# The Biological Reliquary

Infographic Dossier

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MSC2023 - Information Visualization

## Table of contents



Images used in section 4, 5, and 6 can be found on this miro board: https://miro.com/app/board/uXjVLivMtqM=/

# 1. Project Overview

**Goal**: to tell the story of how Alvar ecosystems were formed by two major geographical and climatic processes over the course of millenia, and the resulting uniqueness of the plant species in these habitats.

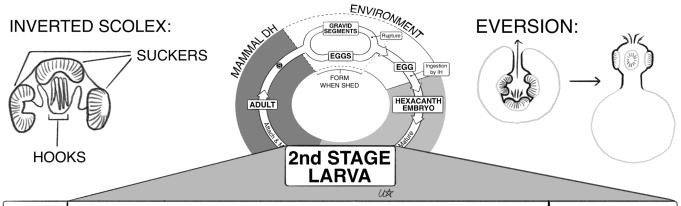
**Audience**: the intended audience is a lay audience, with at least a high school science education.

**Publication venue**: The piece would be printed and hung in a museum, university, or other educational space where it can be read closely. It might accompany a display of ice age flora and fauna (fossils, taxidermy, etc).

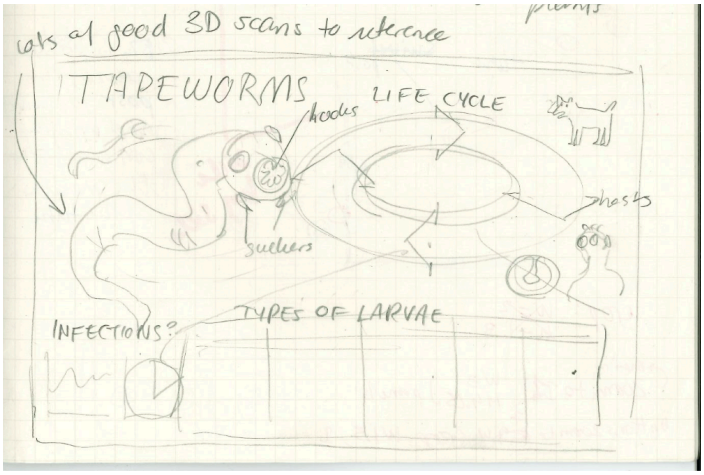
# 2. Topic Exploration

I wanted to choose a topic I had some background in so I could focus more on the visual and creative aspect than on the research, which I have a tendency to get lost in (and I still did, despite this choice...). Here's a list of potential topics I explored, along with visuals I considered:

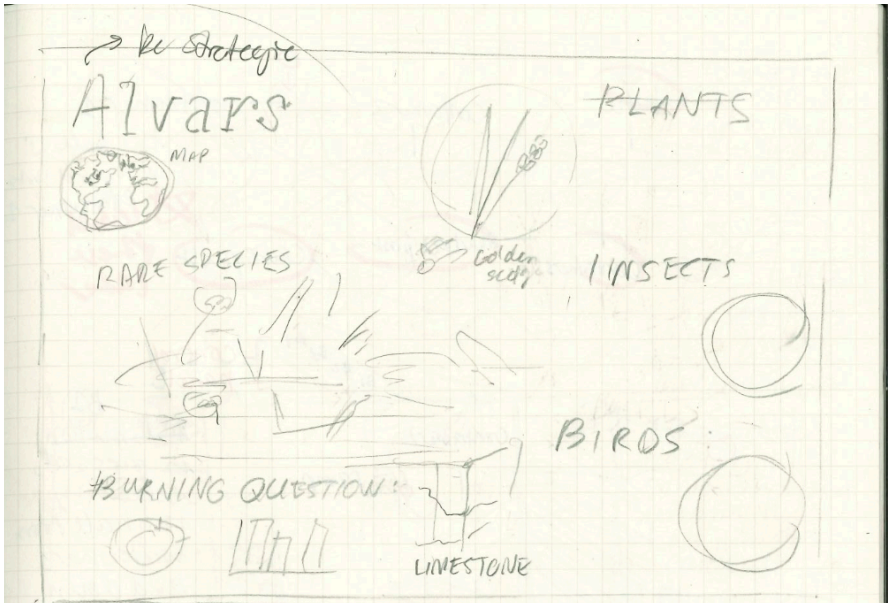
- Relationships between parasites and allergies
- Life cycle and morphology of tapeworms
    - Life cycles I created as course materials for the veterinary parasitology course at OVC:




| IH | MAMMAL | | | | | ARTHROPOD |
|---|---|---|---|---|---|---|
| LARVAL FORM | CYSTICERCUS | STROBILOCERCUS | COENURUS | HYDATID CYST | ALVEOLAR HYDATID CYST | CYSTICERCOID |
| STRUCTURE | | Scolex | | | | |
| SPECIES | *Taenia pisiformis, T. crassiceps, T. solium, T. saginata* | *Taenia taeniaeformis* | *Taenia multiceps, T. serialis* | *Echinococcus granulosus* | *Echinococcus multilocularis* | *Dipylidium, Moniezia, Anoplocephala* |




- Orchid/pollinator relationships
- Animal welfare topics - e.g. behaviour and welfare of fur-farmed mink, animal welfare as a science
- Alvar ecosystems



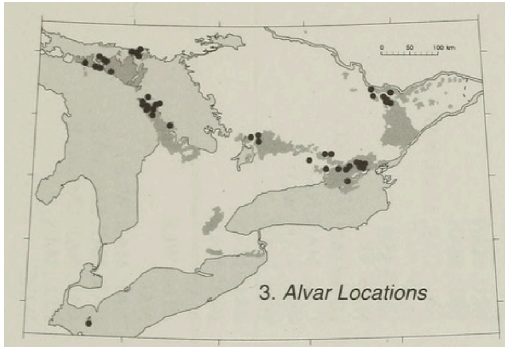

Once I landed on Alvars as my topic, I played with a few questions as an idea for the central narrative beyond simple description of what they are:

- What are potential research applications of these environments?
- What is special about the species that live there?
- How were these environments formed?

# 3. Research

This document is not chronological. The research process is integrated into every step outlined in this process, as more information was to be gleaned, or confirmed, or reviewed, etc. Furthermore, I was able to land on a central narrative before I began the research phase due to prior knowledge I had acquired on alvars during my undergraduate degree.

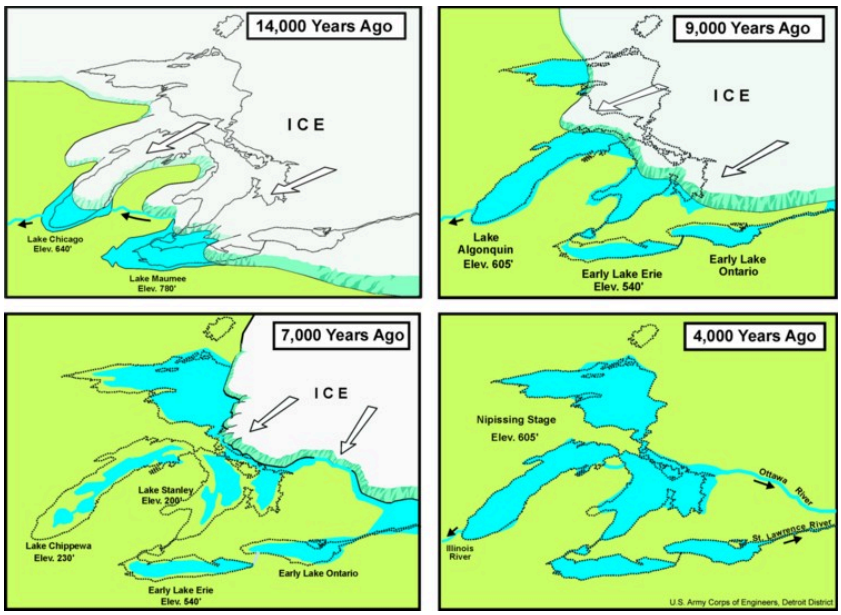
**What are Alvars?**

- In short, alvars are environments of thin soil over limestone with sparse, grassy vegetation and little to no tree cover (mostly shrubs), with a unique amalgamation of flora and fauna.
- The technical definition of an alvar from the Alvar Working Group (1995):
    - "Alvars are natural communities* of humid and sub-humid climates, centered around areas of glaciated horizontal limestone/dolomite (dolostone) bedrock pavement with a discontinuous thin soil mantle. These communities are characterized by distinctive flora and fauna with less than 60% tree cover, that is maintained by associated geologic, hydrologic, and other landscape processes. Alvar communities occur in an ecological matrix with similar bedrock and hydrologically influenced communities."
- *In the context of ecology, "communities" refers to an association of 2+ species occupying the same place at the same time; "ecosystem" refers to the communities and the environment they occupy (takes abiotic factors into account)
- There are many different types of alvars, with variations in plant and insect community makeup, but they share the same key characteristics (Reschke et al., 1999)
- Key characteristics of alvars from Reschke et al. (1999, p. 1):
    - Occur on flat limestone or dolostone bedrock where soils are thin or absent;
    - Naturally open landscapes, with tree cover absent or severely restricted;
    - All subject to seasonal drought, and some types to seasonal flooding;
    - Have a distinctive set of plant species and characteristic vegetation associations; and
    - Contain many species that are rare elsewhere in the Great Lakes basin and some species endemic to the basin, including plants, terrestrial molluscs, and invertebrates
- 64% of Alvars are in Ontario, south of the Canadian shield; the remaining 36% are scattered through New York, Michigan, and Ohio (Reschke et al., 1999)
    - 

(Catling, 1995)
- Most alvars are surrounded by forest, however vegetation and environmental conditions are very different between alvar and forest, with minimal transition zones to separate them (Schaefer & Larson, 1997)

**How were Alvars formed?**

- NOTE: moving forward, boreal is used interchangeably with northern, and grassland, prairie, and western are synonymous with one another. “Boreal” or “grassland” describe the environment, “northern” or “western” describes the direction
- Since the Last Glacial Maximum, 20,000 years before present (BP), North America has undergone multiple warming and cooling periods (Pielou, 1991)
    - Last Glacial Maximum - when the ice sheets of the most recent ice age reached their maximum surface area (Pielou, 1991)
- The Laurentide ice sheet covered all of Canada and some of the eastern U.S. at the LGM, and the Cordilleran ice sheet covered the rockies in the west
    - 

    - https://en.wikipedia.org/wiki/Laurentide_ice_sheet#/media/File:Laurentide_ice_sheet_map.jpg
- It slowly retreated, carving out the Great Lakes as it went (14,000-9,000 BP) (Margold et al., 2018).
    - 

    - https://en.wikipedia.org/wiki/Wisconsin_glaciation#/media/File:Glacial_lakes.jpg

- The Cordilleran ice sheet also retreated during this time, and a warm, dry channel of grasslands and sand dunes formed between the Cordilleran and Laurentide ice sheets, creating what we now know as the prairies (Pielou, 1991).
- The ice sheets were mostly surrounded by the "periglacial environment", i.e. an environment near or on the fringe of an ice sheet (glacier) (Pielou, 1991).
- Pollen fossils have demonstrated that these environments were a type of spruce parkland = a mixture of grassy prairies with groves of *Picea* (spruce) (Catling and Brownell, 1995).
    - Note: at present, spruce parkland only exists in "glacial relicts", which are ecosystems abundant during the last ice age that have since retreated into refugia (Dítě et al., 2018)
        - Refugia - microhabitats that are stable enough for glacial relicts to survive
- As temperatures rose during the next hypsithermal (= warming period), around 8000 BP, the spruce parkland crawled northeast and grasslands took its place (Manogaran, 1983).
    - Ecotone at the ice sheet border: spruce parkland/boreal forest > deciduous forest > grassland/prairie
    - This evidence is derived from carbon dated pollen cores (as are the maps later used for this infographic)
- The grasslands colonized Ontario through wind-blown pollen, aided in part by prehistoric land bridges across Lake Huron (Catling & Brownell, 1995; Manogaran, 1983; Pielou, 1991)
- Following natural temperature oscillations, a period of cool air and high precipitation drove the prairies back West, except in certain locations in the Great Lakes Basin (Catling & Brownell, 1995; Hamilton & Eckert, 2007; Manogaran, 1983).
- So, what does all of this have to do with alvars?
- The glacier retreat scraped away soil and left exposed limestone in some areas of the Great Lakes Basin; these barren areas do NOT support tree growth (Reschke et al., 1999).
- Grassy remnants of spruce parkland were able to live well in these exposed areas → **colonized by boreal species** (Catling & Brownell, 1995)
- Grassy species could not migrate further north due to colder, harsher climate of northern Ontario
    - Pockets of alvars were then stranded, leaving areas of boreal herbaceous species surrounded by deciduous and mixed forests
- The alvar habitat was very accommodating to the prairie expansion as well
- Prairie plants typically occupy habitats with high summer temperatures and seasonal drought/flood cycles (Manogaran, 1983)
- Exposed limestone = few trees = water table stays low with no tap roots to raise it, and no leafy cover to block the sun = very high soil surface temperatures (Stephenson & Brewer, 1983)
    - Exposed rock has a greater frequency of surface fractures than soil-covered rock; fractures enhance surface drainage, further drying out exposed rock, while the covered fractions maintain their moisture through prevention of cracking (Stephenson & Brewer, 1983)
    - Self-perpetuating cycle owing to permanence/unchanging aspect of alvar soils and their level of cover; i.e. the dry spots stay dry, the wet spots stay wet
    - No soil accumulates in these exposed spots is because they lack the moisture to support soil formation
    - Thin soil = not much moisture holding capacity = prone to drought/flood cycles (Catling & Brownell, 1995; Stephenson & Brewer, 1983)

    - These conditions mimic the prairie environment, therefore grassland and prairie species live on in these refugia
- In summary:
    - Two main events formed alvars: the expansion and retreat of the Laurentide ice sheet and the expansion and contraction of grasslands during the warming period that followed the last ice age (Catling and Brownell, 1995)
- The stage has been set; alvars have been colonized with northern and western plant and animal species, so what now?

**What Lives in these Habitats?**

- Alvars house plant, insect, and bird species whose main populations live thousands of kilometers north, west, and south (Catling and Brownell, 1995).
- These species are rare elsewhere in the Great Lakes Basin, and are therefore considered "disjunct" populations (Hamilton & Eckert, 2007)
- Alvars are also home to endemic species, which are highly specialized to that specific environment and generally remain confined (Reschke et al., 1999)
    - Endemic - species that live in single, limited geographical area and are usually native
- The occurrence of most of the disjunct populations of flora and fauna can be explained by the processes described in the last section, though not all alvars are created equal
- Brownell and Riley (2000) hypothesize that of the three main groups of alvars, their species composition suggests a blend in phytogeographic origin:
    - (1) Western Lake Erie alvars – mostly contain southern and western species, relatively recently developed
        - Species migrated northward and eastward during warm + dry times during Xerothermic interval (warm dry period 8000-4000 BP).
        - Mainly developed from prairie expansion-contraction
    - (2) Saugeen* peninsula/Manitoulin Island alvars – northern, western, and endemic, some southern species.
        - *This region is still widely known as "Bruce" peninsula, but the land is the traditional territory of the Saugeen Ojibway nation and was seized in violation of multiple treaties. Many now refer to the region as Saugeen peninsula, rather than the name of a colonizer (Wright, 2017)
        - Glacial relict of spruce parkland from Laurentide ice sheet
        - Periglacial hypothesis: they developed along the edge, ice retreated, left alvars stranded.
        - Presence of western and endemic species support hypothesis because they spread along ice sheet, and some evolved on their own there.
    - (3) Central and eastern Ontario, northern NY – southern and northern species.
        - Partial relicts of ice front vegetation + more recent invasions of southern + western species on open ground
- Maps of pollen cores showing changes in grassland range from Bernarbo and Webb (1976) are consistent with these findings

- No Ontario alvars can be considered entirely relicts of former environments though they possess elements of these former habitats (Brownell & Riley, 2000)
- Most of the endemics of alvars are "paleoendemics", meaning they used to be widespread but have become confined to a much smaller region in recent history (Catling & Brownell, 1995)
    - Endemics mostly concentrated to the Saugeen peninsula (Catling & Brownell, 1995)
    - Majority are boreal and western disjuncts, with one notable exception: the Dwarf Lake Iris (*Iris lacustris*), which came from the south (Catling & Brownell, 1995; Van Kley, 1989)
    - Lakeside Daisy (*Tetraneuris herbacea*) has no populations outside of alvars and its closest living relatives are western species (Catling & Brownell, 1995)
        - Likely to have moved along periglacial sidewalk from the west
- A list of other species of interest (species for spot illustrations are **bolded**):
- Endemics:
    - **Dwarf lake iris** (*Iris lacustris*)
        - Status: threatened
        - *I. lacustris* is well adapted to the setting of alvars, requires thin calcareous soil (high levels of $CaCO_3$) and forms associations with White Cedar (*Thuja occidentalis*)
        - Though suited to alvars, *I. lacustris* grows in the understory of coniferous woodlands elsewhere in Ontario (Jalava, 2008)
    - **Lakeside daisy** (*Tetraneuris herbacea*)
        - Status: threatened
        - These are the only (known) plant species that are ENTIRELY reliant on alvars for their habitat
    - Red-Tailed Leafhopper (*Aflexia rubranura*) - endemic to nearctic grasslands, along with 16 other species of leafhopper, restricted mainly to alvars and some grasslands in Michigan and Illinois (COSEWIC, 2018)
- Western:
    - **Prairie Smoke (*Geum triflorum*)** - this flower is a disjunct of prairie species and occurs in a handful of Ontario alvars
        - Extensive genetic studies have shown that these populations have developed few genotypic modifications from their parent populations, which lends credence to the prairie expansion-contraction hypothesis (Hamilton & Eckert, 2007)
        - They have developed phenotypic differences though, to adapt to difference in climate of alvars (e.g. flower later in the spring because it is colder)
    - *Chlaenius purpuricollis* - ground beetle native to NA, common in western prairies but isolated to alvars in easter NA
    - **Clustered Broomrape (*Aphyllon fasciculata*)** - widespread westerly but very rare in the east due to habitat loss
        - Parasitic plant, prefers *Artemesia* spp. as hosts
    - Garita Skipper (*Oarisma garita*) - disjunct population of skipper (similar to butterflies), with closest population 1,000 km to the west
    - Loggerhead Shrike (*Lanius ludovicianus*) - alvars are only one of this species' habitats, but with habitat loss due to human interference, these birds flock to alvars as breeding grounds
- Boreal/cordilleran:

- Northern Single-Spike Sedge (*Carex scirpoidea*)
- **Chestnut Sedge (*Carex castanea*)** - northern sedge species that only occupies eastern alvars (ON and NY), usually in wetter areas
- **Alaska Rein Orchid (*Platanthera unalascensis*)** - cordilleran species (from the Rockies)

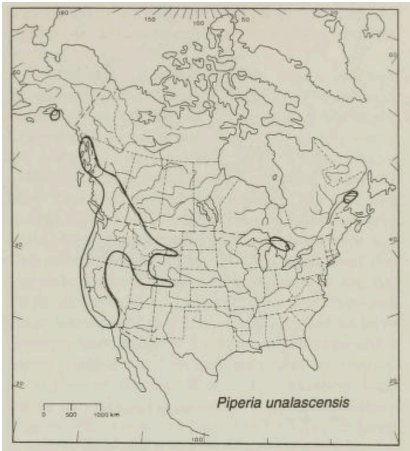
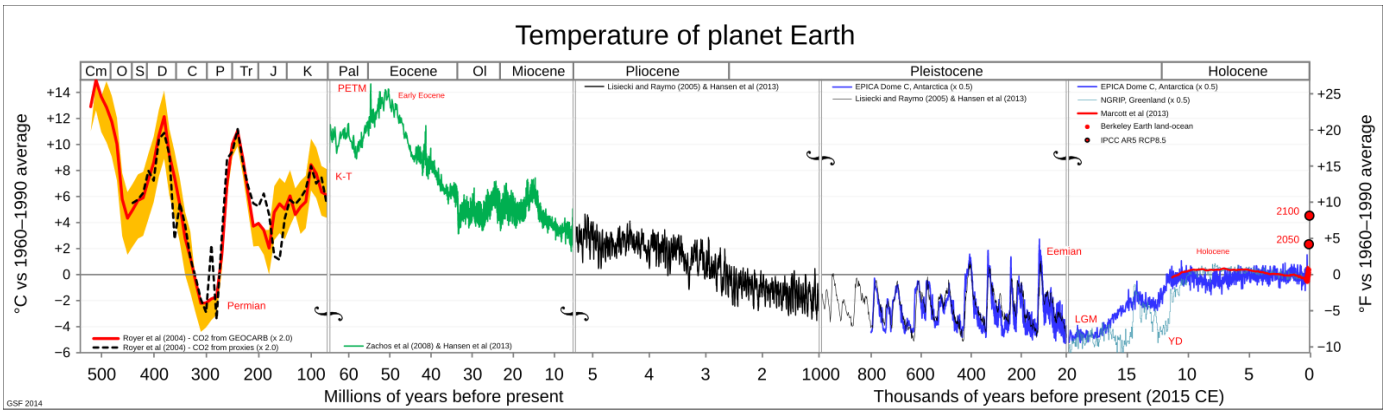



FIGURE 11. Distribution of *Piperia unalascensis* in North America based on references to distribution in regional floristic manuals and specimens at CAN and DAO.

  - Example of what disjunct population distribution map; showing the range of Alaska Rein Orchid in North America
- Chryxus Arctic (*Oeneis chryxus*) - type of butterfly widespread from northern to southern tip of Rocky mountains, at far eastern limit of range in Ontario

- Southern:
  - Juniper hairstreak (*Mitoura gryneus*) - widespread in southern and western NA but only localized population in Ontario is confined to Napanee plain alvar
- Note: proper distribution maps for species of interest are outline later, in section 5 (draft 3)

**Glaciation-Warming Timeline**




https://en.wikipedia.org/wiki/Paleoclimatology#/media/File:All_palaeotemps.svg

- Early events of the timeline take place during the late pleistocene, and extend into the holocene
- Timeline based on Pielou (1991)
- 20,000 BP: Last Glacial Maximum, ice sheets at their biggest
- 15,000: LGM ends, climate warms for the next 2000 years
- 12,900-11.700: Younger-Dryas, period of abrupt cooling but with minimal change in ice cover

- 11,700: Holocene begins (we are still currently in the holocene)
- 9,500: Holocene Climate Optimum, time of warming and expansion of vegetation
- 8,000: thermal maximum of HCO in northern hemisphere
    - Northwestern North America warms first, around 9,000 BP and warms expands to northeastern NA over the course of the next 2,000 years
- 5000: Neoglaciation; slow cooling until the industrial revolution
    - Little ice age from 1500 - 1900 AD, then climate change started catching up with us
- Note: this timeline describes the way timelines are divided in paleoclimatology, not geology

# 4. Inspiration & Ideation

I am interested in making a piece that connects the geological and climatic changes (cause) to the unique communities of plants and animals that live in these environments (effect). The key elements to depict this relationship are:

- Spot illustrations of the species of interest
- Maps showing the historical changes of ice sheets and prairie habitats
- A timeline, linked with the maps to indicate the scale of time

I came up with the perfect idea for a narrative centred around a timeline: scrollytelling with animated maps. The only issue was that I don't know how to code, I have minimal experience with animation, and it would be far too big of an undertaking. Back to the (literal) drawing board.

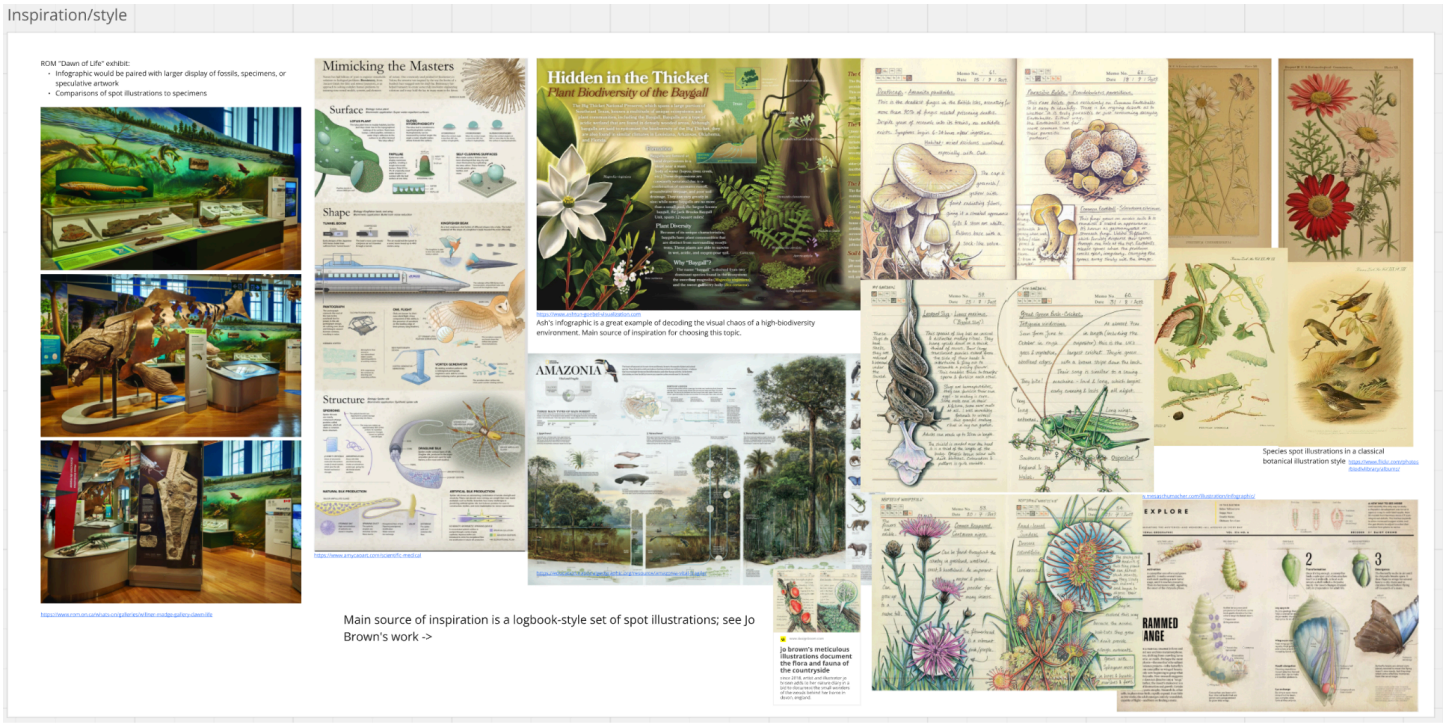
With the central narrative decided, and my first thought (worst thought) out of the way, I asked myself the following questions:

- Where will this piece live?*
- How will it be consumed?

*Bridget asked me this but I like to pretend it was me

I liked the idea of a static museum display graphic which could accompany an exhibit. I thought about the art I saw in the ROM's Dawn of Life exhibit, and went to work finding visual references for something that might emulate that style. After some feedback, I pivoted towards more of a logbook style. I am particularly taken with Jo Brown's work: https://www.designboom.com/art/jo-brow-nature-journal-illustrations-09-29-2020/

Follow this link to see the images more clearly: https://miro.com/app/board/uXjVLivMtqM=/

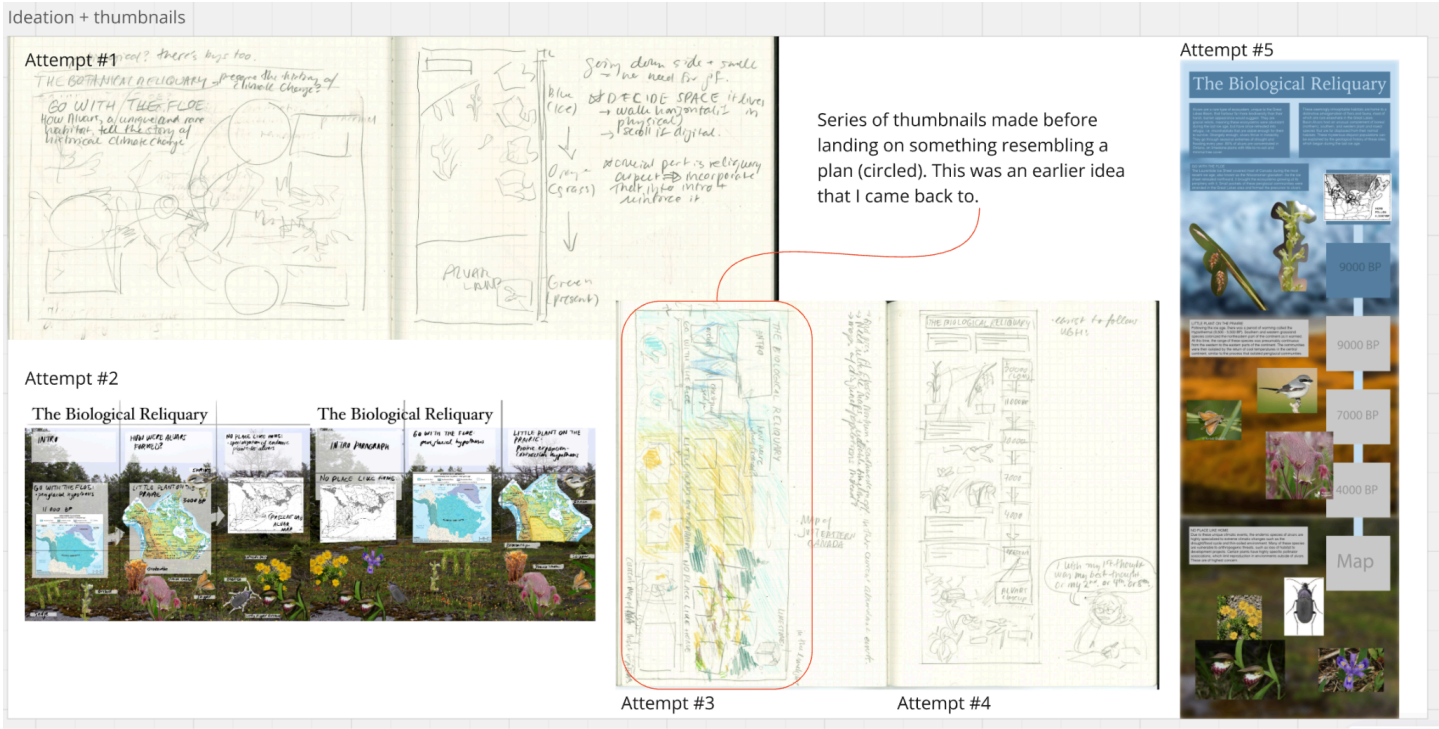


As for how this infographic would be consumed, I was mainly concerned with orientation, and could not decide between vertical or horizontal. Here's a comparison (pros in green, cons in red):

| Vertical | Horizontal |
|---|---|
| - Reading order is unequivocal<br>- Text heavy beginning<br>- Backgrounds do not flow<br>- Unconventional (but not in the good way) | - Follows convention for display of a timeline<br>- More clarity off the bat for an unfamiliar topic<br>- Audience can stroll along and read<br>- Backgrounds flow nicely into one another<br>- Reading order not inherently clear |

Winner: Horizontal!!!

**Thumbnails**

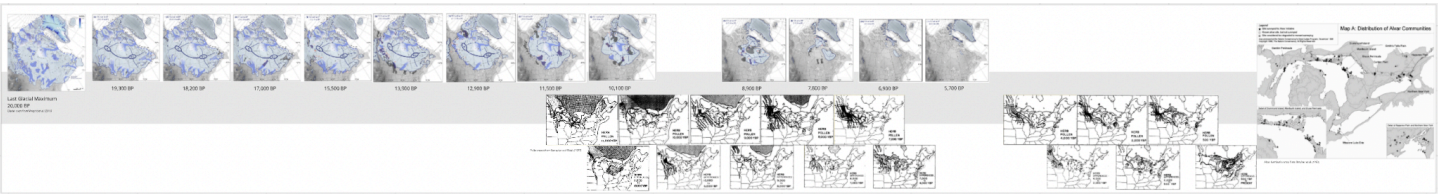



- Attempt 1: quick ideation, considering possible orientation, map placements, insets
- Attempt 2: trying to fit maps into the story, seeing where to order the text and spot illustrations
    - Aspect ratio was all wrong
    - Information hierarchy unclear, all of the important species, which are also the most visually interesting element, are squished to the bottom
    - Maps are important but should not be dominating the space
    - Timeline unclear
- Attempt 3: taking into account feedback, I made it much wider and tried to fade the backgrounds together, while considering where the spot illustrations would live
- Attempt 4 and 5 were sincere shots at the vertical layout. But it was never meant to be.

**Title** - a reliquary is a container that holds relics, i.e. sacred, (usually) ancient objects. Relics are not the same thing as relicts (bygone environments), but I enjoyed the idea of alvars being the container of sacred, ancient plant communities.

**Maps**

- The key idea I am trying to get across with the maps is that ice sheets passed over the alvar sites and the periglacial parkland at their border deposited species as it retreated, and then the prairie passed over and deposited species
- With this goal in mind, I decided that having perfectly accurate maps was not paramount, an approximation would get the point across
- While I would not normally sacrifice accuracy if I could avoid doing so, I encountered an issue during the research phase that forced my hand somewhat: a distinct lack of consistent maps on the prairie expansion and contraction during the hypsithermal period
- The closest figures I could find was a set maps of herbaceous pollen cores from Bernarbo and Webb (1976) from 11,000 BP to present
    - Cores with less than 10% herbaceous pollen represent the edge of a grassland range
    - These edges usually coincide with increasing amounts of arboreal pollen, indicating a transition zone
    - The spruce pollen cores indicate boreal forest of the tundra
    - Where the spruce and herbaceous pollen overlap, there is spruce parkland
    - Therefore, there are 3 zones to indicate: spruce parkland, prairie, and ice sheet
- I did a brief search for conventions in creating approximate maps. It was not fruitful.
- I decided to use the conventions I had observed in other maps, wherein a dashed line delineates the approximate border of an expanding range
- I created simple tracings of the maps in illustrator, using a basic North America .svg I found on wikimedia commons (Winkel Tripel projection)
- An approximate timeline of the maps of the glaciers and prairies:

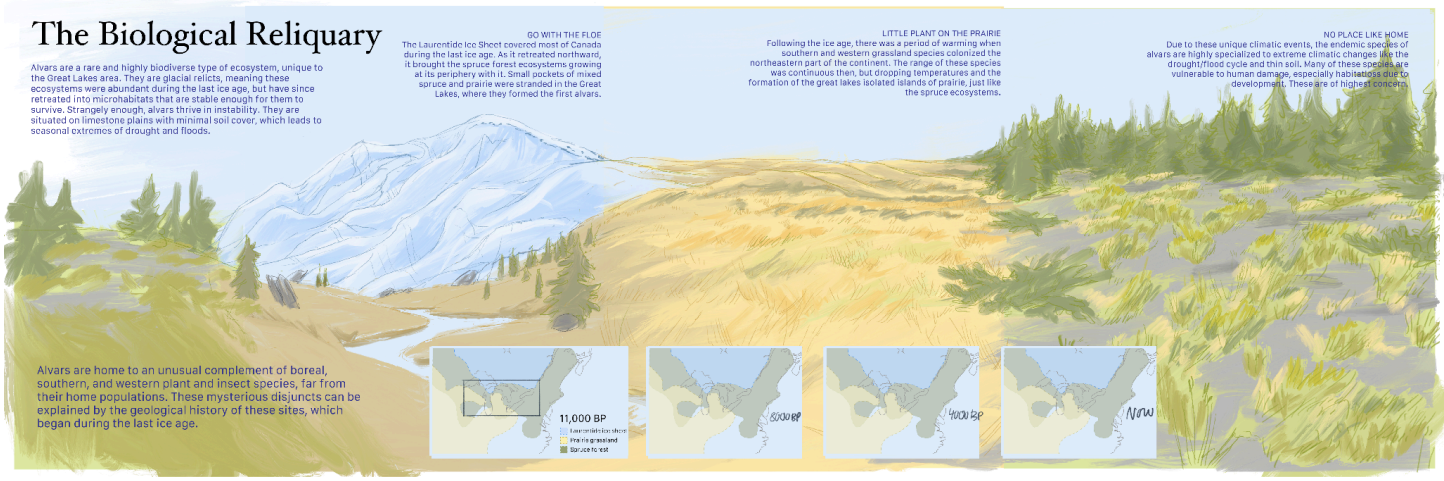


    - It's sooooo tiny so I would recommend looking at it via the miro board link above
- I am using only a portion of northeastern north america to keep the focus on alvars, not the whole geologic process of ice ages
- Since using all of those maps would make this infographic actually unreadable, I condensed it down to the 4 most important moments:
    - 11,000 BP: glacial retreat, spruce pollen maximum, prairies encroaching on southern Ontario
    - 8,000 BP: prairie maximum
    - 4,000 BP: prairie retreat
    - Present day alvar sites

**Background**

- I like the idea of a background corresponding to the changing maps on the timeline:
    - Section 1: low-detail alvar environment through some grasses, low juniper shrubs, some view of limestone pavement
        - Helps orient the reader, flows into section 2 through connected grassland
    - Section 2: light outline of a glacier, with a pale blue flat colour
        - Connect to section 3 with spruce parkland and blue skies, so there is a continuous flow between the sections
    - Section 3: windswept grassland; rich yellow and ochre with white clouds on blue sky
        - Connect to section 4 with creeping juniper plants dotted in the landscape
    - Section 4: alvar environment, i.e. greens and deep reddish browns to communicate grassland with lichen on limestone
- I want the overall direction of the background to lead toward the alvar on the far right

**First Draft** (not including spot illustrations)



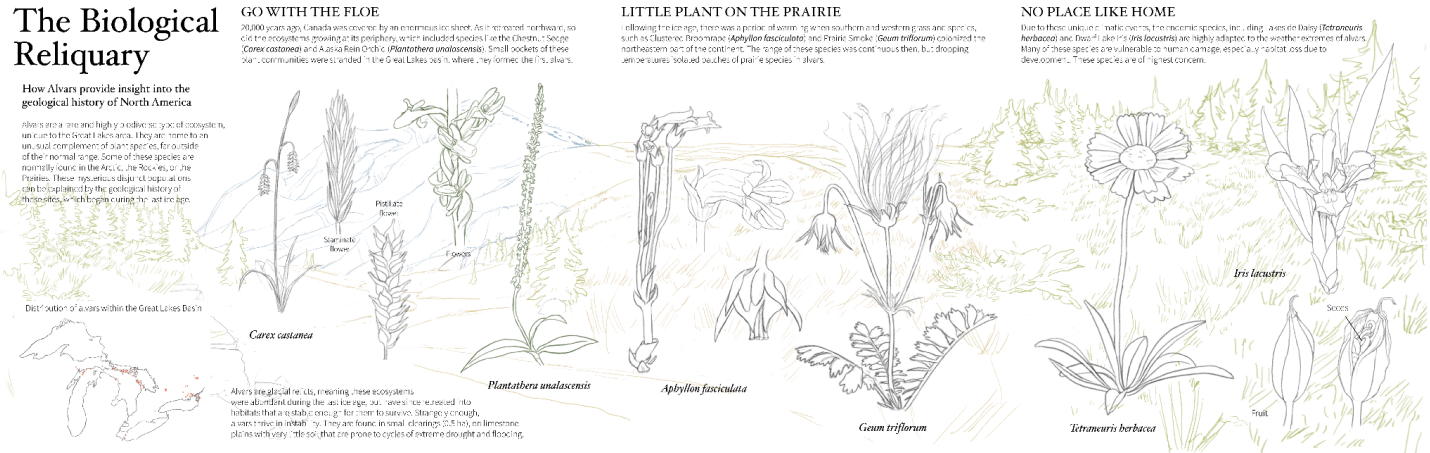

**Spot Illustrations**

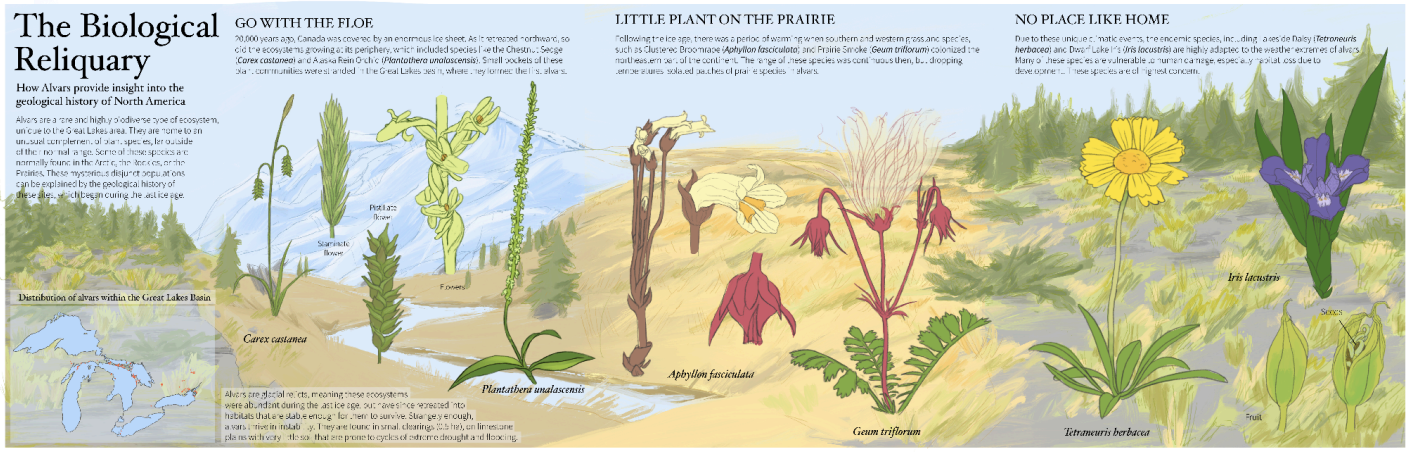
- Most of the information on these is in the research section, but a quick few notes:
- I want to include species name, and a mention of them in the text (endangered, threatened, etc), home range (if disjunct), and any particular tidbit that is interesting
- Challenge is keeping text manageable
- Logbook style (see inspiration board), so sketchy and loose but with a realistic, natural illustration feeling → not overly polished
- Making these big because they are the most visually intriguing part of the graphic

# 5. Revisions

**Draft 2**

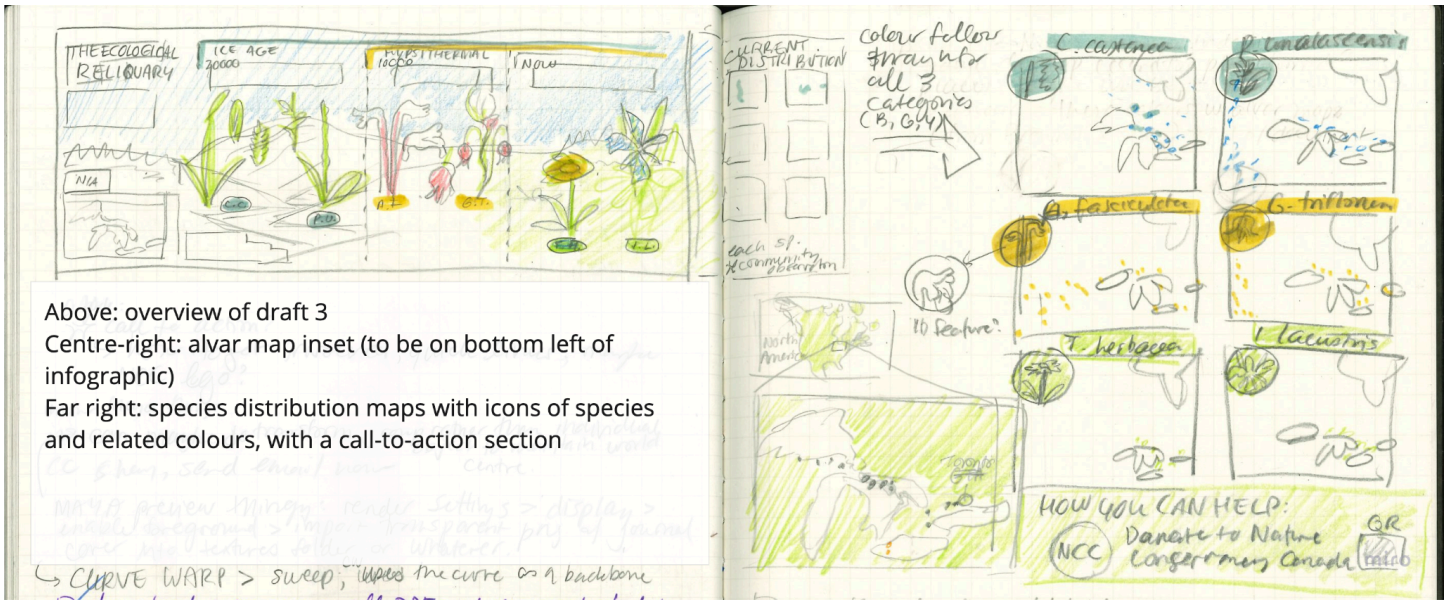
- The following is a list of revisions incorporated since the first draft
- This attempt is meant to be a comprehensive, not a final, so the piece still requires many edits
- **Maps:** After attempting the maps, I found they crowded the infographic and were not supporting the idea any more than the background would. More than that, I was having to do a lot of guesswork to get them to communicate my idea. So, for my next attempt I omitted the maps of the changing ice sheets and prairies and only included a map of the alvar sites themselves
    - Map based off Reschke et al. (1999) map
- **Background**: left side was underdeveloped, so I painted it to look more like the right side, and increased the density of the trees to give it more of a "clearing" feeling (rather than open plain)
- **Spot illustrations**: actually present in this attempt
    - Originally planned to include 2-3 species per section, including insects, but opted for 2 plants per section (north, west, endemic)
        - Maintains consistency, visually interesting elements are more prominent
    - Included some zoomed in parts to show interesting features of the plants, such as blooms
    - Brief attempt at colouring made to see how these contrast against the background
    - Scale bars added, then removed because of how distracting they were to the overall piece
- **Text**: content more or less finalized, top left corner is problematic because of how crowded it is



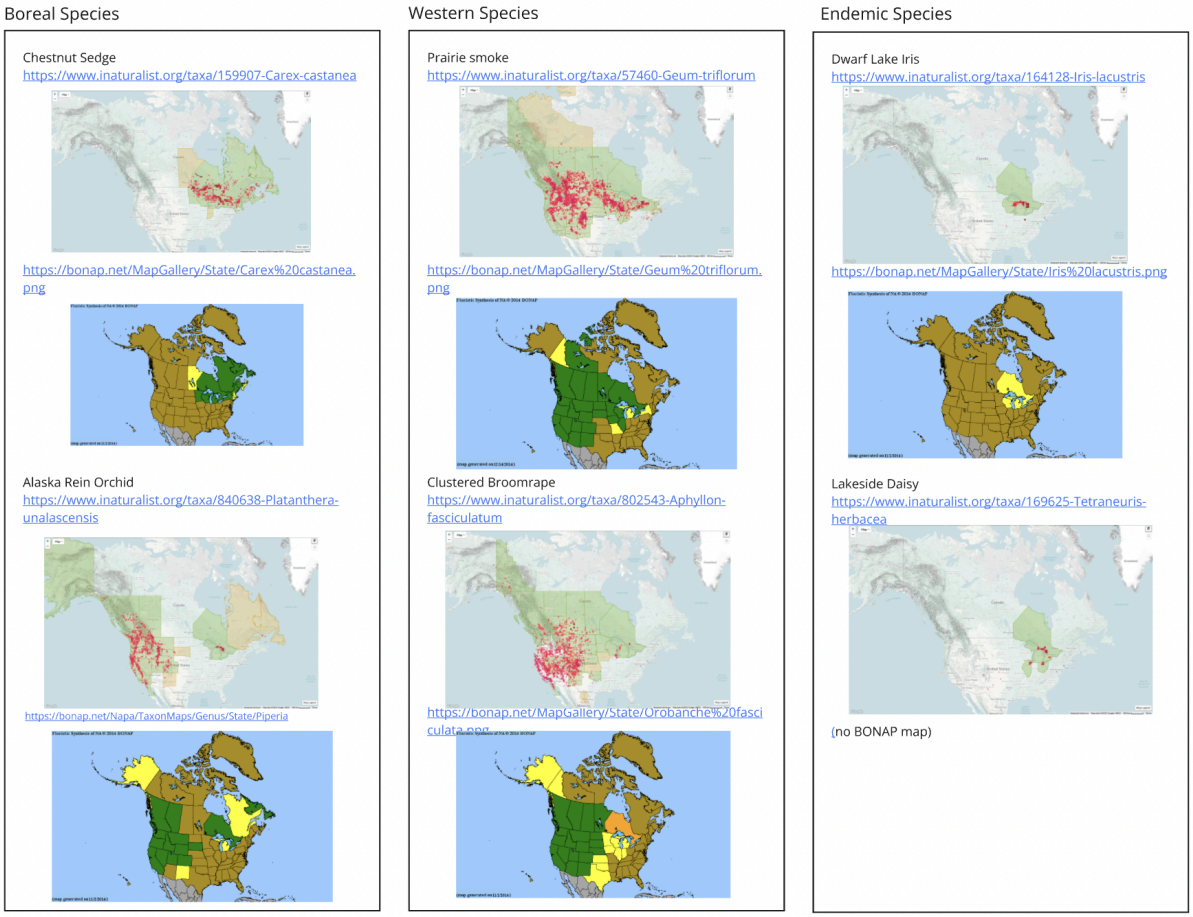
**Draft 3**

- Overarching changes:
    - Add a timeline that describes the time periods of glaciation and warming
    - Add more maps showing **current** distribution of each species depicted
    - These changes better support narrative of change of alvars over time with an end result shown as distribution maps (ties together elements of plants and environment)
    - Current plan for changes:



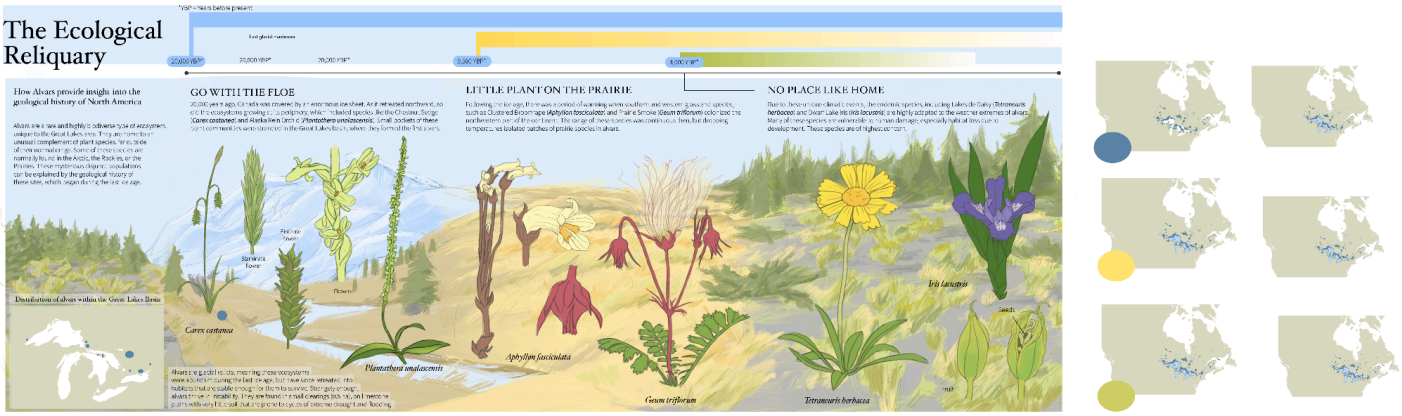

Above: overview of draft 3
Centre-right: alvar map inset (to be on bottom left of infographic)
Far right: species distribution maps with icons of species and related colours, with a call-to-action section

- I also decided to change the title to “The Ecological Reliquary” because this is more specifically related to ecology than the broader realm of biology
- **Timeline**
    - Bars fade as they span the page, stacked, colours correspondent to time period
- **Species distribution maps**
    - Add these in two columns of three on the right side of the infographic (extend it)
    - Use **iNaturalist**: has individual citizen scientists contributing their observations and organizations contributing their data through GBIF
        - Side note, GBIF (global biodiversity information facility) is super cool–it allows institutions to contribute their research to improve the robustness of species distribution maps and overall knowledge, AND it’s free and accessible to everyone
    - Also checked against BONAP (biota of North America program) maps just to be extra sure of the distribution (note: they’re from 2014, there may be some change)
    - See below for distribution maps (also see Miro board)
    - Map-making process:
        - Download svg of base map of North America with Web Mercator projection (same as iNaturalist) from https://vemaps.com/north-america-continent/na-c-01
        - Had to download a separate great lakes svg 😕 and align it 😕 because there were no North America + great lakes maps that were in Web Mercator projection
        - Used illustrator to image trace maps from iNaturalist; had to lower resolution of imported map screenshot first but otherwise no issue
        - Changed colour of lakes to white to improve readability




Distribution maps for spot illustration species

*Carex castanea* distribution map based on iNaturalist data (will be cropped)




Draft 3 (sort of because not all of the changes have been incorporated properly)

**Draft 4**

- Some of these revisions were discussed earlier but were not incorporated in time to be part of draft 3, so the feedback is here
- Changes with a strikethrough are those I would still like to implement but did not have time for before having to submit the final assignment
- **Timeline**
    - Make text bolder, line up text label with year
    - Include important climatic history events, along evenly spaced bar below 3 stacked bars
    - Link divisions of glacial, prairie, and modern times with timeline, adding leader lines where necessary to keep scale of timeline accurate
- **Species distribution maps**
    - Make a map for each species with ~~corresponding profile picture style icons~~ to connect them to the species they're for
        - Also colour code with a little legend, using blue for northern, yellow for western, and green for endemic
    - Add note to maps saying "based on data from iNaturalist" or something similar
    - Clipping mask to constrain size of maps
- **Alvar Map**
    - Add a small map of North America, above the alvar map to contextualize it, with lines showing a blowup of the alvar area
    - Increase readability of alvar sites by tweaking the map, remove linework and darken dots
    - Add labels of different regions of alvars and of the lakes themselves
    - ~~Add a recognizable landmark (e.g. Toronto) that'll help place these as the great lakes~~
    - Coordinate colours for this map with colours of distribution maps
- **Background**
    - ~~Add some dots of colour matching the plants in the spot illustrations so that it looks like the species belong in their environment~~
    - Shift horizon down ¼" to allow text to clear treeline, especially to the left and right
        - Use the gap between *C. castanea* and text (from draft 2) as the template for amount of space to leave between illustration and text
        - May need to increase height of infographic overall

- Decrease focus on background by reducing saturation somewhat
- Clean up trees on left and right, currently painting is messy and shadows are inconsistent
  - Add overall detail (but not too much)
- Do something about the edges of the background:
  - Extend painting to edge of canvas so it fills up entire space
  - Blur/fade edges into white background

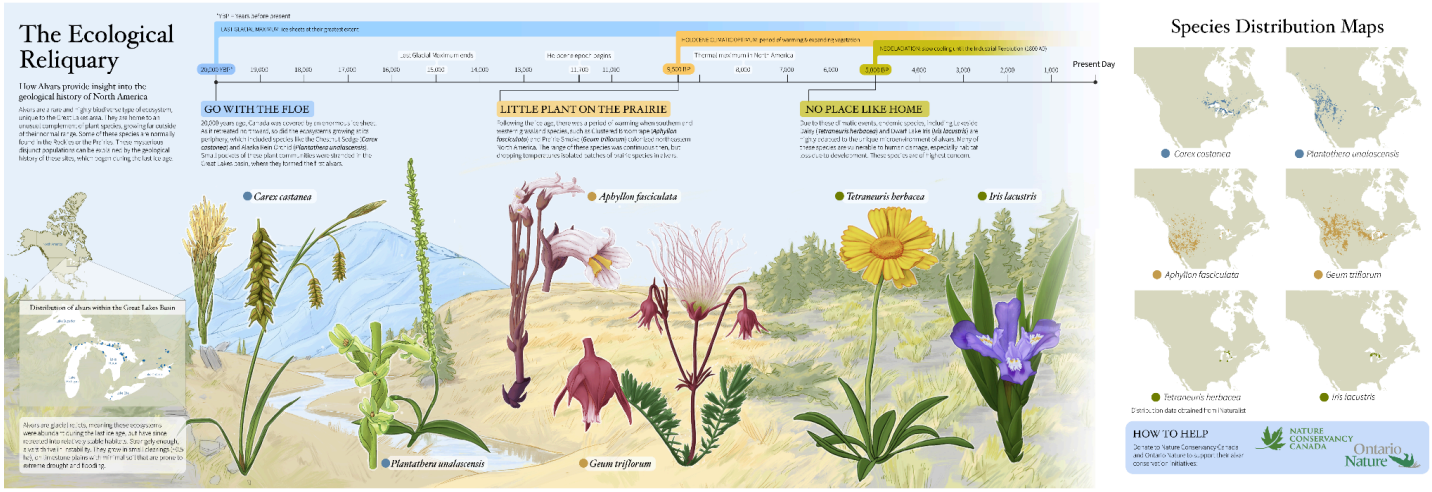
- **Spot Illustrations**
  - ~~Small scale bars along the bottom of each plant, not too obstructive~~
  - Semi-transparent halo around each plant to help them stand out from background
  - Re-arrange all plants with zoomed in elements for more logical visual grouping (i.e. bring zoomed bits closer to the main plant)
    - ~~Enhance this with dashed lines to connect plant parts~~
  - Improved colourization with consistent upper left lighting to match background
    - Just more realism and detail in general
    - EDIT: I tried more realism and it took several hours for one part of one species and I did not like the result, so I am going to go with the logbook style I had originally planned (i.e. linework on colour burn over SIMPLE painting)

- (I do not like this style and it took 2.5 hours)

- (I DO like this style and it took 1 hour 🙂)

- **Text**
    - Reduce text box width for text on top row to follow max 65 characters/line guideline
    - ~~Bold important words~~
    - Change alignment of info paragraph to not have a weird curve
    - Might try making whole infographic an inch taller so the title can clear the top line of the text above each section (i.e. go with the floe, little plant, etc)
    - Add a what you can do to protect/call to action section at the end with QR codes for Nature Conservancy Canada (with NCC logo) and parks canada information

Here is the (current) final!

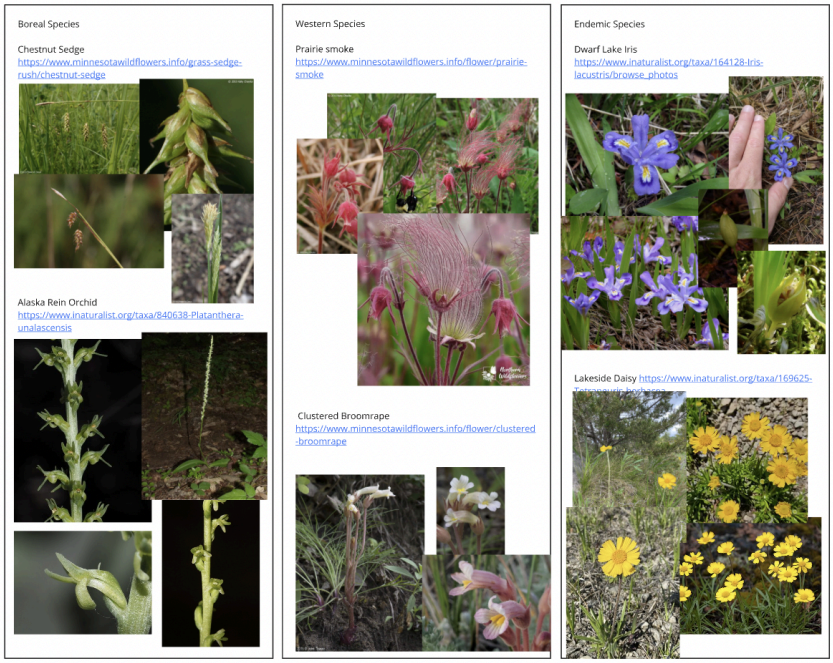



I am certain that I will need future iterations to be happy with this project, and there is a lot to fix, but for the time being I am satisfied with my work.

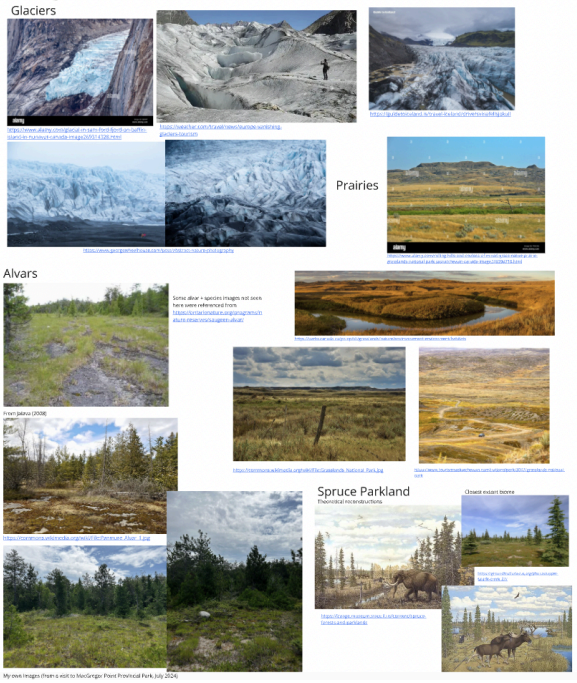
I did not realize before starting this how much more research I would need. I had plenty of material on what is necessary to complete an ecological survey of an alvar, but very little knowledge of how to depict the origins of one. I enjoyed that this project required me to ask myself: “what is needed to tell this story visually?” over and over again.

# 6. Visual references

Spot illustrations




Background Environments




## Style guide:

Possible font pairings:

The Biological Reliquary

Header: Iowan Old Style
Body: Galvji

Alvars are a rare and highly biodiverse type of ecosystem, unique to the Great Lakes area. They are home to an unusual complement of plant species, far outside of their normal range. Some of these species are normally found in the Arctic, the Rockies, or the Prairies.

Final pairing

The Biological Reliquary

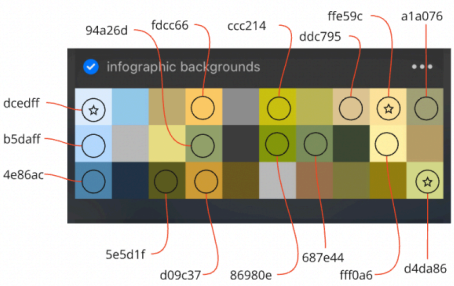
Header: Hoefler
Body: Source sans variable (light)

Alvars are a rare and highly biodiverse type of ecosystem, unique to the Great Lakes area. They are home to an unusual complement of plant species, far outside of their normal range. Some of these species are normally found in the Arctic, the Rockies, or the Prairies.

*The Biological Reliquary*

Header: Georgia
Body: Euphemia UCAS

Alvars are a rare and highly biodiverse type of ecosystem, unique to the Great Lakes area. They are home to an unusual complement of plant species, far outside of their normal range. Some of these species are normally found in the Arctic, the Rockies, or the Prairies.




Colour palette for the background painting and spot illustrations was developed through colour picking from reference images in Procreate

Most used colours are highlighted with hex code (used to build palette in illustrator). A star indicates a key background colour.

Spot Illustrations palettes

# 7. Bibliography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