GEOVISUALISATION FOR EFFECTIVE MANAGEMENT OF INVASIVE SPECIES: BRIDGING THE KNOWING–DOING GAP

Elvia Willyono[1*], Christopher Bone[1] and Robert Newell[2]
* Corresponding author: elvia.willyono@gmail.com

[1]University of Victoria, Victoria BC, Canada.
[2]Royal Roads University, Victoria BC, Canada.

ABSTRACT

Invasive species are a major threat to protected areas, as they disrupt native ecosystems and contribute to biodiversity loss. Invasive species management is faced with a challenge known as the 'knowing–doing gap', which refers to the disconnect between scientific research and its application in conservation efforts. Addressing this challenge requires collaboration between stakeholders (including researchers, managers, policymakers and the public), creating a need for tools that can clearly communicate invasive species and strategies to diverse audiences. Realistic, immersive geographical visualisations (geovisualisations), have the potential to serve a role in bridging this gap. This study engages people with management- and place-based relationships in a provincial park in British Columbia, Canada in the use of a novel geovisualisation tool for supporting invasive species management efforts. Using focus group methods, the research collects insights and perspectives on the usefulness of the developed tool. The results indicate that geovisualisations have the potential to engage and educate stakeholders in management options; however, it is important for geovisualisations to maintain realism and account for the diverse backgrounds of users. The paper concludes with suggestions from study participants on how to improve geovisualisation tools in ways that increase their effectiveness and appeal to park and protected area stakeholders.

Key Words: stakeholder collaboration, interactive tools, virtual environments, scenario assessment, landscape visualisation

INTRODUCTION

Participatory approaches and stakeholder engagement are crucial in the management of biological invasions due to the complex interplay of environmental challenges, such as climate change, land degradation, pollution and invasive alien species, which necessitate equal consideration of ecological and social processes (Shackleton et al., 2019a). However, including a variety of actors in effective management practices can be challenging, given that translating knowledge into practice in landscape conservation and ecological restoration requires overcoming existing gaps between 'knowing' and 'doing', where scientific research does not always result in on-the-ground conservation action (Matzek et al., 2014). This 'knowing–doing gap' (Lavoie & Brisson, 2015) is common in invasive species management (Funk et al., 2020). Despite the availability of scientific research on biological invasions (Matzek et al., 2015), there can be a lack of effective applications in conservation and natural resource management due to a focus on the advancement of basic research rather than considering mechanisms for conveying knowledge to relevant practitioners (Esler et al., 2010). The disconnect between research outcomes and effective management decisions can hinder the development and implementation of evidence-based solutions (Matzek et al., 2015). Closing this gap requires a coordinated effort by stakeholders in the invasive species community, including researchers, managers, policymakers and the public, to ensure that the knowledge generated about invasive species is translated into effective action.

Increasing stakeholder engagement and ensuring that communications are accessible and applicable to management audiences have been identified as key factors for improving invasive species management practices (Beaury et al., 2020). Shackleton et al. (2019b) suggest ways to improve collaboration in natural resource management, such as promoting co-design and social learning, providing feedback to stakeholders, and enhancing partnerships beyond academia. Such co-design, feedback processes and partnerships can be supported by using geovisualisation tools that communicate how research-based practices can potentially lead to different management outcomes. Advancements in geographic information systems (GIS) and media technologies have enabled the creation of realistic place-based tools, enabling a deeper understanding of local planning and management issues (Newell & Canessa, 2015). Geovisualisations can provide a first-person perspective of different scenarios applied to a particular location, offering levels of detail that can help people better relate to the issues and landscape depicted (Appleton & Lovett, 2003). Geovisualisations can help to communicate complex ideas, data and concepts to broad audiences, including those who may not have a technical background. For example, complex climate change data and issues can be made more comprehensible to diverse stakeholders through scenario development and visualisation in community engagement and participatory planning processes (Jenkins et al., 2020). When created as 3D realistic scenes, geovisualisations hold advantages over conventional methods for representing geographic information, such as 2D maps, by allowing people with different backgrounds and technical knowledge to see and better understand proposed management options (Lewis & Sheppard, 2006). Note that the term 'geovisualisation' in other studies can refer to any visual representation of geospatial data, including maps, map-like displays, multimedia, plots and graphs that facilitate an understanding of geographic information (Çöltekin et al., 2018). However, in the context of this paper, geovisualisations refer to 3D digital representations of real-world places.

The majority of studies on geovisualisation as tools for planning, management and stakeholder engagement focus on urban contexts (Al-Kodmany, 2002; Jaalama et al., 2021; Newell et al., 2020). While some research has been performed in parks and protected areas (Canessa et al., 2015; Newell & Canessa, 2017; Newell et al., 2017), the degree to which geovisualisations can assist with bridging the knowing–doing gap specifically in invasive species management is lacking. This paper examines how geovisualisation tools can close the knowing–doing gap among a diverse group of stakeholders.

This study developed and tested the utility of Mitlenatch Island Visualisation (MIVis), a geovisualisation tool, for improving stakeholder understanding of the implications of management options for Himalayan Blackberry (*Rubus armeniacus*) on Mitlenatch Island, British Columbia (BC), Canada.

METHODS

Study area

Mitlenatch Island Nature Provincial Park (hereafter Mitlenatch Island) is a 155 ha protected area located in the northern Strait of Georgia, British Columbia (Figure 1). The park is located on the territory of the We Wai Kai First Nation, Wei Wai Kum First Nation, Xwemalhkwu (Homalco) First Nation, K'ómoks First Nation, Klahoose First Nation and Tla'amin Nation. It is characterised by semi-arid conditions due to its location in the rain shadow of Vancouver Island, receiving less than 750 mm of rain per year (BC Parks, n.d.). The park is home to a diverse array of wildlife, including various seabirds, marine life, and land animals (BC Parks, n.d.). The park also holds significant cultural value to local First Nations communities, with it traditionally serving as a site for foraging and gathering (Maslovat et al., 2019).

Mitlenatch Island is unique in its abundance of traditionally-used vegetation species due to previous generations of Indigenous resource management practices (Maslovat et al., 2019). The park is only accessible by boat, and the only human infrastructure on the island is a small cabin for daytime volunteer activities. Mitlenatch Island is thus an interesting case study for geovisualisation research by allowing users to experience and interact with the island remotely.

Himalayan Blackberry

Himalayan Blackberry is native to the Caucasus region of Eurasia (Caplan & Yeakley, 2006) and was introduced to British Columbia in the 19th century as a berry crop (Metro Vancouver, 2021). Himalayan Blackberry is difficult to control or eradicate because of its robust and rapid reproduction (Soll, 2004). On Mitlenatch Island, Himalayan Blackberry has traditionally been controlled by hand-cutting, which is mainly done by volunteers every two weeks during the growing period (Maslovat et al., 2019). The cut stems are then broken into smaller segments and left on the ground to decompose. While this method has proven effective, it is also very labour intensive. Managers are considering using other methods, such as prescribed burning, to control Himalayan Blackberry on Mitlenatch Island, but to date there has been no evaluation of the feasibility of these alternatives.

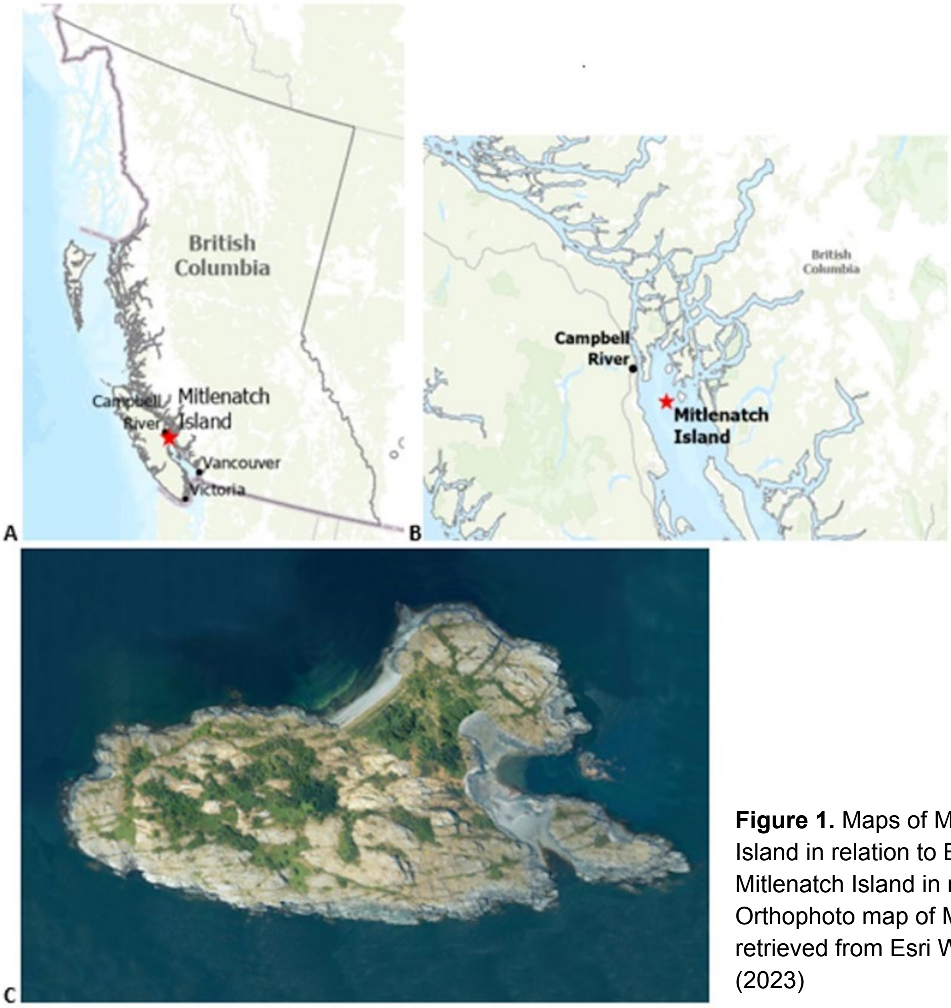

Figure 1. Maps of Mitlenatch. Location of Mitlenatch Island in relation to British Columbia (A); Location of Mitlenatch Island in relation to Vancouver Island (B); Orthophoto map of Mitlenatch Island (C). Basemap retrieved from Esri World Topographic Canada Style (2023)

Table 1: Summary of the scenarios included in MIVis

Visualised states	Scenario description
Current state	The state of the area before any management
Directly after treatment	The state of the area immediately following the implementation of one of four management strategies (hand-pulling, mowing, burning, and mowing and burning)
After one growing season	The changes that have occurred in the area after a full growing season following a chosen management strategy
Future unmanaged	How the Himalayan Blackberry might look if they were unmanaged

Geovisualisation and scenario creation

MIVis communicated potential outcomes of Himalayan Blackberry management options on Mitlenatch Island. A map provided by BC Parks, fieldwork photos and GIS data, and online images were used to identify the locations and appearance of Himalayan Blackberry. Management scenarios included in MIVis were based on the current strategies being used and those that practitioners were interested in exploring (Maslovat et al., 2019). The scenarios were developed using data and findings from previous studies on Himalayan Blackberry management done in the Pacific Northwest (Chow, 2018; Clark & Wilson, 2001; Ensley, 2015). Specifically, the studies on the management of Himalayan Blackberry examined changes in plant density and counts before and after implementing various management strategies, and these data were used to develop MIVis with respect to numbers and densities of plant elements visualised.

The Himalayan Blackberry management scenarios incorporated three key factors essential to understanding invasive species management: the impact of invaders, the consequences of management strategies, and the potential for secondary invasions (Pearson et al., 2009). As shown in Table 1, visualisation options include viewing (1) the current state of the landscape, (2) the landscape immediately following a particular management strategy and (3) the landscape a season after treatment, and (4) the landscape if left unmanaged. Detailed description of the scenarios can be found in Supplementary Material 1.

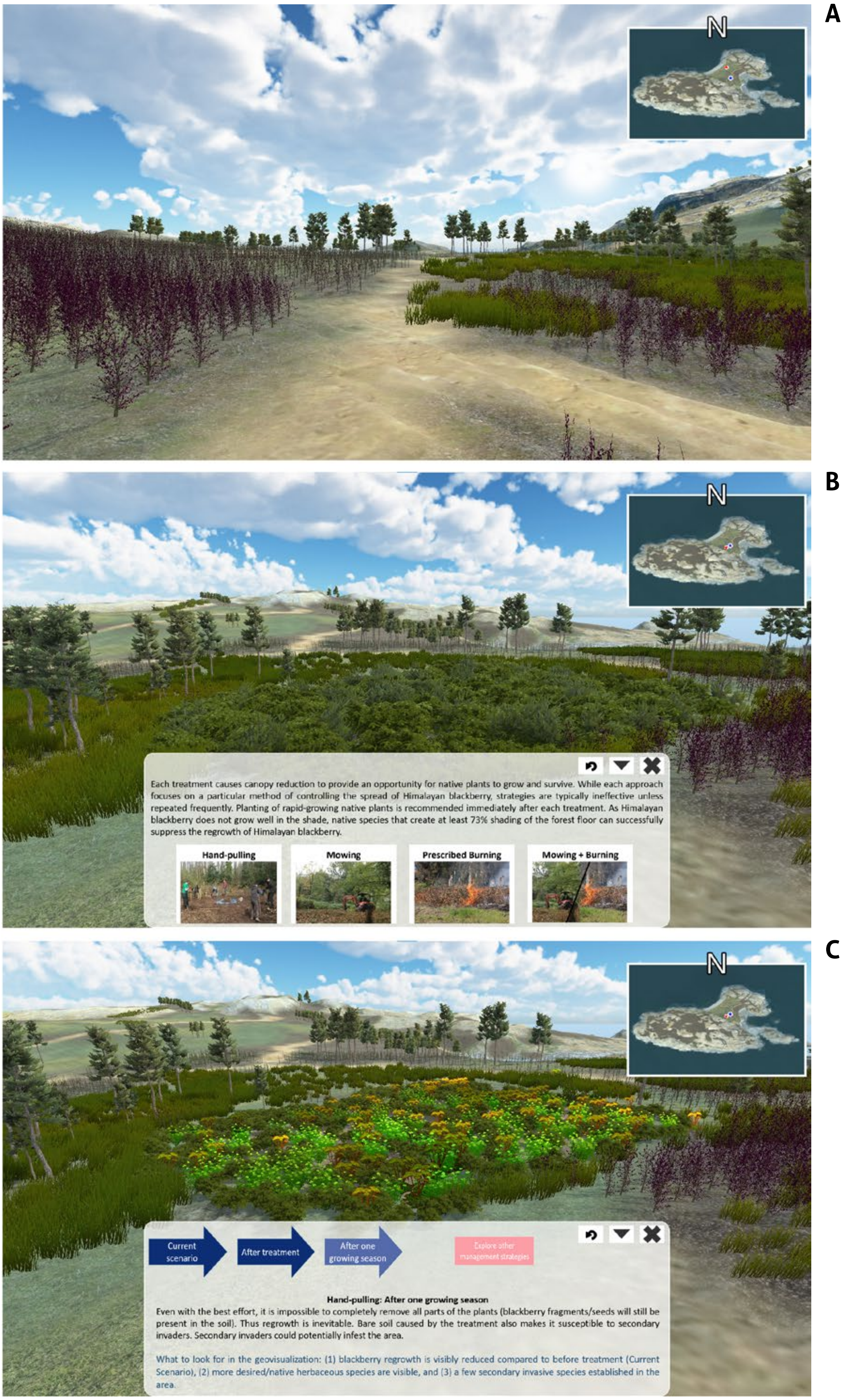

Figure 2. Screenshots of the geovisualisation. First-person perspective (A); Information and the four Himalayan Blackberry management strategies (B); 'After one growing season' stage (C)

Geovisualisation development and use

The geovisualisation experience places the user in the role of a first-person character standing on Mitlenatch Island, allowing them to freely explore the island and the Himalayan Blackberry plots (Figure 2). An information panel appears when the user is near a site with Himalayan Blackberry invasions, providing details and the option to view the four management scenarios. Each management strategy is accompanied by scenarios displaying what the landscape would potentially look like after one growing season. Explanatory text is included in each scenario with the aim of helping users to better understand the management outcomes for Himalayan Blackberry on Mitlenatch Island.

MIVis was developed using a game engine, Unity 3D (version 2020.1.9f1), using techniques established by Newell et al. (2017). This software allows the capability to construct an open-world environment, incorporating features such as terrain, weather, first-person character movement, and interaction. The tool is designed to provide interactive experience, where users can virtually freely explore Mitlenatch Island. Additional software including QGIS (version 13.16.10), GIMP, Adobe Photoshop and SketchUp are used to prepare data and visual elements for integration into Unity 3D, following the methods of Newell et al. (2017). These additional software allow for more detailed design elements, creating a visually realistic virtual environment. While this paper provides a succinct overview of the modelling process, a comprehensive description is available in the Supplementary Materials.

Focus groups

Focus groups involve gathering insights from small groups of participants whose knowledge and/or opinions are of relevance to the subject under examination. Snowball sampling was used for recruitment. This strategic method for recruiting currently unknown and hard-to-reach stakeholders (Parker et al., 2019) is commonly used in the investigation of local planning matters (e.g. Newell et al., 2020; Newell et al., 2022). Recruitment began with a small number of initial contacts with whom the researchers had previously developed relationships, and these contacts were asked to identify other individuals who might be interested in our study. This method allowed us to identify individuals who had connections to Mitlenatch Island, which is particularly important for this study due to the island's inaccessibility. Invitations were sent to over 100 people; approximately 30 invitees expressed interest in the project, and 20 participants attended the focus groups. Participants included members of BC Parks, Laich-kwil-tach Treaty Society and Mitlenatch Island Stewardship Team (MIST).

In September 2022, three two-hour focus groups were conducted: one in-person session and two online sessions. The focus groups began with a brief presentation on the research project and its objectives, followed by a demonstration of MIVis. Participants were given the chance to explore MIVis at their own pace, after which they were provided with feedback forms (Supplementary Material 2A) to share their experience, noting any encountered opportunities and limitations. The research involving human participants underwent ethical review and received approval from the University of Victoria's Human Research Ethics Board. Each participant was briefed and received a letter of consent (Supplementary Material 2B) outlining the research, focus group procedures and their right to withdraw.

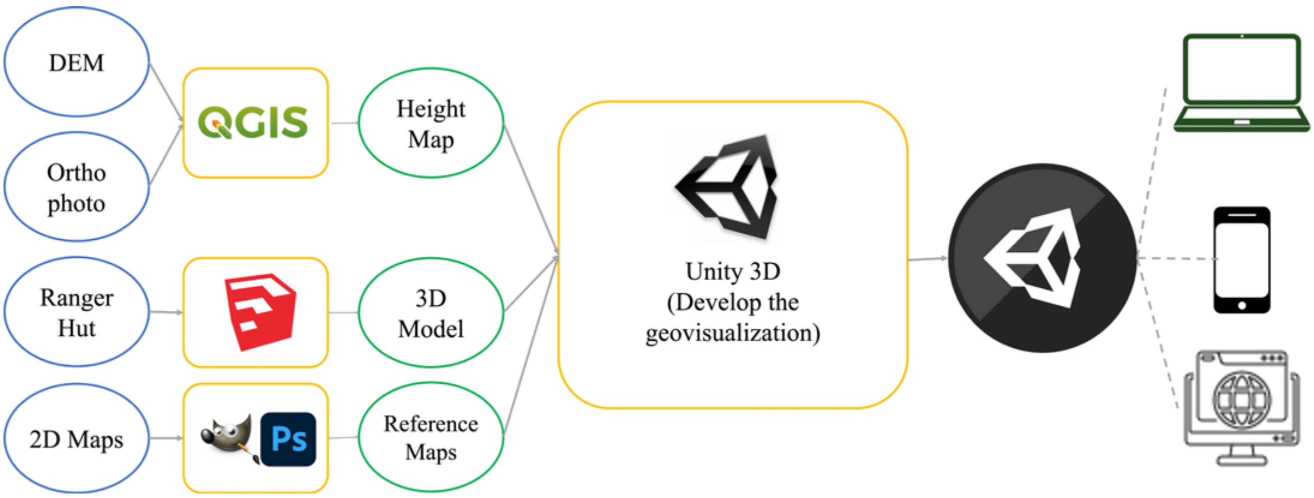

Figure 3. Workflow of developing MIVis

Table 2: Summary of results

Categories	Themes	Codes
Weaknesses and Limitations: *adoption gaps of MIVis*	Lack of representation	Too oversimplified Lack of animals and birds, vegetation is a lot thicker on the island
	Lack of content	Region-specific resources, long-term outcome results
	Varied familiarity with the platform among different audiences	Preferred to view data, charts and graphs Preferred using Google maps
	User skill level	Future/next phase of the project
	Technology Compatibility	Problems with opening the application on my device
Opportunities: *the potential contributions to planning/other uses*	Making informed decisions	Different perspectives, Multiple dimensions, Outcomes
	Reviewing resource management/enabling scenario planning	Planning, Budgeting, Manpower, Maintained
	Empowering the voice of First Nations	First Nations' values and sites, middens, burial sites, canoe runs, fish traps, nesting sites
	Providing a sense of context	Topography, Mainlanders, Accessible vs. restricted areas
	Addressing/ communicating current issues and opportunities	Floods, climate change, (Elk Falls, Strathcona Park)/other invasive species (Scotch Broom)
	Engaging/educating the public	Educational, awareness, outreach
Potential for improvements: *factors for improving the success of MIVis*	Work with practising users/local experts	Hand-cutting, photos, sound clips of the island
	Improve user experience	Movements, buttons, mobile phones
	Planning needs and requirements	Bird's-eye and street-level, views comparison, 2D man, planning information

Data analysis

Data included written feedback, researchers' notes and transcripts of focus group discussions. The audio data from the focus groups were transcribed, and the transcripts were imported into NVivo (version 12) for qualitative analysis. Thematic coding was used to analyse the data using NVivo, following an inductive coding approach that involved both applying and revising the coding framework as the data were analysed (Thomas, 2006). After completing the open coding process, an axial coding process was used to group the coded data based on commonalities in ideas, thoughts and comments (Thomas, 2006). This process identified a series of coherent themes that emerged from the focus group discussions and written feedback, which described the opportunities, issues and areas for improvement in MIVis.

RESULTS

As shown in Table 2, the thematic analysis was organised into three categories: (1) weaknesses and limitations, (2) opportunities, and (3) potential for improvement. These results are discussed in the sections below, with the specific themes identified in italic text.

Weaknesses

This category includes themes that relate to the weaknesses and limitations associated with the use of MIVis. Participants acknowledged the presence of certain limitations inherent in MIVis, with one participant describing it as "having minimal effectiveness". While MIVis captured some of the realistic aspects of the appearance of the island, some expressed that it *lacked representation*. Some participants noted that the visualisation failed to accurately depict the appearances of vegetation, thickness of vegetation, and the plants and bushes. Additionally, participants also noted that

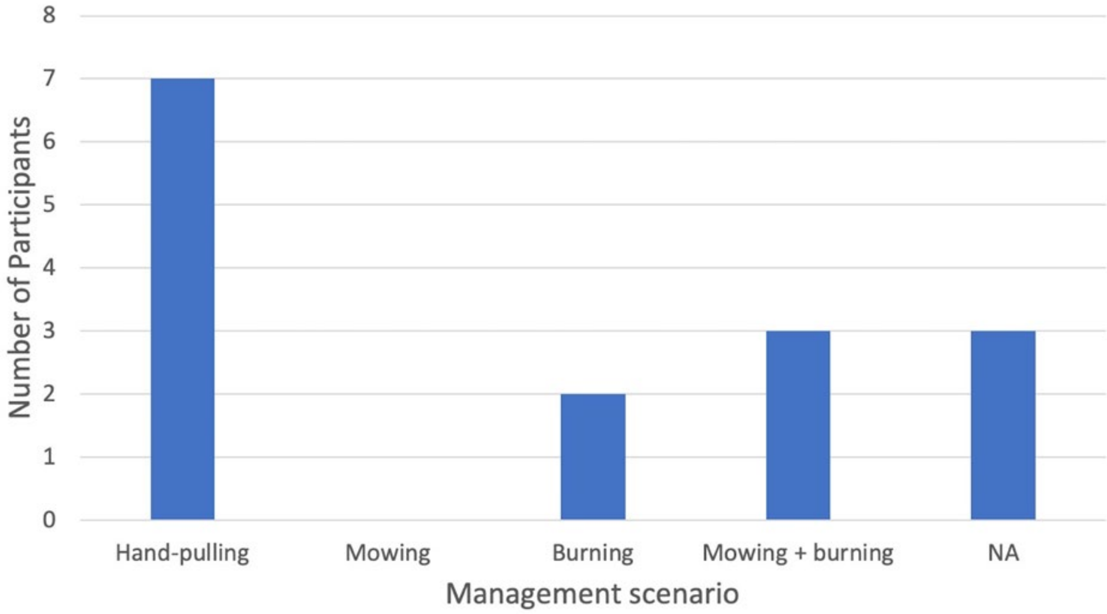

Figure 4. Participants' preferred first choice of management strategy after using MIVis

the absence of animals in MIVis was a limiting factor. For example, the seagull population on the island is significant and cannot be ignored, and thus the lack of seagulls in the tool made the tool look less realistic.

Some participants expressed the *lack of content*, particularly their interest in seeing the outcomes of the hand-cutting method, which is the current management strategy for controlling Himalayan Blackberry on Mitlenatch Island. In the feedback form, most participants stated that their preferred method was hand-pulling when asked about their first choice (Figure 4). However, it was found that the reason behind their choice was not based on MIVis, but rather their previous experience with hand-cutting. Participants believed that hand-pulling was "*the most similar to the hand-cutting*" which made it their preferred management strategy.

The *participants' level of familiarity* with the island was found to be a factor in their perception of the usefulness of MIVis. Those who were more familiar with the island tended to rate the tool as minimally or somewhat effective at best. In contrast, participants who were less familiar with the island were more likely to find MIVis useful. This suggests that prior knowledge and experience can affect one's perception of the value of geovisualisation tools in exploring and understanding geographic information.

Participants also brought up the *technical challenges* during the focus group discussions. Some participants reported they faced hardware and software compatibility issues, and some of their laptops were too old to run the application or did not meet the minimum system specifications for the tool to run smoothly. This limits their ability to fully interact with and benefit from MIVis. Participants also raised concerns about the *technical skills* required to build and maintain MIVis in the future.

Opportunities

While participants recognised the limitations of MIVis, they also described it as effective and having potential. One key benefit of the tool, as identified by participants, was its ability to *support informed decision-making* by visually exploring and evaluating different options and scenarios. One participant indicated that the visualisation tool was effective in '*seeing*' the outcome of management decisions. MIVis also effectively conveyed the message that a singular management treatment of any kind would not be sufficient in eradicating Himalayan Blackberry and that ongoing management efforts were necessary.

Participants also indicated that MIVis could be *beneficial for evaluating resource management* by offering a visual representation of the area. The visual information provides insights on the specific locations where resources are needed to manage the area. The tool has the potential to be useful for budgeting and managing resources, as well as for planning and allocating personnel.

Participants stated that this tool could also be useful *for addressing and communicating current issues and opportunities* by providing a visual representation of data and information about the state of the environment and the potential impacts of different actions or inactions. According to participants' comments, this tool


Camp Bay and volunteer's hut on Mitlenatch Island © Robert Newell

could be valuable for identifying areas of concern and for developing and implementing effective strategies for addressing certain issues. MIVis *provided a sense of context* such as allowing users to view restricted areas, such as bird nesting sites or areas with thick vegetation, without disturbing the ecosystem or the animals living there. It also enables users to view wildlife activities in their natural habitat without disrupting them. Additionally, the tool can be used to educate users about why these places are restricted to help them understand the importance of preserving these areas.

The potential of MIVis to *assist First Nations* in land stewardship was acknowledged by a few participants, as it could provide the opportunity to enhance how resources in their territory are managed. Multiple First Nations participants recognised the capability of using MIVis to depict the past use and management of the island, including historical sites such as middens, burial grounds, canoe routes and fish traps. One example that was mentioned by a participant was that MIVis could portray the historical gathering of seagull eggs on Mitlenatch Island and support an understanding of the influence of this practice on seagull populations.

Finally, participants indicated other potential uses for MIVis in the future, including *public educational outreach efforts* and virtual visits. The tool could also communicate other plans, such as prescribed burning as a management tool. It could also be used to explore climate change scenarios and to manage other areas. The tool could also track the growth or decrease of all species on the island, as well as the management of over-growth plants and eelgrass, pelagic haul-out areas, gulls, and potential erosion. The tool can be used to mark locations of rare plant species and ecological communities, as well as to track plant growth over time and, by adding a seasonal component, visually depict the phenology of different species.

Potential for improvements

Participants indicated that MIVis could be improved by including more relevant scenarios, particularly those involving *collaboration with experienced users*. They identified the current hand-cutting treatment method as an important inclusion, and expressed being open to help develop this scenario in an update of the tool. They also offered to provide materials and resources that could be utilised to enhance the representation of the island in future versions of the geovisualisations. These resources include photographs taken during one of the participants' recent visit in summer 2022, as well as audio recordings of the island's unique sounds. Participants suggested that the *user's interface* such as the manoeuvrability could be improved (i.e. making it easier to move around and navigate). Also, some features were not intuitive, as participants noted that the buttons did not appear to be clickable, which made it difficult to use the tool effectively. Other suggestions included the option to use the tool on different platforms, such as mobile devices, which would make it more accessible and user-friendly. Furthermore, they suggested that a user guide on how to use MIVis would be helpful in allowing users to better understand the tool and its capabilities.

Several areas for improvement in MIVis were suggested to make them more *relevant for managers*. They suggested the inclusion of aerial views and 2D maps to provide a bird's-eye view and better overall understanding of the island. Participants suggested the capability to fix the view at certain locations and to minimise screen movement, as the current movement was causing some participants to experience a dizzy sensation. They also emphasised the importance of the ability to view all scenarios at the same time for easy comparison. Lastly, they suggested the inclusion of visual information on financial and human resources to aid in planning.

DISCUSSION

The results showed that MIVis has great potential for enhancing understanding and connecting to a sense of place, as evidenced in the opportunities category. However, the study also revealed challenges associated with using geovisualisation for decision-making purposes. Participants also raised several suggestions during the focus groups to enhance the effectiveness and appeal of the geovisualisation to users. These suggestions are explored in this section, offering practical ways to improve the strategies and engage stakeholders in a more meaningful way.

Enhance understanding through sense of place

Sense of place is defined as a complex of emotional, physical, and cultural factors that give a place its unique character and meaning for individuals (Tuan, 1977). When developed with high degrees of realism, geovisualisation tools can engage and interact with people's sense of place (Newell & Canessa, 2015). MIVis thus has potential to connect with people's sense of place, engaging users' deeper understandings of the complexity, issues, and management opportunities associated with Himalayan Blackberry on Mitlenatch Island. By interacting with sense of place, users can assess scenarios based on their place-based perceptions and values, as well as their attitudes and behaviours toward the environmental issues affecting a place. MIVis enabled participants to gain a nuanced understanding of managing Himalayan Blackberry by providing visual access to data, context and to hard-to-reach areas, thereby enhancing participants' awareness of locational characteristics and exposing them to the issues and opportunities present in those areas.

Participants agreed that MIVis had the potential to effectively communicate those issues and opportunities to a broader audience, engaging and educating the public. This finding is consistent with other research on geovisualisation tools, which has found that realistic environmental models and simulations can facilitate effective and efficient communication and consensus-building among participants by providing a common language (Al-Kodmany, 2002). The findings are also supported by Hayek (2011), who noted that 3D geovisualisations are best employed in the context of motivating people, raising awareness, and drawing their attention to a specific topic.

While the tool has the potential to be valuable for public engagement and education (i.e. communicating and making sense of what is known), there is a need to work towards improving the tool and making it more effective for collaboration and creating the opportunity for scientific knowledge discovery. This may involve incorporating more opportunities for the two-way flow of knowledge by involving stakeholders in the co-design, co-creation and co-implementation of research and management actions (Shackleton et al., 2019b).

Facilitate decision-making

MIVis may not be effective in facilitating decision-making, as several participants reported that it did not have the potential to support their invasive species work, describing it as being only minimally effective. The lack of realistic representations of many features was a significant factor, as participants felt that it did not accurately resemble the environment of the island. Secondly, participants felt that they needed more data to make informed decisions. Specifically, they expressed the need for long-term impact scenarios and comparisons with the existing method of controlling Himalayan Blackberry invasions. However, due to the lack of literature on hand-cutting, this method was not incorporated in MIVis. Participants also expressed an interest in seeing the outcomes of management strategies over a longer period, as most research on Himalayan Blackberry focuses on the short-term impacts of these strategies.

Increasing levels of detail in a visualisation can indeed contribute to people's ability to connect with and envision the presented landscape. The more realistic the depiction, the easier it becomes for individuals to immerse themselves in the visualised environment and imagine its real-life counterpart. However, the search for a 'sufficient' level of realism is challenging because some elements are not simulated or represented with the same level of accuracy, realism or quality as other elements (Appleton & Lovett, 2003). The complexity also arises from the fact that the real landscape is constantly changing due to seasonal and daily variations in atmospheric conditions, and these diverse and everchanging elements cannot be accurately replicated in a simulated environment (Lange, 2001).

Our study also revealed that participants who frequently visited Mitlenatch Island did not think that the current geovisualisation accurately represented the island. This highlights the importance of understanding that perception of 3D geovisualisation is not only influenced by the realism it can present but also by the individual's knowledge, prior experiences and unique characteristics of the audience (Jaalama et al., 2021). Furthermore, research has shown that how a place is seen and experienced can also differ between people and groups (Newell & Canessa, 2017). Therefore, when creating a geovisualisation, it is crucial to incorporate place-based cues and consider the characteristics and preferences of the intended audience. This includes understanding their sense of place, their expectations, and their familiarity with the depicted landscapes.

Despite the criticisms of MIVis, participants recognised its potential. This was demonstrated by the willingness of some participants to share data and feedback to help improve the tool, such as the most recent photos taken from Mitlenatch Island and sound clips, all of which can present a more immersive and realistic experience for users, and aid in creating an accurate representation of the island.

Limitations

Limitations of this study include its sample size. Although the participant sample represented many targeted users on the management of Himalayan Blackberry on Mitlenatch Island, the sample size was relatively small. The engagement was also limited to one First Nations community, and the results cannot be generalised to other communities or the broader population due to the relatively few participants who were involved. In addition, several other challenges were faced during the project's online focus groups process, including hardware and software compatibility issues for some participants. As a result, some participants were unable to open the application on their own devices and relied on walkthroughs of the tool conducted by researchers to understand MIVis, limiting their ability to fully interact with it.

CONCLUSION

Geovisualisations have potential for improving public communications, outreach and participatory governance of environmental issues. By providing a sense of context for out-of-reach sites, the public can be engaged to help them better understand complex issues and make management decisions. However, to fully realise the collaborative potential of geovisualisation, it is crucial to involve stakeholders in the co-design, co-creation and co-implementation of research and management actions. This two-way flow of knowledge can lead to more effective decision-making and implementation of management actions. Moreover, the ability to enhance understanding is another key benefit of MIVis.

Building an effective geovisualisation requires careful consideration of the data, its sources and its potential uncertainties. The process of building a geovisualisation tool does not necessarily need to result in a final product (Newell et al., 2017). Instead, it can involve an ongoing and iterative approach where the base model is continuously improved as more stakeholders interact with it. Conducting geovisualisation research in this manner requires a flexible tool that allows for continual modification, as well as scenario building, so that users can explore different hypothetical situations, their potential outcomes, and the uncertainty that exists in the information and in the model. Although ambitious and time-consuming, this longitudinal approach to geovisualisation research could produce valuable insights into what makes for an effective geovisualisation planning and management tool, as well as how these tools are shaped depending on who is involved in their

SUPPLEMENTARY ONLINE MATERIAL

Supplementary Material 1. Development of the Geovisualisation Tool for Invasive Species Management.
Supplementary Material 2A. Letter of Information for Participant Consent.
Supplementary Material 2B. Focus Group Feedback Form.

ABOUT THE AUTHORS

Elvia Willyono was an MA student at the University of Victoria specialising in geomatics and geographic visualisation.

Christopher Bone is an Associate Professor in Geography at the University of Victoria. He focuses on the use of geospatial technologies and spatial modelling for enhancing environmental monitoring and analysis.

Robert Newell is the Canada Research Chair in Climate Change, Biodiversity and Sustainability at Royal Roads University. Newell's research focuses on integrated sustainability planning and policy.

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Trail through a field on Mitlenatch Island © Robert Newell

RESUMEN

Las especies invasoras constituyen una grave amenaza para las áreas protegidas, ya que alteran los ecosistemas autóctonos y contribuyen a la pérdida de biodiversidad. La gestión de las especies invasoras se enfrenta a un reto conocido como la “brecha entre el saber y el hacer”, que se refiere a la desconexión entre la investigación científica y su aplicación en los esfuerzos de conservación. Para hacer frente a este reto es necesaria la colaboración entre las partes interesadas (investigadores, gestores, responsables políticos y público en general), por lo que se precisan herramientas que comuniquen con claridad las especies invasoras y sus estrategias a públicos diversos. Las visualizaciones geográficas realistas y envolventes (geovisualizaciones) pueden contribuir a colmar esta laguna. Este estudio involucra a personas con relaciones de gestión y basadas en el lugar en un parque provincial de la Columbia Británica (Canadá) en el uso de una novedosa herramienta de geovisualización para apoyar los esfuerzos de gestión de especies invasoras. Utilizando métodos de grupos focales, la investigación recoge ideas y perspectivas sobre la utilidad de la herramienta desarrollada. Los resultados indican que las geovisualizaciones tienen el potencial de implicar y educar a las partes interesadas en las opciones de gestión; sin embargo, es importante que las geovisualizaciones mantengan el realismo y tengan en cuenta los diversos orígenes de los usuarios. El documento concluye con sugerencias de los participantes en el estudio sobre cómo mejorar las herramientas de geovisualización para aumentar su eficacia y atractivo para los interesados en los parques y áreas protegidas.

RÉSUMÉ

Les espèces envahissantes constituent une menace majeure pour les zones protégées, car elles perturbent les écosystèmes indigènes et contribuent à la perte de biodiversité. La gestion des espèces envahissantes est confrontée à un défi connu sous le nom de “fossé entre le savoir et l’action”, qui fait référence au décalage entre la recherche scientifique et son application dans les efforts de conservation. Pour relever ce défi, il faut une collaboration entre les parties prenantes (notamment les chercheurs, les gestionnaires, les décideurs et le public), d’où la nécessité de disposer d’outils permettant de communiquer clairement sur les espèces invasives et les stratégies à divers publics. Les visualisations géographiques réalistes et immersives (géovisualisations) peuvent contribuer à combler ce fossé. Cette étude implique des personnes ayant des relations avec la gestion et le lieu dans un parc provincial en Colombie-Britannique, au Canada, dans l’utilisation d’un nouvel outil de géovisualisation pour soutenir les efforts de gestion des espèces invasives. En utilisant des méthodes de groupes de discussion, la recherche recueille des idées et des points de vue sur l’utilité de l’outil développé. Les résultats indiquent que les géovisualisations ont le potentiel d’impliquer et d’éduquer les parties prenantes dans les options de gestion ; cependant, il est important que les géovisualisations restent réalistes et prennent en compte les différents contextes des utilisateurs. Le document se termine par des suggestions des participants à l’étude sur la manière d’améliorer les outils de géovisualisation afin d’accroître leur efficacité et leur attrait pour les parties prenantes des parcs et des zones protégées.