THE MITLENATCH ISLAND VISUALIZATION PROJECT

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SUMMARY

This research project explores the use of realistic visualizations as tools for climate change adaptation planning, environmental management, and other activities related to protecting ecological, social, and cultural values in protected areas. The project developed an interactive visualization of Mitlenatch Island, and it tested it through two workshops, where we discussed the tool's usefulness and its potential applications with stakeholders from local governments and interest groups. The project involved three major activities: (1) visualization development, (2) fieldwork, and (3) workshops; each of these activities are discussed below.

The project detailed in this report is the first phase of a multi-phased research effort, and we plan to incorporate comments from workshop participants when developing future versions of the tool. In addition, we aim to deliver training sessions to potential users of the visualization tool, and we welcome previous workshops participants (and other individuals that they identify) to join these sessions. Training session participants will be provided with a working project of the visualization tool, which can be further developed to include other landscape features, maps, objects, and scenarios.

This project was supported by the BC Parks Living Lab for Climate Change and Conservation program. We are grateful for this funding and for time the workshop participants contributed to share their valuable ideas and feedback on the visualization tool.

VISUALIZATION DEVELOPMENT

The visualization tool was developed as a realistic virtual environment that can be navigated from the first-person perspective. It was built using methods developed by one of the Lead Researchers (Newell et al., 2017a,b; 2021), involving a workflow from geographic information systems (GIS) to video game development software (Figure 1). A variety of computer programs was used: ArcGIS was used to map the visualization features; Adobe Photoshop was used to format maps and create realistic textures; Trimble SketchUp was used to build 3D objects; the Unity 3D video game engine was used to create the virtual environment. The process is briefly summarized here, and detailed information on how to develop these types of visualization tools can be found in Newell (2017a; 2021).

Figure 1. *Workflow for developing visualization, from ArcGIS to Unity 3D game engine*

The visualization terrain consists of a highly-detailed model of Mitlenatch Island and a lower-detail model of the surrounding terrain that forms the viewshed. Once the terrain models were developed, orthophoto images and surface textures were added to create realistic terrain surfaces. Then, other elements were added in order to develop the virtual world and enhance its representation of the real-world environment, such as an ocean surface, 3D models of vegetation, a model of the volunteers' hut, light sources, atmosphere and sky imagery, and other elements.

Unlike other visualization research that approaches the development of visualization tools with distinct planning objectives and scenarios in mind (e.g., Salter et al., 2003; Schroth et al., 2011; Tress and Tress, 2003), this project took a more exploratory approach. The research team experimented with a variety of features and functions when developing the visualization, such as the ability to explore sea level rise scenarios, fire restoration planning scenarios, changes in landscape vegetation (as seen through orthophotos), and heights and densities of vegetation on the island. In addition, users can explore Mitlenatch Island scenarios and imagery through both a first-perspective and a map view (Figure 2). Furthermore, the visualization contains functions for visiting 'information sites' and playing videos related to these sites.

Figure 2. *Mitlenatch Island visualization in (A) first-person perspective mode, and (B) map view*

FIELDWORK

Most of the visualization work was done using previously collected data, without needing to physical access the island. However, some field data were collected to gather images of local vegetation and other island features in order to inform the modelling and appearance of different elements within visualization elements, as well as for examining changes in landscape and vegetation that could have occurred from when the last set of data were collected. The fieldwork was conducted in early March 2021, where we performed a drone flight from a location near the southern beach (Figure 3). Data collected by the drone included both LiDAR and orthophoto imagery. In addition, we collected photographs of vegetation and other objects in the park that were found near the drone launch site.

Figure 3. *Drone flight conducted on Mitlenatch Island for collecting LiDAR and orthophoto data*

WORKSHOPS

After completing a beta version of the visualization tool, we ran workshops with members and affiliates of the BC Parks, Laich-Kwil-Tach Treaty Society (LKTS), the Mitlenatch Island Stewardship Team (MIST), and Terra Remote Sensing to explore the usefulness and potential applications of the tool. Two workshops were held by Zoom in mid-March. The workshops involved groups of 7 and 8 people, including the researchers.

The workshops began with a round of introductions, and then a presentation on the research and its objectives was given. A letter of information for participant consent was then read and provided to participants, which provided information on the research objectives, importance, procedures, participant inconveniences, benefits, risks, process for withdrawing, confidentiality, dissemination of results, and data management. Finally, the researchers gave a demonstration of the visualization tool, and this was followed by a discussion on its usefulness and potential applications. During the discussion, the visualization tool was continually shown/demonstrated in order to stimulate ideas and suggestions.

OUTCOMES AND INSIGHTS

A number of interesting insights emerged from both developing this 'beta version' of the visualization and testing/discussing it in the workshops. These project outcomes and insights provide ideas for future phases of the project and further developing the visualization tool. The outcomes and insights are categorized and presented below through fourteen themes.

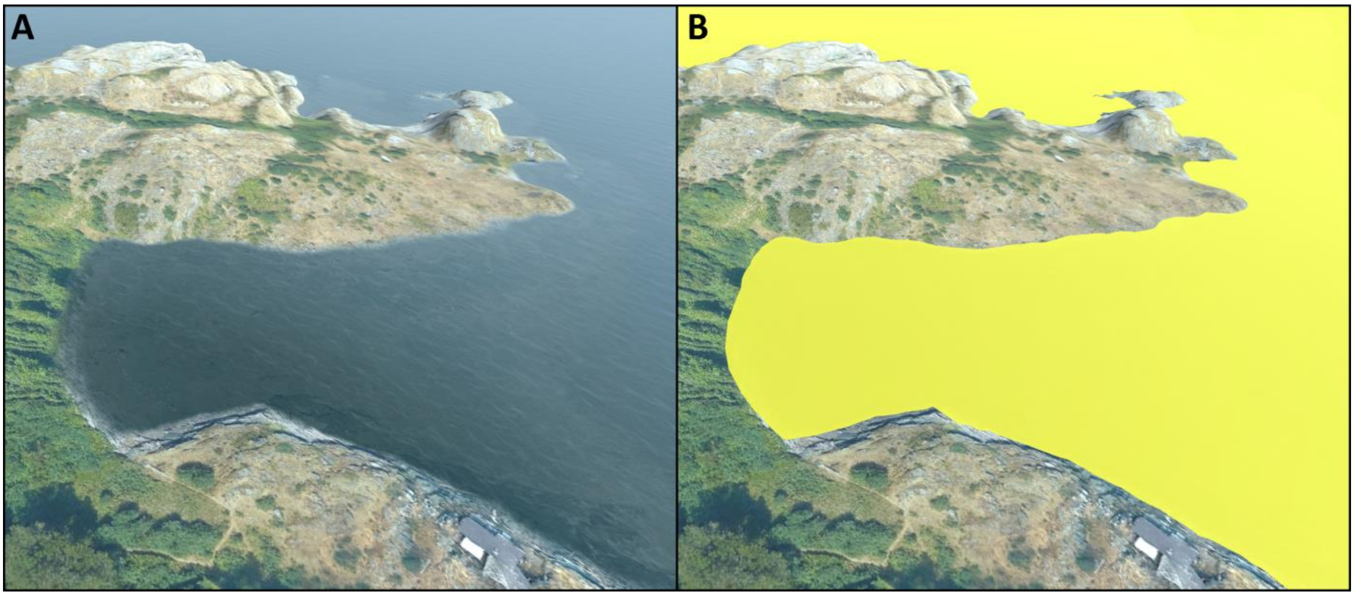
1. ***A tool for exploring multiple objectives*:** The first functions implemented in the Mitlenatch Island visualization were those that allow users to examine effects of different sea level rise scenarios on the island park, these being scenarios defined by the Intergovernmental Panel on Climate Change (IPCC, 2014). The tool demonstrated to be useful for this purpose, and it revealed that vegetated areas near the southern beach of Notch Meadow of Mitlenatch Island are potentially more vulnerable to sea level rise than those near the northern beach (Figure 4). However (and perhaps more importantly), the tool proved to be useful for exploring multiple objectives for park management together. For example, the visualization also included the ability to view prescribed burning and native vegetation restoration in Notch Meadows, using the Mitlenatch Island Fire Restoration Plan (Maslovat et al., 2019) to guide the design of these scenarios.

Figure 4. *Sea level rise under the RCP8.5 scenario, depicted using the Mitlenatch Island visualization*

2. ***A platform for exploring maps and imagery*:** The visualization platform demonstrated to be quite versatile in terms of the functions that could be incorporated into the tool, and we explored a range of these functions. We found that the ability to examine maps and orthophotos to be one of the more straightforward and useful functions to implement: straightforward in the sense that (once this function has been built into the visualization) new maps can be added with ease and relatively little effort, and useful in the sense that it allows for park managers and stakeholders to see their own maps in an interactive, 3D environment. During the visualization development process, we incorporated multiple maps provided by managers/stakeholders, including the fire restoration plan maps and orthophotos from 2017 and 1982. We are hoping to make this a user-side function, that allows users (and not just developers) to easily upload and explore maps on the platform.

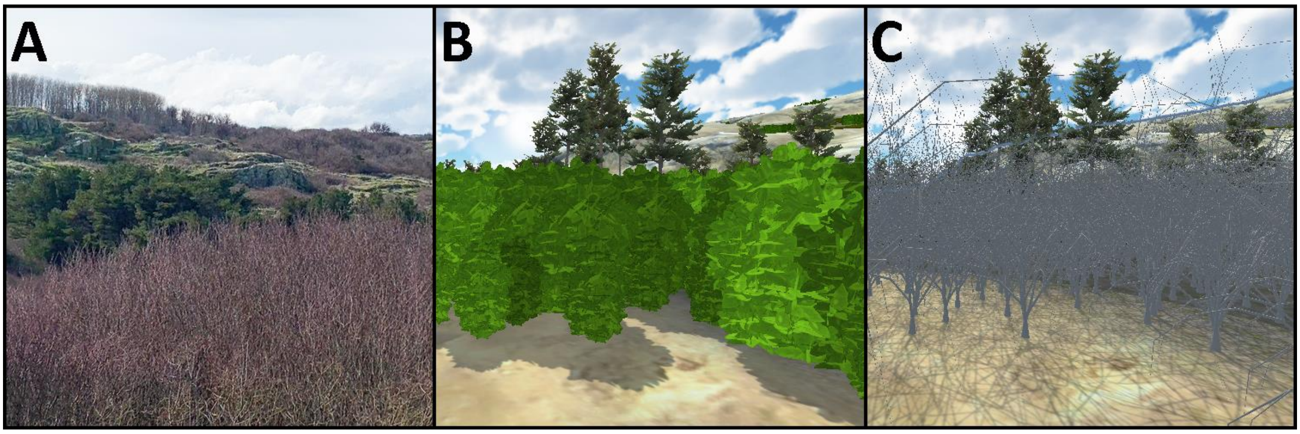
3. ***A combination of abstract and realistic elements*:** The visualization tool was designed to be a realistic representation and experience of Mitlenatch Island; however, we found that there was opportunity and value in also adding abstract elements. For example, the Intergovernmental Panel on Climate Change scenarios have uncertainty ranges for their projections of sea level rise, and we represented the high-range estimate using highly-visible, yellow-plane elements that can be toggled on and off (Figure 5). These abstract elements clearly show where an inland migration of coastline will encroach on terrestrial habitat, if the higher range of sea level rise occurred.

Figure 5. *Sea level rise projection shown (A) without uncertainty and (B) with high-range estimates*



4. ***The importance of field work and ground truthing*:** The majority of the visualization development was done without setting foot on the island, which is encouraging in that it demonstrates a virtual experience of a park can be developed without physically entering park and potentially impacting the ecosystem during fieldwork. However, we found that there were limitations to developing the visualization purely through remote work, and thus we conducted a field trip to 'ground truth' and confirm the nature of some of the elements within our visualization. These data allowed us to refine the visualization to make a more accurate representation and experience of Mitlenatch Island; for example, earlier versions of the tool displayed vegetation that is much denser than is seen in the real environment, and using our field photos, we revised the visualization accordingly (Figure 6).

Figure 6. *Vegetation in (A) photograph, (B) first version of visualization, and (C) revised visualization*



5. ***A potentially powerful tool for outreach and education:*** The Mitlenatch Island visualization could be a tool for education and outreach. During the visualization development stage of this project, we had conversations with potential users of the tool that inspired us to include capabilities for playing videos at different locations and points-of-interest on and around Mitlenatch Island. Currently, the tool contains 'placeholders videos' (i.e., animations previously created by one of the Lead Researcher); however, this function holds possibilities for presenting videos, footage, stories, etc. that share key information about the park and its ecological and cultural values.

6. ***Develop and offer multiple versions of the tool:*** The tool was developed for multiple platforms, including desktop applications for Windows and MacOS and an online version was embedded in the project web page. Some challenges were experienced by workshop participants when attempting to downloading and/or accessing the visualization. Such challenges highlighted the importance of having multiple versions and methods of access, and also the value of providing clear instructions on how to download and open the visualization application.

7. ***Highlight impacts and how these could occur over time:*** Workshop participants gave suggestions for building on the climate change features in the beta version of the tool to better highlight potential impacts. Some of the suggestions included showing how rising sea levels would change the coastline and result in erosion and inland migration of the intertidal zone. Other suggestions included added a time dimension to the visualization to show potential changes in the island's landscape and vegetation over time in response to a changing climate.

8. ***Use the tool for visitor experience and education***: A number of the comments from workshop participants related to visitor experience and education, particularly in terms of directing park visitors to stay on the trails. Suggestions for the visualization included showing impacts to vegetation that could occur when visitors continually go off-trail, as well as incorporating data and visual elements that represent visitor traffic. The latter could be done by added human models to the visualization, as done in a previous visualization project conducted by one of the Lead Researchers (Newell 2017a,b). Workshop participants also noted that the visualization could be used as a tool for allowing visitors to virtually experience park areas restricted to general public, while also clearly highlighting the paths that people need to remain on when visiting the island.

9. ***Use as a crowdsourcing tool***: Workshop participants provided interesting suggestions around using the visualization as a crowdsourcing tool. It was suggested that people can use to tool specifically for reporting whale sightings, and due to its first-person perspective, the tool could be used to report sightings from the same (but virtual) location and perspective that the whale spotters experienced in the real-world. Other crowdsourcing suggestions were made related to LiDAR data; as LiDAR scanner applications on smart phones become more sophisticated, visualization developers can take advantage of these technologies by working with communities and the public to collect 3D models and terrain data.

10. ***Highlight and visualize cultural features and values:*** The workshops illuminated possibilities for highlighting cultural sites, such as those that are important to local Indigenous communities and histories. A particularly interesting suggestion was presented, involving the use of oral history and archeological information to recreate Indigenous villages that were historically present in protected areas (and other areas). If done in collaboration with the appropriate communities, this type of visualization could provide a means of saliently communicating important information related culture, history, and traditional territories.

11. ***Identify and highlight conservation areas and species of interest***: Workshop participants suggested that the visualization tool could support biodiversity objectives by highlighting conservation and nesting areas. Highlighting these areas would be useful for capturing and communicating specific locations of sensitive habitat to managers, stewardship volunteers, and (so they avoid and do not disturb these areas) the general public. Examples for Mitlenatch Island discussed in the workshops, include highlighting/visualizing rockfish conservation areas and gull nesting sites. In addition, suggestions were made to link the visualization tool with other useful tools and databases, such as providing links to the iNaturalist website (www.inaturalist.org) so that users can explore relevant local species data while navigating the visualization environment.

12. ***Develop a tool for integrating resource, social, and environmental considerations:*** The workshop discussions broadened beyond the Mitlenatch Island context, and explored potential visualization applications for other places and environments. In these discussions, we spoke about ways these tools can be used to balance resource, social, and environmental objectives. The example of Quadra Island was discussed, and it was noted that the tool could be used to visualize forestry activity and potential impacts to the viewshed (as done in Lewis and Sheppard, 2006). Other suggestions included developing the visualization with analytical capabilities, such as a tool that would be able to calculate both the amount of wood harvested from different forestry scenarios, as well as the associated impacts to wildlife habitat. Inspired by these discussions, we are currently brainstorming and devising approaches for creating such a tool.

13. ***Develop a tool that can be experienced at multiple scales***: In the workshops, we discussed ways of developing a visualization that captures multiple scales, and we explored questions around how these types of visualizations could be developed as tools for managing larger parks (i.e., larger than Mitlenatch Island) and networks of protected areas. This is a significant challenge because first-person, on-the-ground visualization experiences require developing virtual environments with higher degrees of detail and resolution than can be accomplished when modelling large areas. Ideas for addressing this challenge included creating a coarse-resolution (i.e., low detail) visualization that encompasses a large area, and then, adding features that allows users to zoom in and 'land' on smaller, high-resolution parks/spaces.

14. ***Provide different levels of access***: In some cases, visualization developers and user communities and groups may want such features to be visible only to members of the communities/groups. In cases where there are sensitive ecosystems and/or cultural and archeological sites, displaying these to the general public through the visualization may be problematic, as people may wish to visit these sites, potentially causing impact. During the workshops, we spoke about methods for creating differentiated access in the visualization tools, where different versions will have certain features and elements disabled so that they can be displayed on public websites, and the complete versions of the tool (i.e., with all features available) can be hosted on password-protected sites.

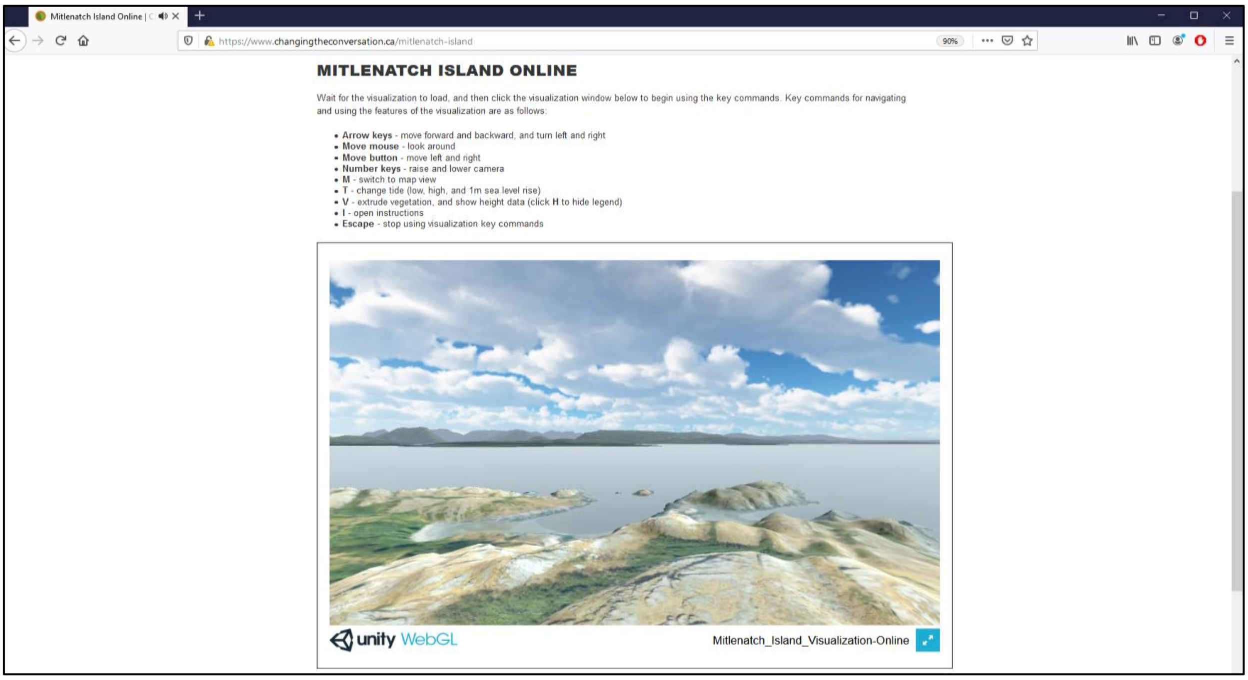
CONCLUSIONS AND NEXT STEPS

This report presents the first phase of a multi-phase research effort, and future phases will build on this work. We will review the feedback provided in the workshops to determine what can be incorporated into the next versions of the visualization tool. The tool will be refined accordingly, and then, we will reach out to the communities and groups (both those who previously participated and new participants) to arrange another set of workshops. Such an approach will allow the visualization tool to be developed through an iterative process, with multiple stages of engagement and feedback.

It is not feasible to incorporate all feedback and suggestions from workshop participants when refining and creating new versions of the tools; however, rather than constraining the imagination of the participants, we decided to maintain an open discussion and collect many suggestions and ideas for further developing these tools. The type of interactive visualization developed for this project is relatively novel in terms of being a tool for park planning and engagement, and every idea provided through the workshops could serve as an interesting avenue for future visualization research, whether this be done in the next phases of this project or in other studies.

During the workshops, we discussed how the online version of the tool (Figure 7) provided valuable opportunities for collaborative planning, engagement, and public education, particularly due to it being easy for users to access. In addition, with the online visualizations, communities and stakeholder groups could host versions of tool on their respective websites. Some technical challenges were experienced with the online visualizations, such as browser compatibility and limitations in the number 3D models that can be visualized. However, this research has indicated that online access is useful; thus, exploring ways of addressing these challenges is a worthwhile pursuit.

Figure 7. *Online version of the Mitlenatch Island visualization embedded in a webpage*



In addition to future workshops, we plan to hold training sessions on the visualization working projects and ways of further developing the visualization tools. The training will be held (ideally) in the fall of 2021 over a three-day period, and we will follow-up with the participants of these sessions with interviews in early 2022. In the interviews, we plan to discuss whether participants (and their respective communities and groups) have been able to make use of the training and visualization tools, and if not, what barriers or challenges need to be address to better harness opportunities and utilize the tools. Our hope is that this final research phase will serve to better equip user groups with the knowledge and skills to effectively make use of the visualization tools, with the ultimate goal of closing the gap between research and practice.

The beta version of the visualization tool is available for download and online access, and it can be accessed from the project webpage: www.coraluvic.ca/sidneyspitviz/mitlenatch-island. We plan to continue developing the tool, and as we create new versions and upload them to the server, the most recent versions will be available from the same download links and web player.

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