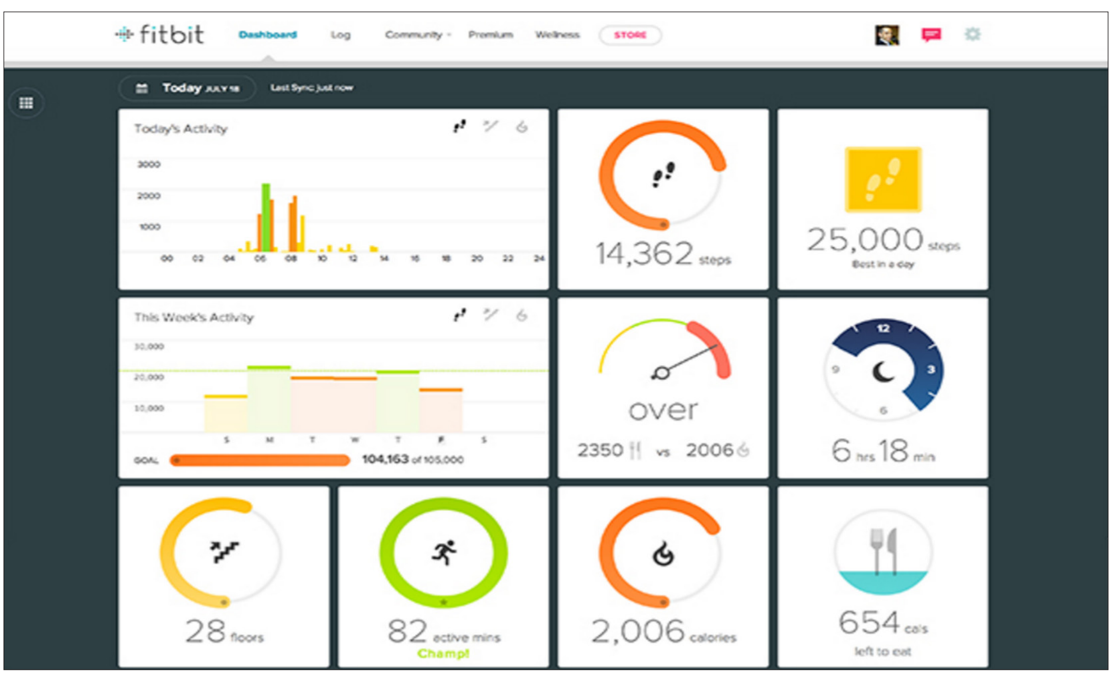
Issues

- The general abundance of lamprey and how this may vary from year to year is unknown.
- The actual distribution of lamprey in New Zealand is not fully known.
- Lamprey spawning habitat and behaviour is undocumented.
- The extent of existing Maori fisheries and whether catches have changed over time.
- All aspects of the ocean going stage of the lamprey lifecycle, e.g. where, how far, how long, what prey species?

Ideation&Sketches

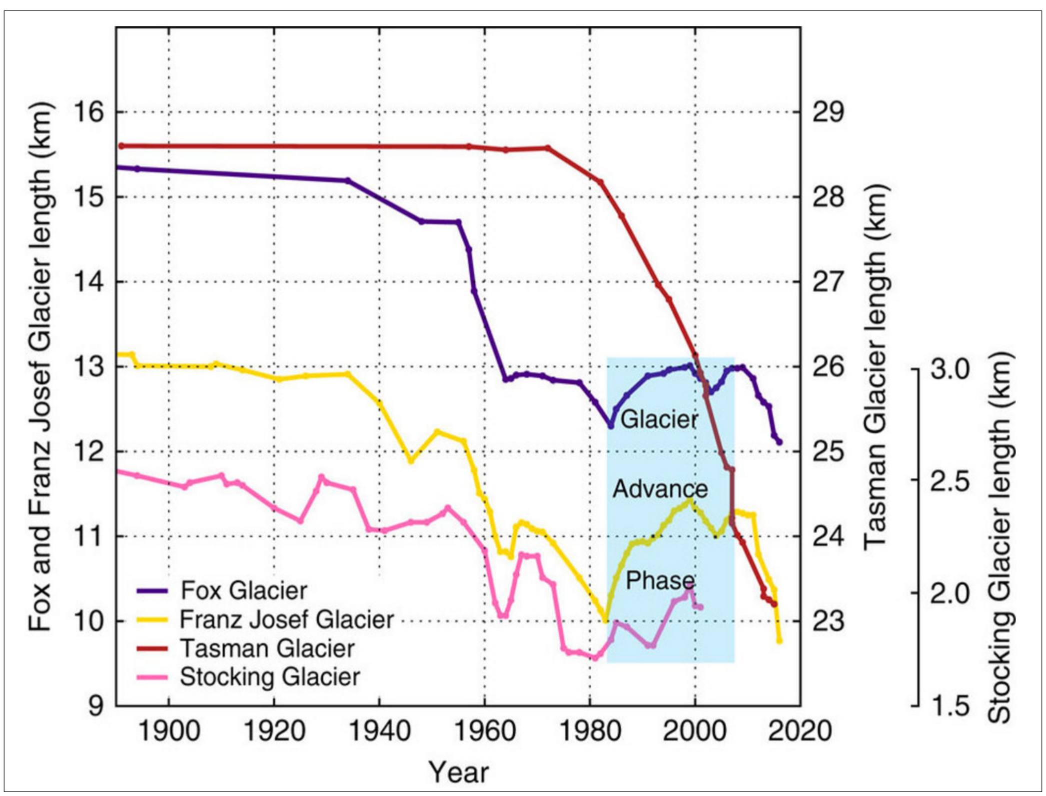
In addition to researching New Zealand's biodiversity, we carefully considered different methods and forms of information visualization. We wanted the data to be easily understood by users while still conveying all factors we considered important to the issue of biodiversity. Furthermore, we wanted the visuals to be aesthetically pleasing without becoming tiring over time; since we knew that this dashboard would be in sight at almost all times, we wanted it to capture user attention without being too distracting.


Facebook Account Dashboard
Facebook Sources of Daily Likes (90 Days)
Page Profile
Favorite
Like Story
Mobile
External Connect
Recommended Page
Facebook Daily Reach (90 days)
Daily Reach
Key Metrics | Facebook
673 Visits
Compared to 497 visits last month
176 Shares/Likes
Compared to 192 last month
89 New Followers
Compared to 69 last month
65 Conversions
Compared to 45 last month
Comments and Posts for Facebook (Last 30 Days)
Comments
Facebook Impressions by Demographic
Men
Female
Unidentified
Facebook Engagement (Last 28 Days)
53,298
Total Page Impressions
1,048
Engaged Users


fitbit
Dashboard
Log
Community
Premium
Wellness
STORE
Today
Last Sync just now
Today's Activity
14,362 steps
25,000 steps
Best in a day
This Week's Activity
GOAL
104,163 of 105,000
over
2350 vs 2006
6 hrs 18 min
28 floors
82 active mins
Champ!
2,006 calories
654 cals
left to eat

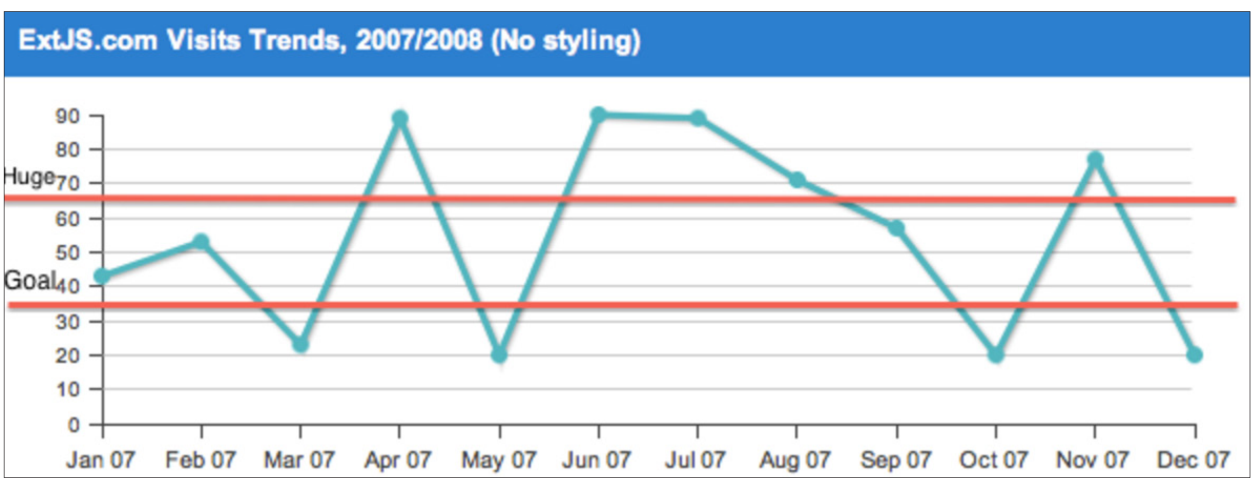
We gathered inspiration from existing dashboards, including Facebook's dashboard for analytics (left top) and Fitbit's dashboard for health and physical activity (left bottom). We thought these dashboards were glanceable and easy to understand. As a bonus, Fitbit's dashboard is also visually engaging and appealing while maintaining a clean interface.

Using our research and data, we considered different forms and methods of visualization for each factor we wanted to portray in our dashboard.

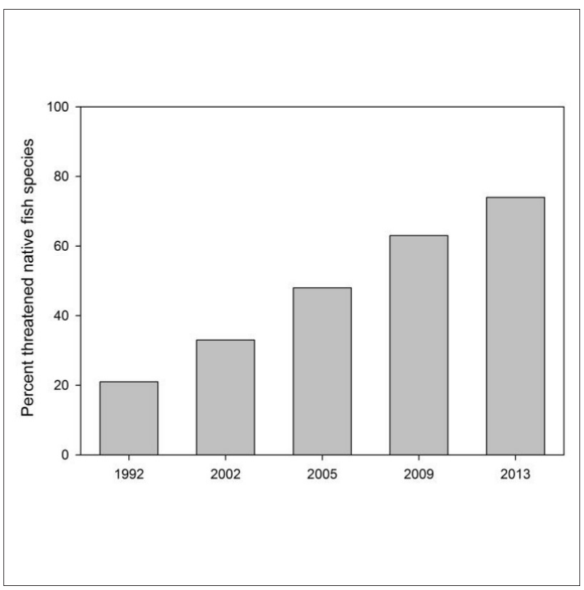


Since we wanted to convey trends in factors such as glacier length, commercial fishing, and water pH, line graphs seemed most appropriate in terms of conveying past trends (image on p19). Since data points typically don't fall on a perfectly linear plot, we also considered illustrating the actual data points with the observed trend line.

We also considered conveying specific thresholds and goals set by the NZ government on line charts, similar to the graph below.



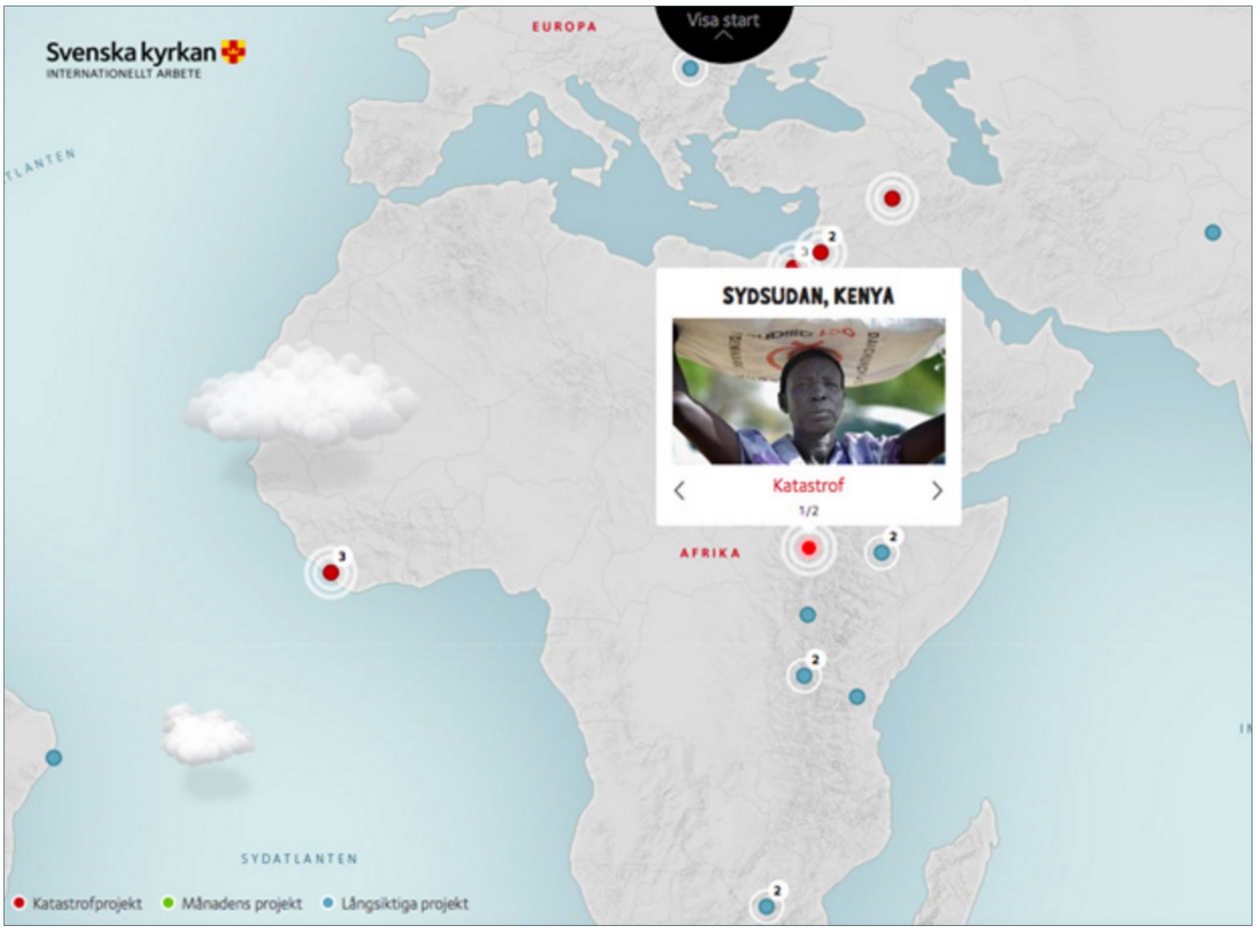
While line graphs effectively show trends in data, we also wanted to convey a concept of increasing or decreasing volume with the visualization for number of species at risk over time. We considered bar graphs (see below) and histograms, and ultimately decided to do a hybrid with a filled line graph.



In addition to past and predicted trends, one goal of our dashboard was to convey current events as they happen. Although animating the graphs and data might convey changes in real-time, we considered including a type of visualization that would show currently relevant events.

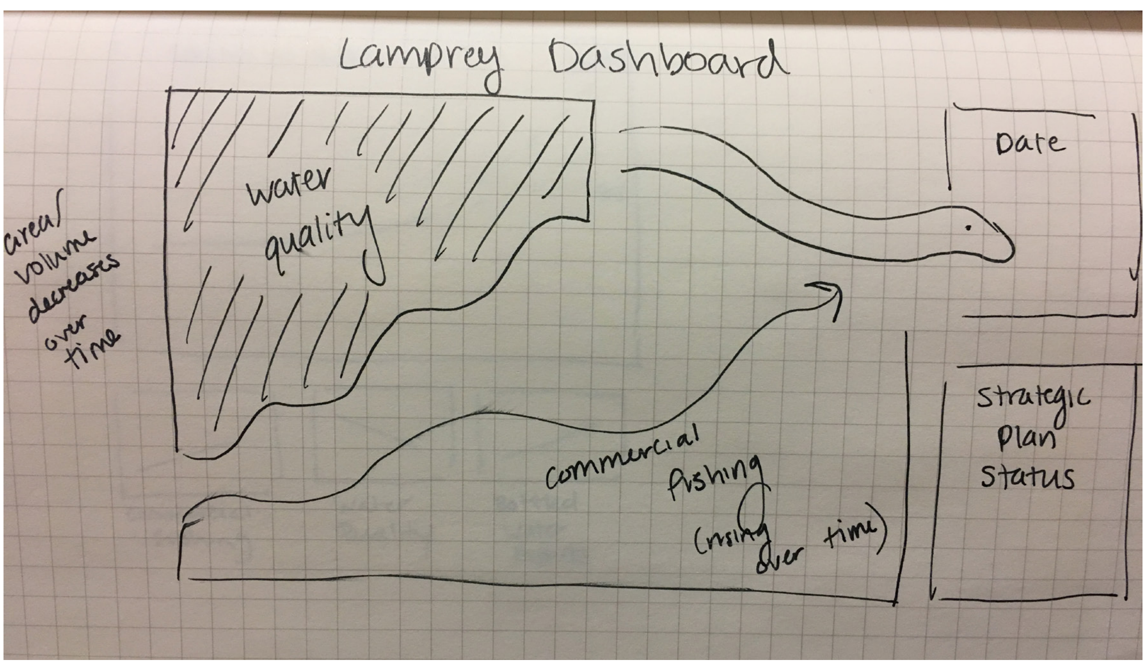
While researching news stories and articles, we found that critical events could be traced back to a geographical location that might be relevant to a policymaker who is watching a specific area, or an area that has been particularly affected by certain factors such as commercial fishing or water acidification. Based on this, we visualized tooltips on a map where each geographic marker conveyed information about an event (see image to the right).

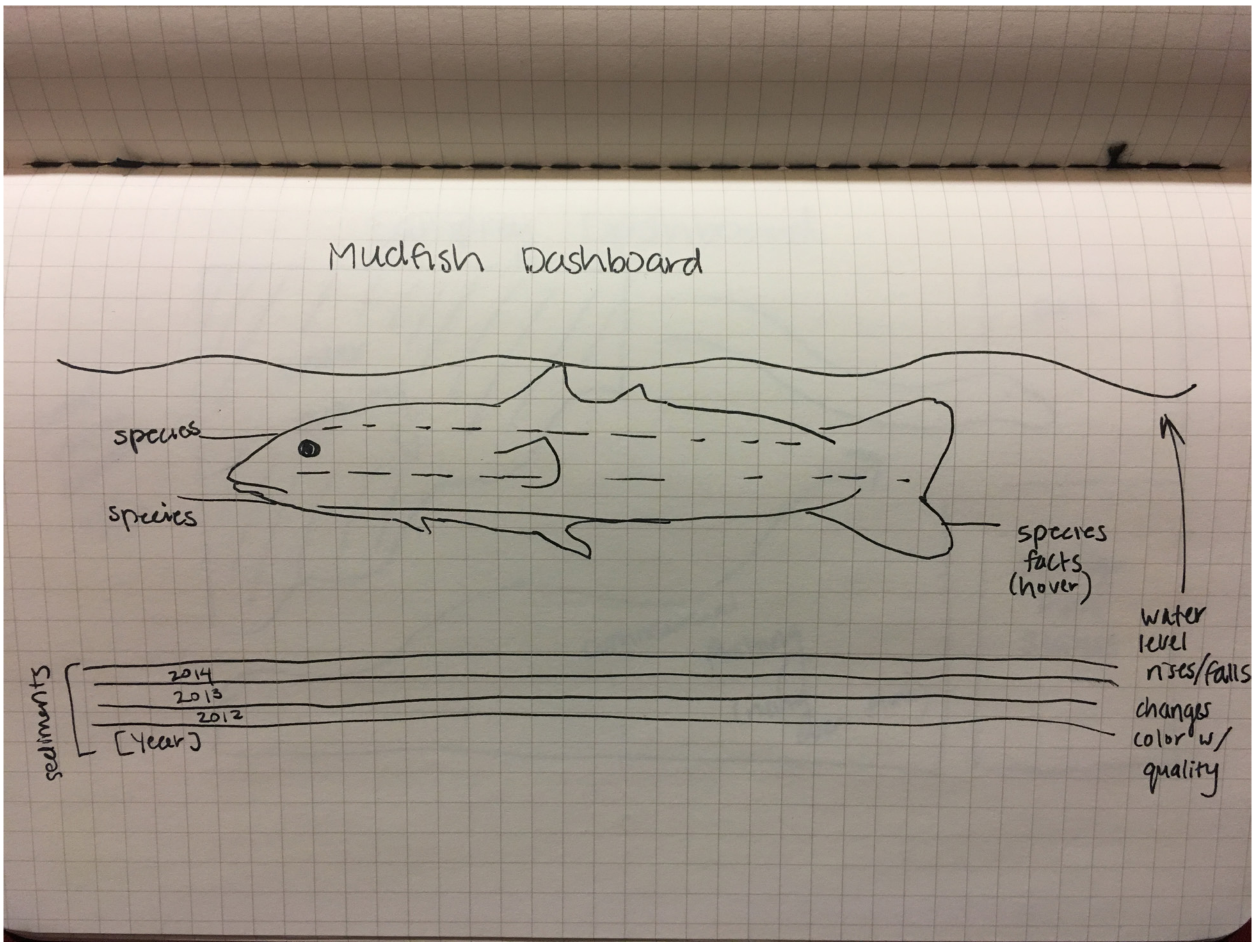
Since the dashboard isn't interactive in a sense that the user cannot directly manipulate visuals, we considered mapping events while coordinating information simultaneously in some of our final designs.

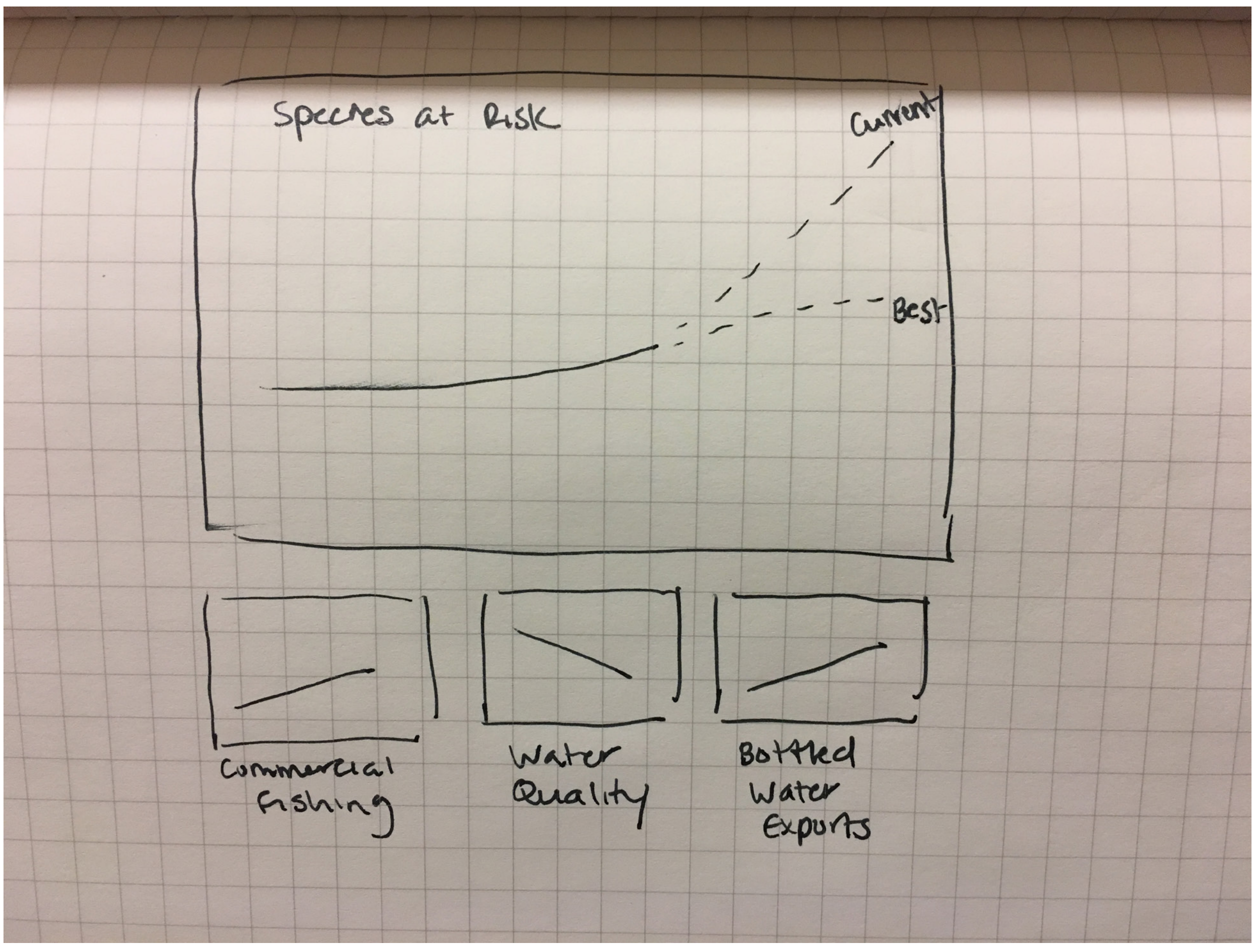

Svenska kyrkan
INTERNATIONELLT ARBETE
EUROPA
Visa start
SYDSUDAN, KENYA
Katastrof
1/2
AFRIKA
SYDATLANTEN
Katastrofprojekt
Månadens projekt
Långsiktiga projekt

After researching potential biodiversity causes and issues we began to ideate and create sketches for a dashboard used by policymakers.

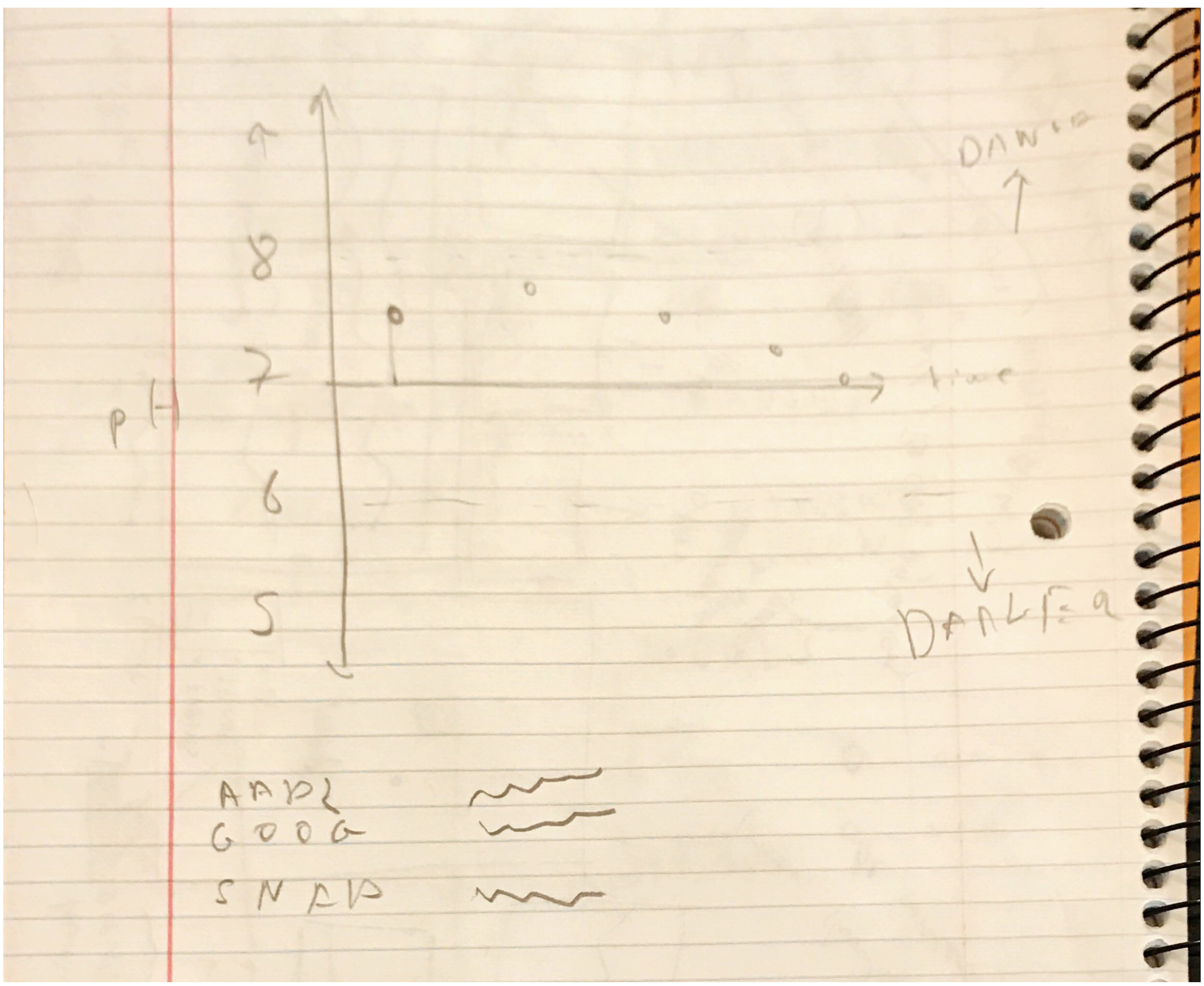
We looked into specific endangered or at-risk freshwater species such as the lamprey and mudfish, as well as factors that affect quality of life and population in those species. Based on data and news events surrounding excessive bottled water exports, poorly controlled commercial fishing, and alarming water quality, we started sketching some ideas.



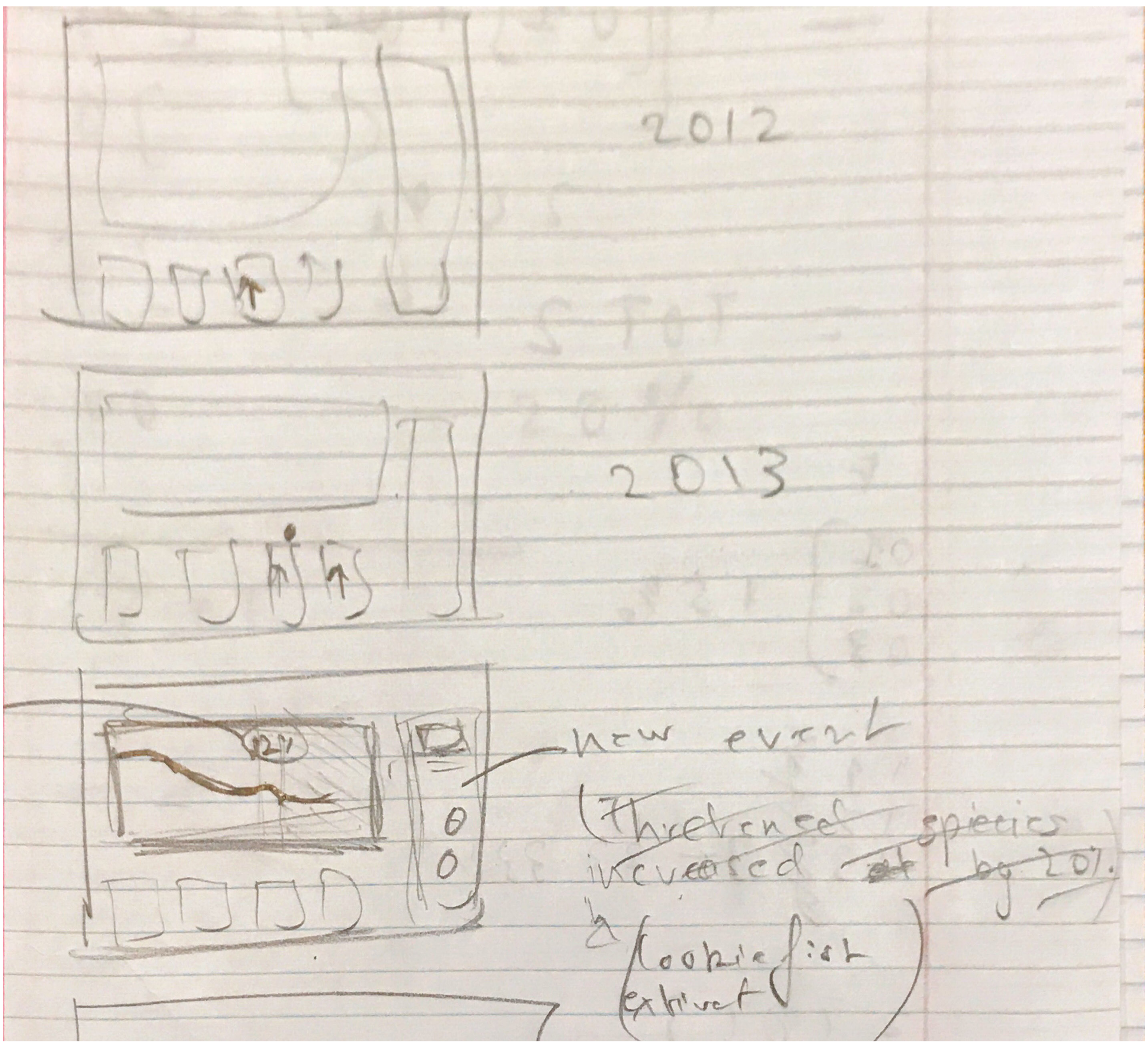

Mudfish Dashboard
species
species
species facts (hover)
water level rises/falls
changes color w/ quality
sediments
2014
2013
2012
[Year]

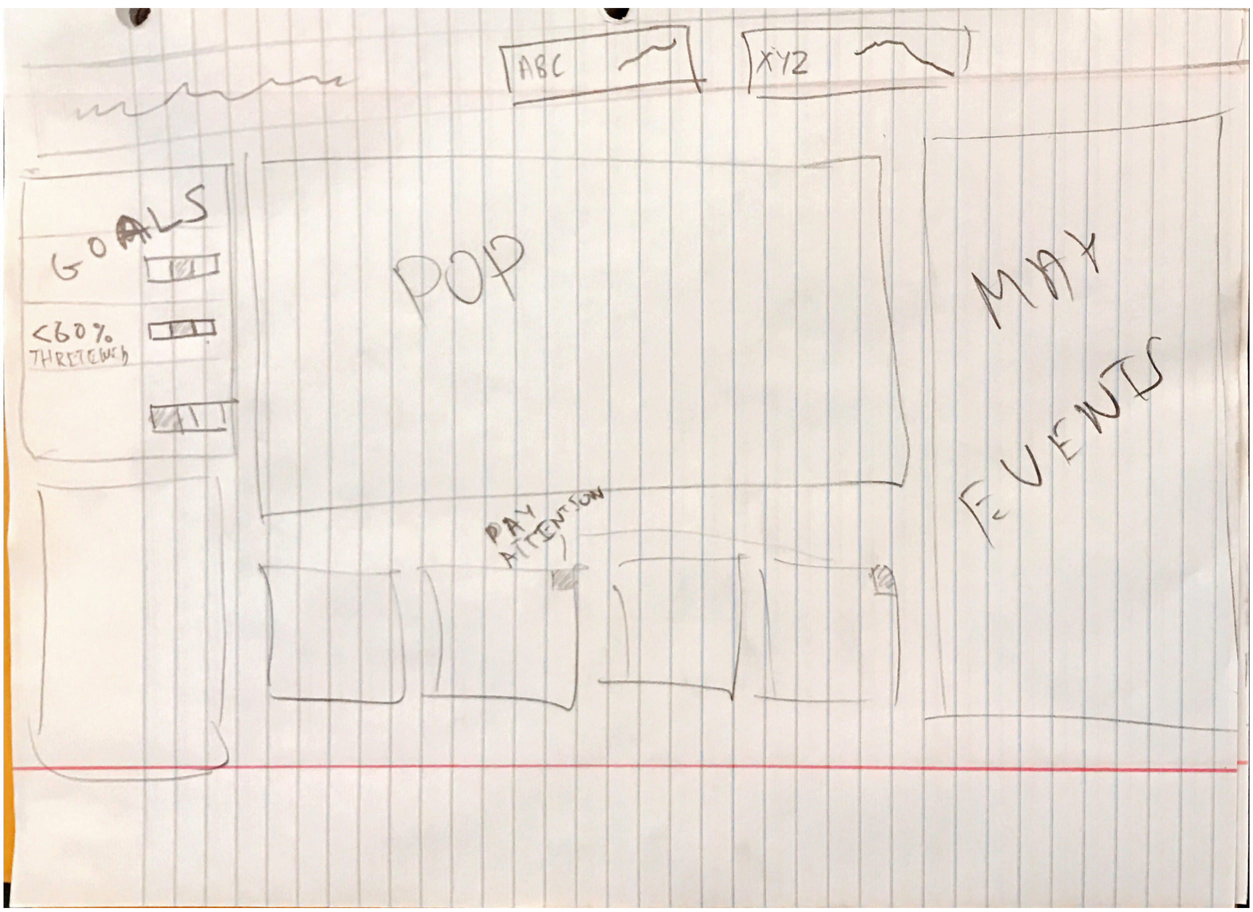

Species at Risk
Current
Best
Commercial Fishing
Water Quality
Bottled Water Exports

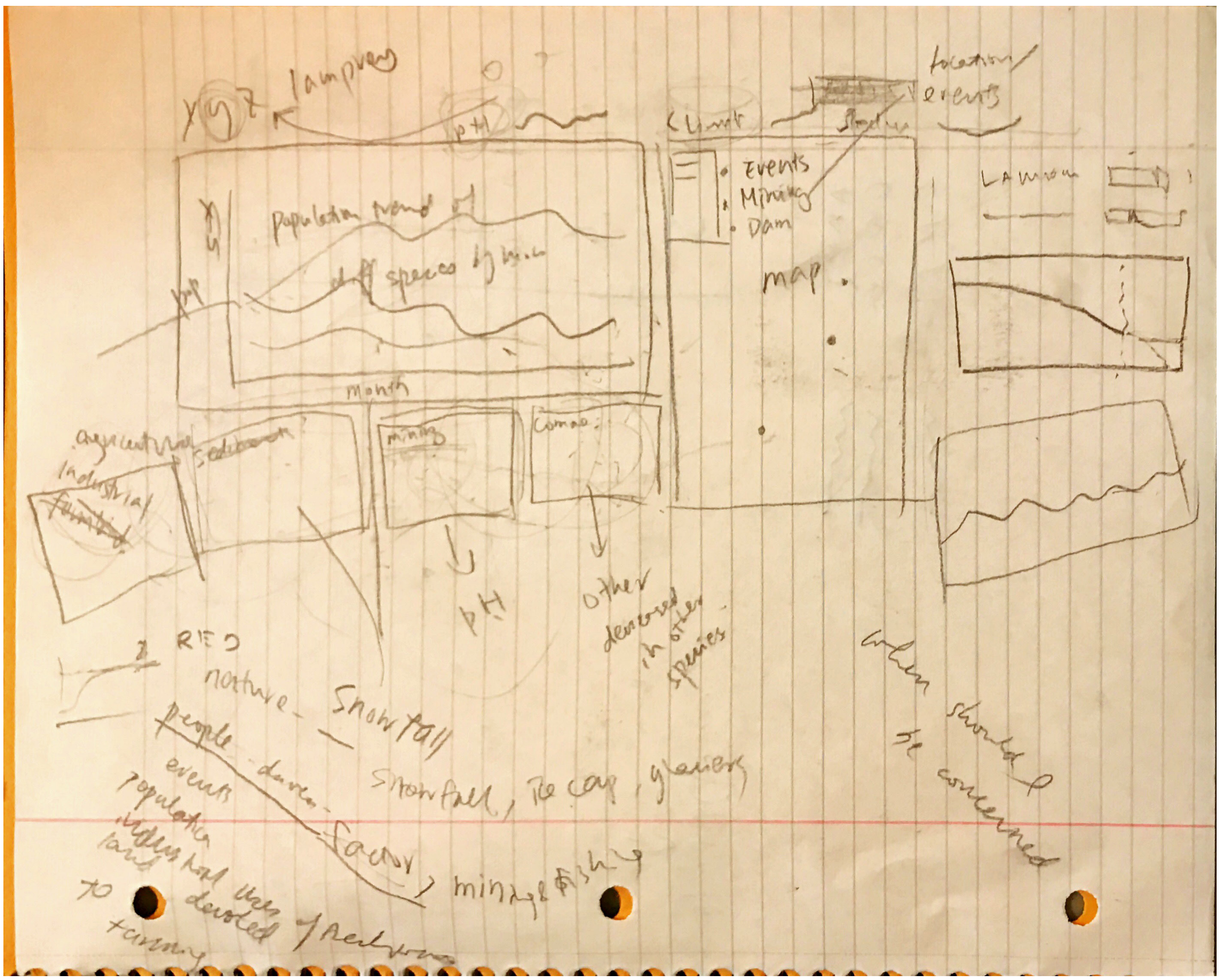
An idea for visualization. pH value is something which should stay around 7. Anything more or less than that is harmful. This needed to be visible in the dashboard.



Developing the narrative




ABC
XYZ
GOALS
<60%
POP
MAP
EVENTS
PAY ATTENTION


pH
Events
Mining
Dam
map
Month
pH
other
RED
nature
Snowfall
snowfall, ice cap, glaciers
when should we be concerned

Design

The design of the dashboard is based on one principle: **letting the data show above everything else.**

To make sure we designed the right thing, we focused on:
/ Selecting the right display media
/ Using the right measure
/ Determining the right information hierarchy

To make sure we designed things right, we focused on:
/ Visual impact
/ Micro and macro info
/ Balance between text & image
/ Color

Together, this principle and elements provided guiding directions for design. We will go into more detail about each element in the following pages.

let the data show above everything else

Giving the combination of content and visual devices we have at our disposal, it can be hard to make consistent design decisions when it comes down to “what font size should I use”, “what color should I use”, or “how big should I make this image?” For us, it has been helpful to look at a mixed inspiration of infographics, data visualizations, and dashboard designs. Along the way, we realized that they are closely related with subtle differences. While an infographic is often **communicative** with a predetermined opinion and plot, a data visualization is more **exploratory** in presenting the viewer with a big picture and letting themselves reach their own conclusions. We felt a dashboard falls somewhere in between, perhaps closer to being exploratory than communicative. Because a user will be looking at a dashboard on a regular basis, we decided to set a principle–let the data show above everything else–so that he or she may form their own conclusions over time.

selecting the right display media

We carefully selected our display media to make sure they are most appropriate for displaying the content. A detailed rationale for our decisions are provided in the Ideation section earlier in this book.

In further note, we found the use of side by side line graphs useful in making comparisons across our critical factors. Had they been displayed using different display medium, it would have been difficult to draw relationships and comparisons. We managed to display our data using three types of display media in total: area line graph, line graph, and map. Hopefully, this restricted use of display media type makes it easy for audience to create relationships and comparisons.

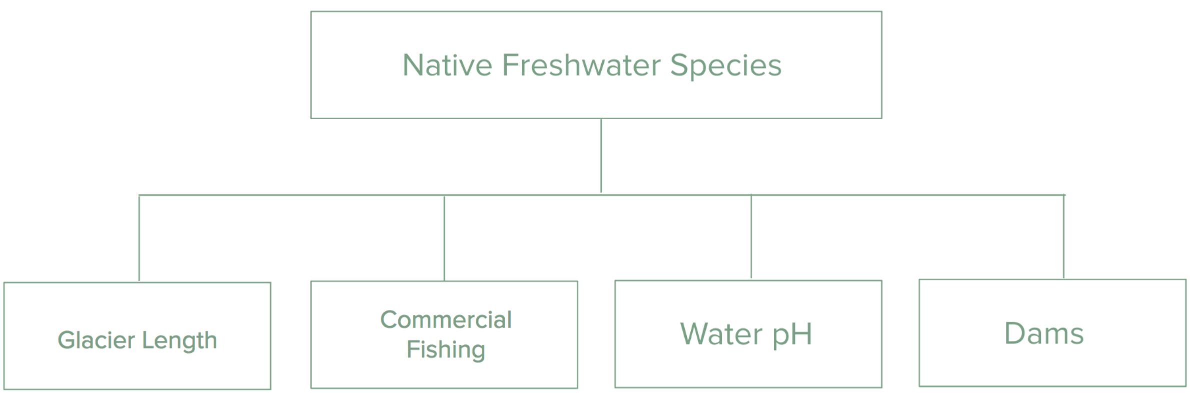
using the right measure

While creating our graphs, we paused for a moment to think about the type of measure for each graph. We considered: how much should the x and y axis increment? What units makes the most sense for each graph? From which year should they start and which year should they end?

We decided to use the same time span for all of the graphs. That is, the data contained on this dashboard all span from 2000 to 2024. We included enough history to show past records, and some years in the future to show projections. While all of the critical factors use the same increments of 8 years, the population graph at top uses an increment of 2. This decision is reflective of their relative important on the dashboard.

determining the right information hierarchy

We distilled our research into a simple chart, the basic gist being the population of native freshwater species is affected by four critical factors. Using this chart as a guideline, we designed our dashboard to reflect this information hierarchy so that users can easily grasp the relationship between each of the parts.



visual impact

We aimed towards a design with minimum distractions while delivering maximum visual impact. Some of the ways we achieved this include: restricting the color palette, using large types for important information, and using flat blocks of color for areas needing attention. The minimum use of decorations and pictures allowed for important information to stand out, while constrast of lines and shapes brought further tension to the overall dashboard. To convey a sense of modern and somewhat serious aesthetic, we utilized a sans serif typeface and a very straightforward layout.

micro and macro info

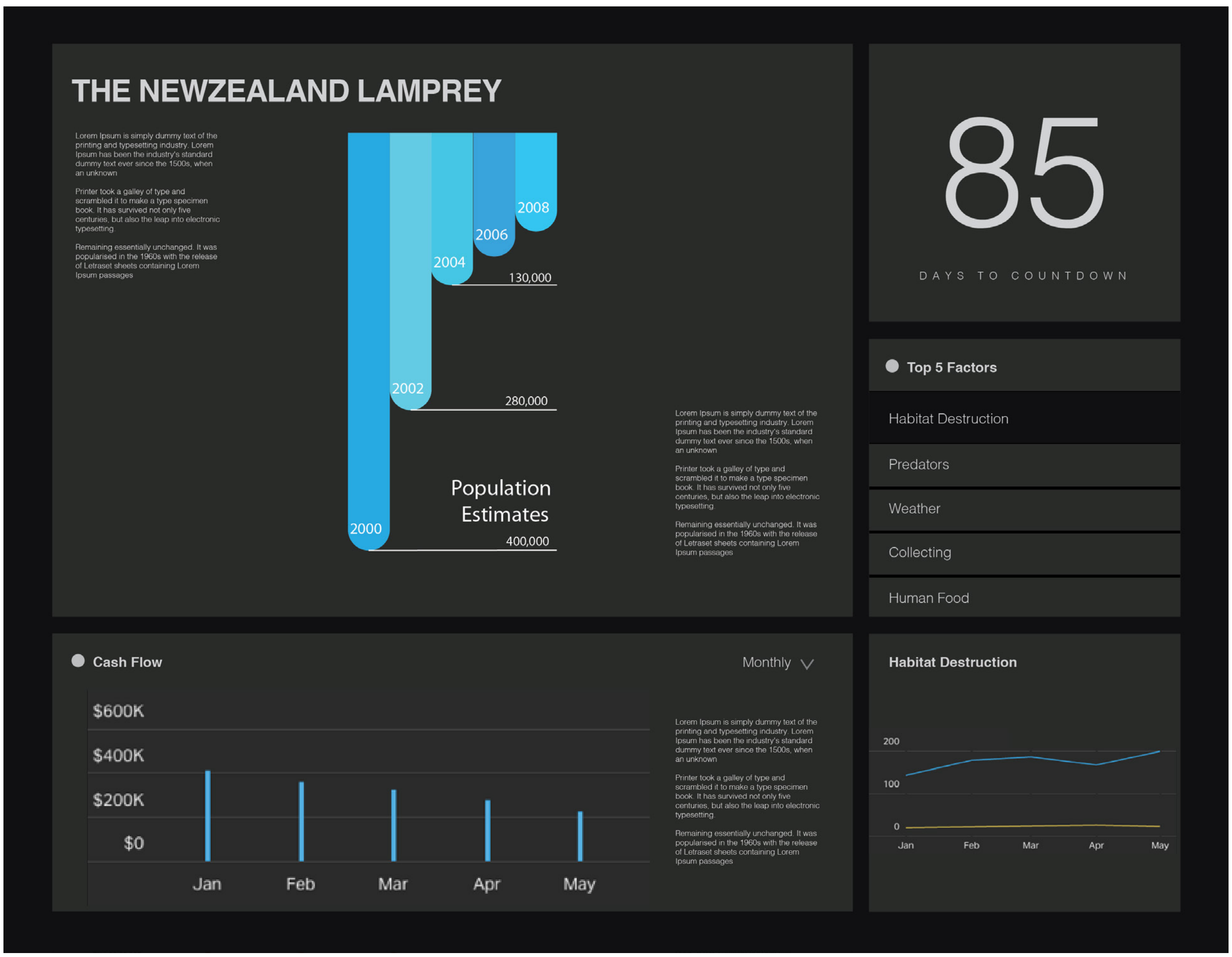
A dashboard can easily overwhelm its user if the presentation is not considerately designed. We wanted to present users with both micro and macro levels of information, so that they can take the liberty of consuming different granularities of information. To achieve this, we utilized different font sizes, shades of color, and layout.

balance between text & image

A dashboard is only digestable through a balanced combination of text and image. Research show, that different regions of the brain are activated when the eyes alternate between image and text. As a result, viewers become more attentitve to what they are seeing, and they are able to recall more of the content. We hope to achieve through a combination of text and image an engaging, easily consumable and easy to recall experience.

color

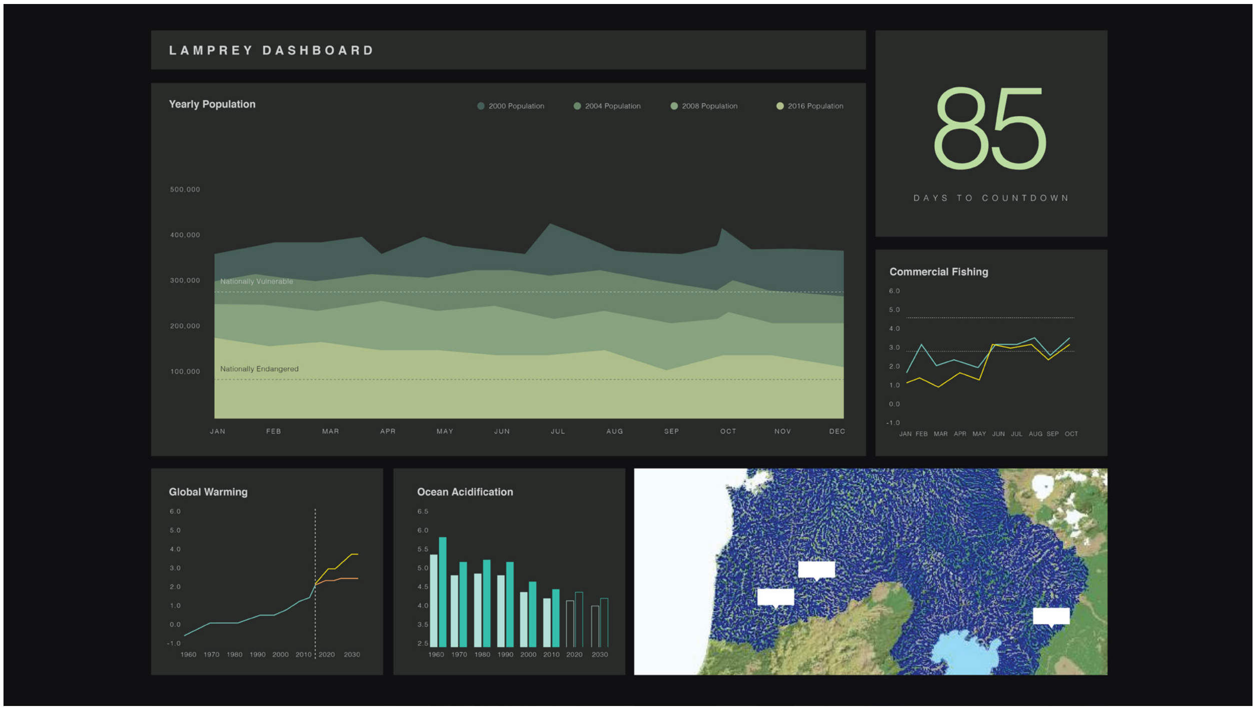
We were very deliberate in our color choice and came upon our solution through a consideration of different color types (neon, pastel, high saturation, low saturation, complementary colors, etc). We chose a low saturation, analogous color scheme to convey a sense of depth and rationality. Having different tints of colors served us well in progressive disclosure and information hierarchy.



First Iteration

Pros: color, number, graphic.

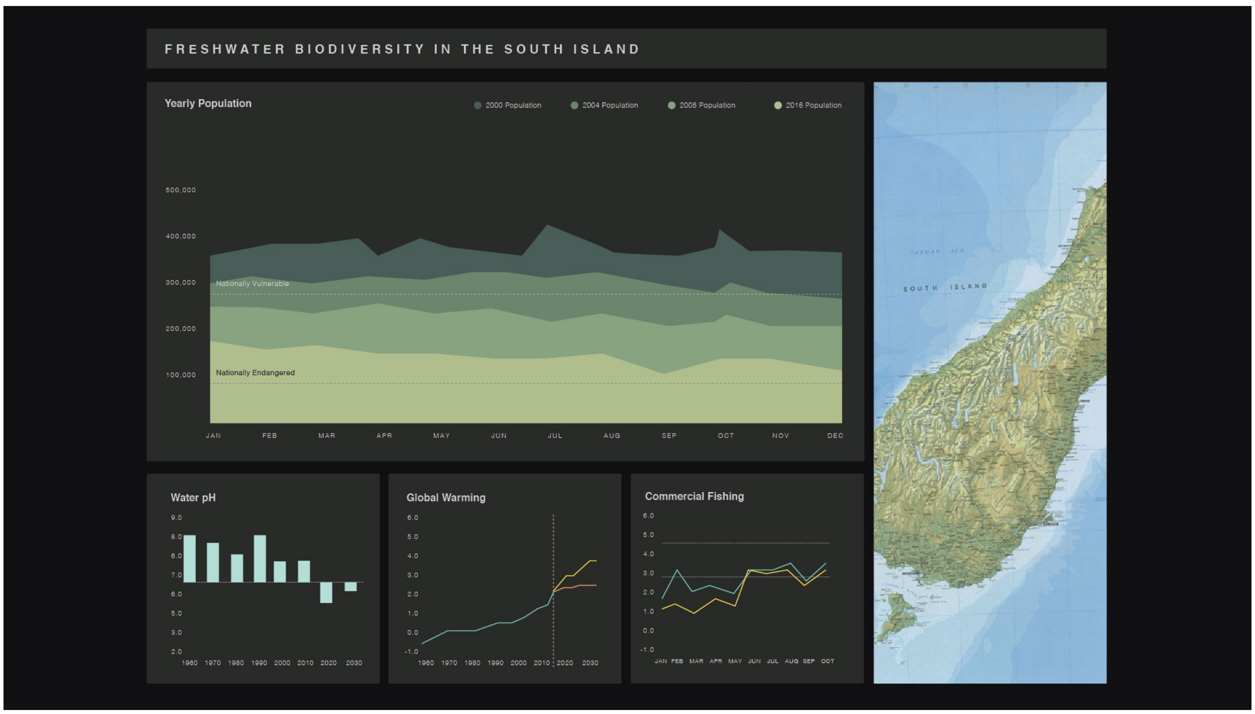
Cons: missing narrative and graph details. Some of the panels are place holders only.



Second Iteration

Pros: layout, number

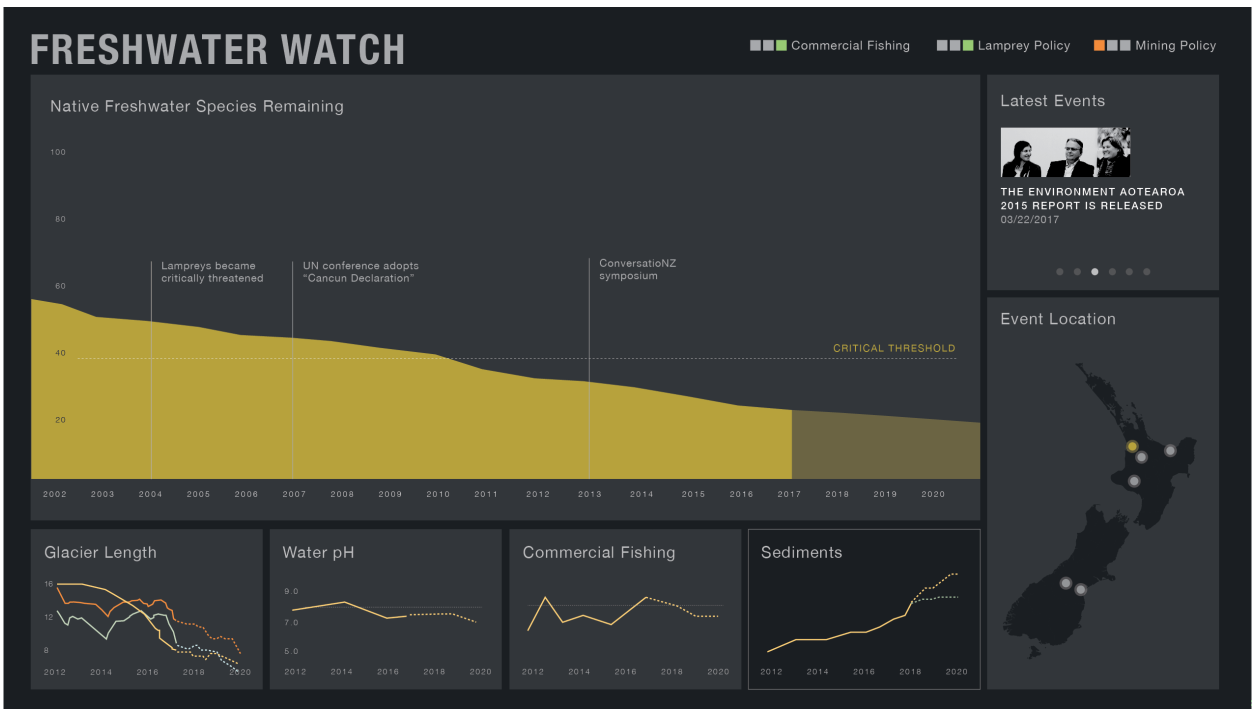
Cons: green is a nice color and can be misleading. Graph is too pretty to be showing a decline in population. Some of the panels are place holders only.



Third Iteration

Pros: layout, map layout now makes more sense

Cons: green is a nice color and can be misleading. Graph is too pretty to be showing a decline in population. Some of the panels are place holders only.



Fourth Iteration

Pros: layout, refinement, information hierarchy, consistency

Cons: color is still being experimented. Yellow is probably not the best solution. Details such as timeline still needed to be worked out.

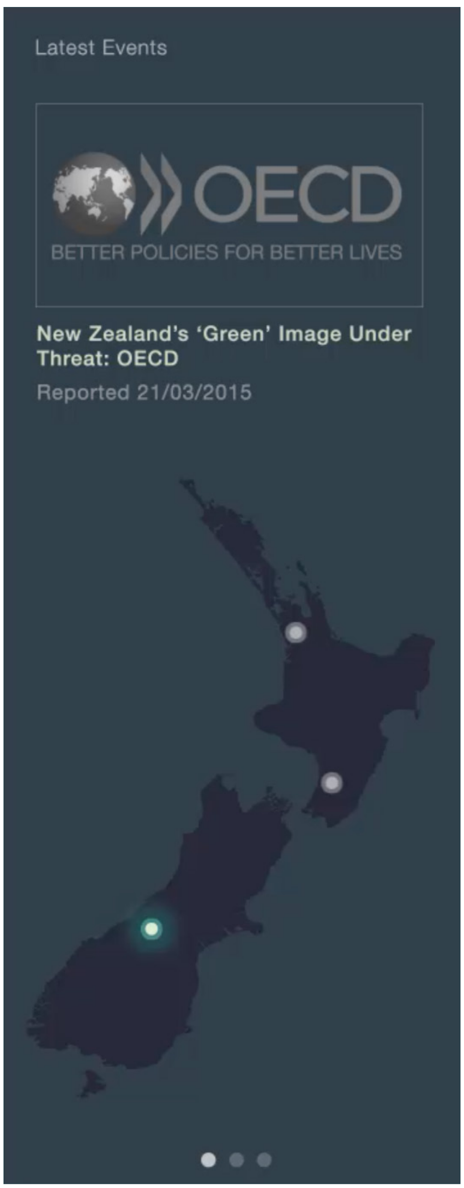
Final Iteration

Please see pitch deck or video for a regular sized image.

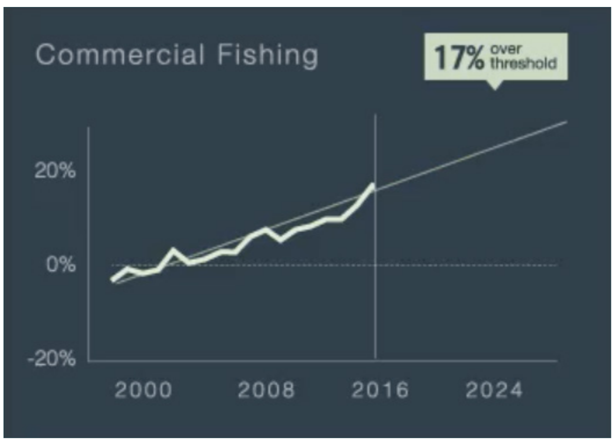
Animation

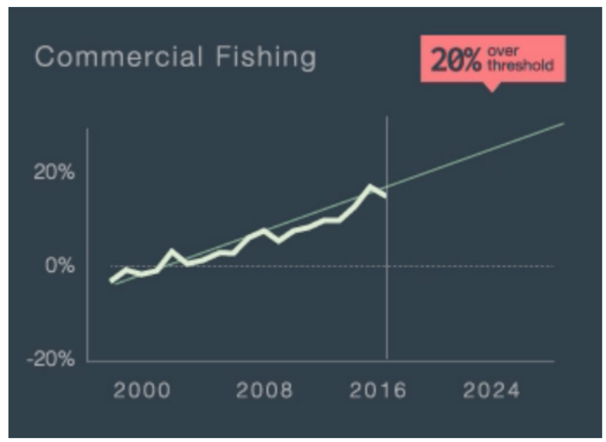
Although dashboards are single screen displays, the visuals change dynamically as information is updated. Given this nature of dashboards, we animated the visualizations to reflect the constant change of time as well as drawing users' attention to critically important, new information.

In order to illustrate multiple events without overwhelming the user's attention, we animated current, relevant news stories that would rotate (like a slideshow with captions) and show just one at a time. New events would be added as they occurred, while older, no longer relevant ones would be rotated out. The screen caps below illustrate the change from one event to the next, from left to right.


Latest Events
OECD
BETTER POLICIES FOR BETTER LIVES
New Zealand's 'Green' Image Under Threat: OECD
Reported 21/03/2015


Latest Events
14000 sign petition urging stronger controls on fishing industry to protect biodiverse seabird gains
Reported 29/03/2015





To illustrate the change or passing of time, graphs would shift in such a way that more of the trend line would be visible or the most recent data point would become part of the actual line chart as opposed to just a projected trend point. This can be seen in the screen caps above, from left to right.

A notification would also pop up in the case that a threshold had been crossed on a chart (seen in left screen cap above, top right of the image). If new data were to be released, however, and the threshold reached an even more severe, critical point, the notification would update to reflect the new data in addition to change color to gently alert the user of an abnormality (right screen cap above, top right of the image). Since the numbers are fairly small, a gentle fading animation seemed appropriate for this change in visuals.

Finally, we wanted to indicate an obvious change in data. Numerically, given any significant drop in a statistic, we wanted the transition to be smooth but still catch the user's attention. We animated larger, more visible numbers so that they decreased smoothly, like a mechanical counter (seen in screen caps below, sequentially from left to right).

Final Deliverables

Please see Box submission for other components of our final deliverable, including: pitch presentation, video, and readme file.

We see our design providing **value** to stakeholders in the following ways.

For scientists, they are able to:
- Communicate scientific research and data as guidance for action
- Create value from trends and projections
- Preserve NZ's native freshwater biodiversity

For policy makers, they are able to:
- Validate the impact of their policies
- Identify opportunities to act before significant losses occur
- Create better future policies

References

http://www.doc.govt.nz/nature/biodiversity/nz-biodiversity-strategy-and-action-plan/new-zealand-biodiversity-strategy-2000-2020/part-three-action-plans/theme-three/

http://www.landcareresearch.co.nz/publications/factsheets/rare-ecosystems

https://en.wikipedia.org/wiki/Climate_change_in_New_Zealand

https://en.wikipedia.org/wiki/Deforestation_in_New_Zealand

https://en.wikipedia.org/wiki/Environment_of_New_Zealand#Environmental_issues

http://www.doc.govt.nz/biodiversity

New Zealand Biodiversity Strategy 2000-2020
http://www.doc.govt.nz/nature/biodiversity/nz-biodiversity-strategy-and-action-plan/new-zealand-biodiversity-strategy-2000-2020/

http://www.mfe.govt.nz/climate-change/how-climate-change-affects-nz/climate-change-impacts

http://www.mfe.govt.nz/node/21990
http://www.mfe.govt.nz/node/21991

http://morganfoundation.org.nz/stop-decline-native-species-infographic/#comments
http://www.nztcs.org.nz/#/reports

http://www.seafriends.org.nz/enviro/reddata.htm
http://www.doc.govt.nz/nature/conservation-status/

https://www.niwa.co.nz/freshwater-and-estuaries/our-services/aquaticplants/biodiversity

http://www.doc.govt.nz/nature/native-animals/freshwater-fish/

http://www.aucklandcouncil.govt.nz/EN/environmentwaste/pollution/Documents/pollutionbrochure.pdf

http://www.fondriest.com/environmental-measurements/parameters/hydrology/sediment-transport-deposition/

http://www.doc.govt.nz/Documents/conservation/land-and-freshwater/Freshwater/ecology-of-nz-lamprey.pdf

http://www.radionz.co.nz/audio/player?audio_id=201789055

https://www.niwa.co.nz/our-science/climate/information-and-resources/clivar/scenarios

http://www.mfe.govt.nz/sites/default/files/national-objective-framework-temperature-dissolved-oxygen-ph.pdf

http://www.stats.govt.nz/browse_for_stats/snapshots-of-nz/nz-progress-indicators/home/environmental/distribution-of-selected-native-species.aspx

https://conbio.org/images/content_groups/Oceania/Scientific_Statement_1_.pdf

http://www.nature.com/articles/ncomms14202

http://www.stats.govt.nz/browse_for_stats/snapshots-of-nz/nz-progress-indicators/home/environmental/river-condition.aspx

http://www.stats.govt.nz/browse_for_stats/snapshots-of-nz/nz-progress-indicators/home/environmental/greenhouse-gas-emissions.aspx

http://proavschool.com/display-viewing-calculations-101/