Exploring realistic immersive geovisualizations as tools for inclusive approaches to coastal planning and management

by

Robert Newell

Bachelor of Science, University of Victoria, 2005
Master of Environment and Management, Royal Roads University, 2009

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Supervisory Committee

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Abstract

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Abstract

Effective coastal planning is inclusive and incorporates the variety of user needs, values, and interests associated with coastal environments. This requires understanding how people relate to coastal environments as 'places', imbued with values and meanings, and accordingly, tools that can capture place and connect with people's 'sense of place' have the potential for supporting effective coastal management strategies. Realistic, immersive geographical visualizations, i.e., geovisualizations, theoretically hold potential to serve such a role in coastal planning. However, significant research gaps exist around this application context. Firstly, place theory and geovisualizations are rarely explicitly linked in the same studies, leaving questions around the (potential) relationship between these tools and sense of place. Secondly, geovisualization work has focused on terrestrial environments, and research on how to realistically model coastal places is currently in its infancy. This dissertation aims to address these gaps by pursuing two research objectives. The first objective is to explore the 'human component' of geovisualizations, referring to how these tools operate within the social and cultural dimensions germane to environmental management plans and processes. In accordance with the discussion above, this exploration is framed through place theories and concepts, and regards realistic geovisualizations as 'place-based' tools. The second objective concerns the coastal context, and it involves

elucidating the considerations around developing and using terrestrial-to-marine geovisualizations as tools for inclusive coastal planning and management.

The dissertation is composed of five manuscripts, which have been prepared as standalone articles for submission to academic journals. Each manuscript details a study designed to support an aspect of the research objectives, respectively serving (1) to develop a theory of geovisualizations as place-based tools, (2) to explore the theory in the coastal context, (3) to examine the relationship between sense of place and one's mental visualization of place, (4) to develop a coastal geovisualization under place-based considerations and examine its capacity for connecting to sense of place, and (5) to assess the geovisualization's potential as a tool for inclusive coastal planning efforts. The first and second study consist of literature review work. The third study involves a survey administered to residents of the Capital Regional District, which collected data for examining a potential relationship between the way people visualize coastal places and how they value and relate to these places. The fourth and fifth study involve developing a coastal geovisualization of Sidney Spit, and then employing focus groups to examine its ability for connecting with people's sense of place (i.e., fourth study) and utility as a tool for inclusive planning (i.e., fifth study).

Outcomes from the first study include a theory on how geovisualizations can function as place-based tools, and this was developed by integrating place concepts with ideas and conceptual models from human-media interaction and sense of presence research. The second study produced insight on how values and interests of different coastal user groups can influence understandings and perceptions of coastal places, and it used this insight to develop recommendations for coastal geovisualizations - full navigability, dynamic elements, and flexibility (i.e., allowing for continual modification and scenario building). The third study produced empirical evidence that place-based values and interests (i.e., framed through sense of place and concerns for place) can influence one's mental visualization of place in terms of the types of elements people include and perspectives they take in said visualization. The fourth study demonstrated that the presence of certain elements in coastal geovisualizations (such as people, dogs, birds, marine life, vegetation, and boats) can contribute to realism and sense of place; however, simultaneously, deficiencies in numbers and varieties of these elements can detract from realism and sense of place. In addition, the fourth study found that the incorporation of soundscape and viewshed elements is significant for the tool's ability to connect with sense of place. The fifth study demonstrated the geovisualization's usefulness for assessing certain qualities of management scenarios, such as aesthetics and functionality of fencing around a restoration area and potential viewshed impacts associated with locations of moored boats. The study also found that incorporating navigability into the geovisualization proved to be valuable for enhancing understandings around scenarios that hold implications for the marine environment because it allowed users to cross the land-sea interface and experience underwater places.

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Dedication

This dissertation is dedicated to my father, Craig Newell (March 28, 1950, to March 27, 2008). My father was passionate about education, learning and the pursuit of knowledge, and he was a PhD student when he passed away. I inherited this passion for learning from him, which ultimately resulted in this dissertation.

Chapter 1

Introduction and Overview

1.1 Introduction

Understanding how to sustainably manage and live within coastal areas constitutes a considerable challenge. The coast acts as an interface between two radically different environments, i.e., terrestrial and marine, and thus can be a highly unstable space consisting of dynamic geographical attributes (Hofmeester et al., 2012). In addition, the coast comprises an overlap between aquatic and land-based ecosystems, leading to the formation of complex food chains (Jentoft, 2007) and unique biophysical interactions and lifecycles (Hofmeester et al., 2012). Due to this complexity and dynamism, human interactions with coastal environments often result in unpredictable outcomes, which creates challenges for the management and governance of these places (Chuenpagdee and Jentoft, 2009). Adding to these challenges is the coast's geometric complexity. The coasts consist of land, ocean surface, water column and seabed, and this presents questions around whether conventional resource planning tools, particularly two-dimensional maps, are adequate for the coastal context (Canessa, 2008).

The complexity of coastal systems is increased when adding the human element to the ecological components. Humans rely on coastal spaces for food, residence, recreation and a variety of other resources, and thus must be integrated into conceptions of coastal ecosystems (Jentoft, 2007). Bowen and Riley (2003) noted that this greatly increases the difficulties in effectively managing coastal and marine resources, as one of the most significant challenges for coastal management is understanding and adequately addressing the linkages between ecological and social benefits of these environments. They argued that any practical environmental program exercised on coastal spaces must sufficiently incorporate the social context and realities into its operations, but such a consideration presents difficulties when taking into account the wide variety of interests and perspectives in coastal communities. The coast serves as humanity's 'gateway' to the ocean, and relationships with and/or values for the ocean are diverse, including those that are recreationally-based, visually-oriented, resource-focused and/or spiritual in nature (Thompson, 2007; Stocker and Kennedy, 2009). Such a diversity frequently results in conflicting interests (Thompson, 2007), thus incorporating social context and realities into coastal management is tasked with the challenge of addressing these conflicts.

Coastal management is also complicated by the fact that coastal systems exist across a multitude of jurisdictional boundaries, varying in scales (Chuenpagdee, 2011). The coast is subject to the interests, powers and decisions of local communities and all levels of government (local, regional and national) (Hofmeester et al., 2012). In certain cases, this can contribute to 'legal pluralism', which is a situation where different legal frameworks overlap and can conflict with one another (Jentoft, 2007). Chuenpagdee (2011) described an example of legal pluralism involving the Actam Chuleb Marine Reserve (ACMR) in the Mexican state reserve of Dzilam de Bravo. The community of San Felipe (the initiators of ACMR) established a system of environmental enforcement that was effective, yet this system became a source of controversy because it did not conform to the weaker regulatory standards of the greater encompassing Dzilam de Bravo. Consequently, the ACMR regulatory standards conflicted with the larger coastal space where in it was nested, creating tension between regulatory efforts designed for effectively managing the coastal reserve and what was considering 'legal' practice within the greater legislative framework.

Succinctly stated, coastal systems are layered with ecological, social, cultural, economic and political dimensions that interact with one another at multiple scales, and this presents appreciable challenges for coastal management as it requires understanding and addressing great complexity. Integrated coastal management[1] emerged as a framework for addressing these challenges by recognizing these environments as complex systems layered with multiple, interdependent human and biophysical dimensions (Cicin-Sain and Belfiore, 2005; Fletcher et al., 2011; Tabet and Fanning, 2012). This framework is designed to facilitate coastal management, which is cognizant of the relationships between different geographical aspects of the coast (i.e., marine, shore, terrestrial) (Sorensen, 1997) and the human and ecological components of coastal systems (Bowen and Riley, 2003). To this end, integrated coastal management involves strategies and plans that identify and incorporate elements/activities of both marine and terrestrial environments, the diversity of different interests and values associated with coastal places, and the multiple scales and political jurisdictions that span coastal systems (Sorensen, 1997; Christie 2005; Cicin-Sain and Belfiore, 2005). The fundamental function of

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[1] Although the term employed here is 'integrated coastal management', this discussion also refers to similar terms that are (for the most part) interchangeable, such as integrated coastal zone management (Fletcher and Potts, 2008), integrated coastal and ocean management (Kearney et al., 2007), and integrated management for marine ecosystems (O'Boyle and Jamieson, 2006; Chuenpagdee, 2011).

integrated coastal management is that of ‘integration’[2], meaning that it approaches coastal management in a holistic manner and avoids compartmentalized, sectorally-segregated strategies (Cicin-Sain, 1993; Portman et al., 2012; Tabet and Fanning, 2012).

By recognizing the variety of relationships between users of coastal and marine resources, integrated coastal management aims to overcome the fragmentation that results from single-sector and single-agency management approaches (Kearney et al., 2007). Accordingly, this approach is highly participatory and includes multiple stakeholders in planning processes, ultimately contributing to more comprehensive and representative management plans and promoting more equitable decision-making (Christie, 2005, Cummins et al., 2004, Pickaver et al., 2004). Such an approach is important for attempting to resolve conflicts and accounting for the social and economic needs of various coastal user groups. For example, Kojima et al (2013) described the integrated coastal management process in Munakata City that was spurred by repeated cases of user conflicts in local coastal areas. The process involved the formation of the Munakata Coastal Use Coordination (MCUC) Working Group to develop a set of rules and strategies for facilitating multiple uses of coastal spaces, and this group consisted of a diversity of people and interests to ensure that a comprehensive range of user types was represented when devising said rules/strategies and attempting to resolve user conflicts. As another example, Christie (2005) discussed the coastal management strategies in the Mabini-Tingloy of the Philippines, where the Haribon Foundation for the Conservation of Natural Resources (a non-governmental organization) worked with local fishers and resort owners to establish the Cathedral Rock, Arthur’s Rock and Twin Rocks marine protected areas. Regulations and bans on activities in these area were developed through a collaborative process involving Haribon, community members, local business owners and local government, thereby ensuring that different interests and values of local community members were captured in the process.

Because integrated coastal management is inclusive and participatory, it follows that tools that support inclusion and participation are valuable for enacting these management approaches. New opportunities for creating such tools have presented themselves through

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[2] It is important to understand that integrated coastal management is a framework with no ‘one size fits all’ approach because human systems and ecosystems differ from location-to-location (Tabet and Fanning, 2012). Therefore, integration is a challenge that is context-specific and requires tailoring plans and strategies according to local political, social, cultural, economic and ecological conditions (Fletcher and Smith, 2007).

advancements in GIS and media technologies. In particular, these technologies have provided means for constructing (increasingly more) realistic and geographically-accurate representations of real-world environments, referred to in this dissertation as geovisualizations[3]. Due to their realism, geovisualizations can communicate outcomes of potential environmental management strategies in a 'relatable' fashion, meaning that they attempt to provide people with vivid understandings of how they would feel about certain management outcomes or impacts if transpired in real places. Sheppard (2001) evoked the metaphor of 'crystal ball gazing' to illustrate this communicative capacity, describing how visualizations essentially provide people with glimpses of potential futures for places that they know, use and value by displaying these places as they would appear if certain courses of action (or inaction) were taken. Such a capacity positions geovisualizations as powerful tools for facilitating collaborative resource planning and management. Supporting this notion, previous research has observed that these tools have potential for functions such as effectively communicating outcomes of natural resource development to local communities (Lewis and Sheppard, 2006), supporting collaborative climate adaptation planning (Schroth et al., 2009; Sheppard et al., 2011), and stimulating discussion among stakeholders regarding future land-uses in the face of changing landscape conditions (Schroth et al., 2011).

Because previous research has demonstrated that geovisualizations have value in inclusive planning efforts, it is tempting to claim these tools also have value in supporting effective coastal planning and management. However, the majority of the visualization research has been conducted in the terrestrial context, whereas coastal and marine applications have been largely unexplored. This dissertation is a response to the lack of attention given to the coastal context, and it explores the development and use of realistic geovisualizations for inclusive coastal planning efforts. This chapter provides a guide for this work by describing the context, purpose and approach of the research. The chapter begins with discussion on previous research

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[3] This dissertation employs the term, 'geovisualization', to refer specifically to digital representations of real-world places that are geographically-accurate and built with high degrees of realism; however, it is important to note that the term can hold a broader meaning in other literature, where it can be used to more generally refer to visual depictions of geospatial data (Nöllenburg, 2007). In addition, what is referred to as geovisualization in this dissertation has been described in other research using different terms such as 'landscape visualization' (Lewis and Sheppard, 2006) or '3D visualization' (Grêt-Regamey et al., 2013).

in landscape visualizations and their applications in inclusive approaches to planning. The chapter then identifies the gaps in this research, and presents the key research questions surrounding these gaps. Following this, the chapter outlines the methodology and studies within this doctoral work, illustrating how this work is designed to effectively address the research questions and advance critical knowledge around the development and application of coastal geovisualizations.

1.2 Visualizations as Tools for Planning and Management

Realistic geovisualizations are powerful communication tools because they can clearly convey management and/or development outcomes in a manner that resonates with different types of people (Burch et al., 2010; Pettit et al., 2012; Schroth et al., 2011). Due to this communicative power, geovisualizations can be more effective tools than abstract visual media (e.g., conventional maps) for engaging certain communities or groups in inclusive planning and stimulating collaborative discussions. For example, Lewis and Sheppard (2006) conducted a study comparing realistic landscape visualizations with conventional maps in terms of the ability these tools have for communicating potential riparian and forest management outcomes to local community members of Cheam First Nation (Fraser Valley, BC, Canada). They observed that the visualizations were regarded positively due to their realism, whereas the maps were found to be confusing by some. Some participant comments indicated that realistic forms of visual media could be necessary for facilitating productive planning discussion with certain communities; for example, a study participant noted that “[i]f people want to come and deal with First Nations, they better come in hand with what the place looks like and then show them what you want to do to it. ... that’s more real to a First Nations person” (Lewis and Sheppard, 2006, 304). Such findings demonstrate that visualizations can be valuable tools for engaging diverse community members, and (perhaps more importantly) they might be integral for facilitating productive planning conversations when including people that are not as comfortable with reading more abstract visuals, such as maps.

In addition to being able to communicate outcomes of resource management options, visualizations also can be used to present trends in landscape changes. Such a function is useful for collaborative planning processes, as it provides stakeholders with an understanding of how their local landscape might appear in the future, thus allowing for discussion on what is contributing to these trends and/or how to adapt. This particular application was explored in Schroth et al.'s (2011) study in Entlebuch, Switzerland, where they used visualizations for agricultural planning workshops. Schroth et al. (2011) developed a series of visualizations to represent potential outcomes of local agricultural trends occurring over a 30-year period. They found the visualizations to be useful for facilitating discussion among the stakeholders on experiences and concerns related to these trends, as well as for stimulating ideas around new land-use possibilities in a (potentially) changed future landscape.

The examples above demonstrate visualizations being used in somewhat different ways, either communicating outcomes of management options or possible landscape changes/impacts due to economic and/or environmental trends. However, visualizations can also be used for both functions in the same planning session, which is particularly useful for engaging stakeholders in climate adaptation planning. For example, Shaw et al. (2009) conducted a study where visualizations were presented to local government and stakeholders of Delta, BC. The visualizations depicted local flooding issues that could potentially occur with sea-level rise, as well as possible options for addressing these issues (e.g., the building of a berm, constructing a sea wall, raising houses on stilts). Employing the visualizations enhanced understandings held by the session participants on climate change impacts and potential adaptation options, thereby paving the way for inclusive planning discussions and participatory processes (Burch et al., 2010; Shaw et al., 2009). In another example, Schroth et al. (2015) conducted a study where visualizations depicting climate adaptation and mitigation options for Kimberley, BC, were presented to community members through an open house event. When attendees of the event were asked whether the visualizations were useful for presenting this information, Schroth et al. (2015) found that the majority (i.e., 34 out of 38) responded positively, noting that the tools helped them better understand local climate action options. Similar to the Delta study, these findings indicate that visualizations have the potential to enhance people's understanding on local climate action options, which ultimately better equips them for providing feedback and engaging in conversations on climate planning.

Visualizations have demonstrated to be powerful communication tools; however, Tress and Tress (2003) described this communicative ability as mostly 'descriptive', meaning that these tools primarily provide information on appearances and are limited in the level of detail they give around a particular scenario. Although this might have been the case when Tress and

Tress (2003) expressed this sentiment, techniques for visualizations have improved over the years and more recent studies have coupled visualized scenarios with information that allows for more thorough evaluation. For example, Grêt-Regamey et al. (2013) visualized different vegetation scenarios for Linear Park in Masdar City (Abu Dhabi, UAE), and they linked metrics to these scenarios (e.g., financial costs, habitat suitability for local wildlife, and water requirements), in order for users to be able to make more informed decisions on the options. In another example, Salter et al. (2009) developed a visualization of Snug Cove (Bowen Island, BC) to convey possible outcomes of residential density policies to local government and community members. They linked indicators to visualized scenarios, such as water consumption, waste production and energy consumption, and found that this coupling of visualization and indicators allowed users to examine multiple aspects of scenarios, such as how policies could affect both the 'character' of the community and its resources (e.g., water). Such findings demonstrate how visualizations used in concert with other information can provide diverse users with the ability to more comprehensively assess and better understand outcomes of policies and plans, which in turn, could support inclusive, participatory planning efforts.

Although geovisualizations show promise as tools for participatory approaches to planning, it is important recognize that the communicative power of these tools also presents risks in terms of misleading audiences. For example, Downes and Lange (2015) discussed how a visualization of a proposed park in Dublin (Ireland) failed to depict the local vehicular traffic, which is an important consideration in developing a place where children will play. In this example, the misleading nature of the visualization might not have been deliberate; however, MacFarlane et al. (2005) cautioned that (in some cases) visualizations can be intentionality misleading, for example, when they are commissioned to address aesthetic aspects of environmental impact assessments (such as with windfarm developments). Understanding these concerns, Sheppard (2001) proposed a series of principles for developing visualizations, including that they are accurate, representative of the typical or important conditions/views of a place, engaging to audiences, clear in their communication, and credible and defensible in terms of having demonstrable levels of accuracy. Building on this line of thought, Lewis et al. (2012) discussed how visualization researchers and developers should focus on tools that 'pull' or engage stakeholders, rather than 'push' particular perspectives onto their audiences. Ultimately, it is important understand that geovisualizations do have potential for supporting participatory planning efforts; however, realizing this potential involves considerations around their preparation and intended purpose.

1.3 Research Gaps and Objectives

Although research has made progress in elucidating how geovisualizations can be used as tools for supporting inclusive planning and management, this is an evolving field of study with research gaps that need to be addressed in order to adequately realize the full potential of these tools. One such gap surrounds the ‘human component’ of geovisualizations, referring to how these tools operate within the social and cultural dimensions in the context of environmental management plans and processes. Lewis et al. (2012) noted that visualization research has made significant advancements in terms of technological considerations, such as processing data and rendering images; however, research on how visualizations operate as effective tools for inclusive, collaborative planning and management (and how users interact with these tools) has lagged behind[4]. One avenue for understanding this aspect of geovisualizations is through regarding them as ‘place-based’ tools. Geovisualizations have the ability to clearly convey possible futures for and changes in places, and accordingly, previous research has observed these tools to hold potential for eliciting strong emotional reactions in cases when dramatic modifications to familiar environments are depicted (Salter et al. 2009; Schroth et al. 2009; Schroth et al., 2011; Sheppard et al., 2011). This indicates that the visual representations are interacting with the personal values and meanings held for particular places, or in other terms, the geovisualizations are interacting and connecting with people’s ‘sense of place’. For these reasons, ‘place’ provides a suitable fit for theoretical explorations around geovisualization research; however, despite this suitability, place theory/concepts and geovisualizations are rarely

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[4] It is important to recognize that the intention of bring forward Lewis et al.’s (2012) comment is not to suggest that there is a complete lack of research on human-visualization interaction. Valuable research has been conducted on aspects of visualizations such as people’s perception of their realism (e.g., Lindquist and Lange, 2016), user-friendliness (e.g., Smith et al., 2012) and ability to serve as a participatory planning tool (e.g., Salter et al., 2009), and much of this research has been cited in this dissertation. Rather, Lewis et al.’s (2012) comment serves as a point of departure to develop a more in depth understanding of the user side of these tools, particularly in terms of the way they operate within cultural and social dimensions germane to environmental planning and management.

explicitly linked and explored in the same studies[5]. Therefore, research is required to first develop the theory, and then apply it to studies that examine geovisualizations as place-based tools for inclusive planning and management.

A second area in need of research attention concerns the coastal context. As discussed earlier, geovisualization research has primarily been conducted in the terrestrial context, leaving the coastal context largely unexplored. This is not to say that the full body of geovisualization literature is devoid of studies that feature coastal areas. However, these studies typically only model and focus on spaces above the ocean's surface (e.g., Shaw et al., 2009; Salter et al., 2009), whereas effective coastal management requires cognizance that coasts comprise interconnected terrestrial and marine environments that form a continuum from land to ocean (Sorensen, 1997). Therefore, albeit some visualizations studies have involved coastal localities, the approach to this research has been (in essence) terrestrial, thus lessons/insights from this work are not directly applicable to coastal and marine contexts. Coasts are layered with a particular variety of social, economic and cultural values and interests that interact and (often) conflict with one another, resulting in a web of complex user relationships that span the land-sea interface (Bowen and Riley, 2003; Rockloff and Lockie, 2004; Thompson, 2007). Consequently, the coastal context constitutes a unique challenge that requires research attention separate to that of terrestrial work.

Drawing from the discussion above, the objectives of this doctoral project are two-fold. The first objective is to explore the theoretical underpinnings of geovisualization research for the purposes of developing a stronger knowledge of how they 'work' as tools for planning and management. As per the discussion above, this exploration is framed through place theories, and it integrates geovisualization and place research to better understand how and why geovisualizations can serve as effective tools for inclusive planning (with a particular focus on the coastal context). The second objective is to elucidate the challenges and opportunities around

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[5] When conducting literature review on landscape visualization studies to develop the research questions, only two references to place theory was found. Sheppard et al. (2011, 402) mentioned that "[u]sing realistic 3D landscape visualisations (pictures of local places under alternative future conditions) can provide greatly increased local salience, linking to people's attachment to place"; however, the reference to 'place' was within a larger list of items describing the visualizations function within environmental management strategies and was not explored in depth. The second reference was in Downes and Lange (2015, 145), who briefly discussed an approach to visualization that "invokes artistic license to communicate more ephemeral aspects such as atmosphere and sense of place"; however, they did not expand on this point.

developing and using geovisualizations that specifically represent coastal places. The two objectives of this dissertation are captured through these research questions.

1. How might geovisualizations function as tools for facilitating inclusive and collaborative coastal management, in terms of the way they operate within cultural and social dimensions and interact with coastal place-based values?

2. What are the challenges and opportunities associated with developing and using realistic, immersive[6] geovisualizations in collaborative management efforts employed in the coastal context?

1.4 Geovisualization Study Area

This dissertation includes applied research, involving the development of a coastal geovisualization. The geovisualization modelled the Sidney Spit area of the Gulf Islands National Park Reserve (GINPR) in British Columbia, an area that comprises the northern most portion of Sidney Island located approximately 4 km east of the municipality of Sidney on Vancouver Island (see Figure 1). The park contains a spit that projects 1.8 km northward (known as the Long Spit) and is contiguous with hook-shaped spit (known as the Hook Spit), which together form the border of a lagoon that provides critical habitat to a variety of shorebirds and marine life. Historically, the island has served as a site for First Nations settlement and shellfish and vegetation harvesting activities, as well as (in the early 1900s) a place of industry for the Sidney Tile and Brick Company (Parks Canada, n.d.). In 1961, the northern part of the island (including the Long Spit and Hook Spit) and adjacent waters were established as the Sidney Spit Provincial Marine Park (Maurer, 1989). In 2003, this area became incorporated within the Gulf Islands National Park Reserve of Canada (GINPRC) (Parks Canada, 2012). Currently, public uses of the area are limited to primarily recreational activities (i.e., camping, walking, kayaking, etc.), and these activities are further restricted in certain areas of the park with particularly sensitive ecosystems (e.g., kayaking is not permitted in the lagoon) (Parks Canada, n.d.). Marine

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[6] The term ‘immersive’ often refers to devices used to display visualizations, e.g., virtual reality headset (Lovett et al., 2015); however, it can also relate to method of interaction. For example, first-person perspective navigation (such as done with the geovisualization featured in this research effort) can contributes to immersion (Isaacs et al., 2011).

areas around the island are used by boaters, and some fishing activities are permitted in the spaces (e.g., Fisheries and Oceans Canada, 2014).

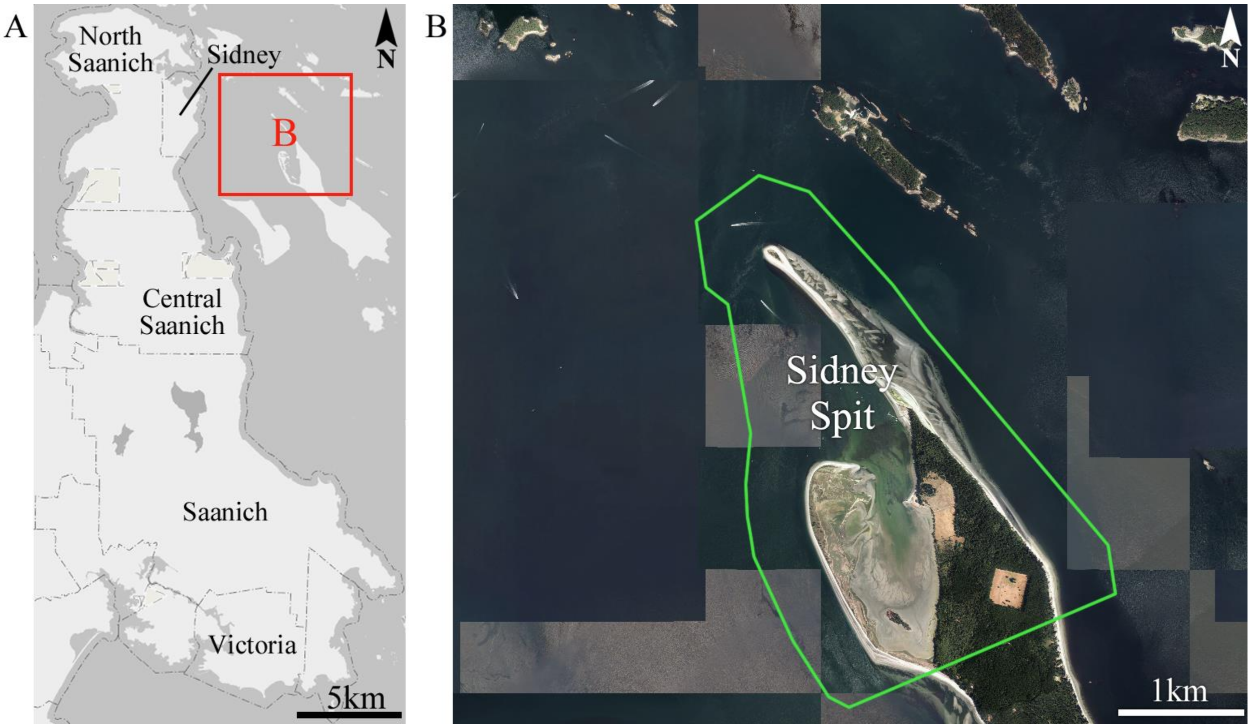

Figure 1. Map of Sidney Spit and surrounding area

Figure 1a features a map of municipalities near Sidney Island, and Figure 1b features a map of Sidney Spit Park with park boundaries displayed in green. Maps were retrieved from the Capital Regional District Regional Map system.

Using Sidney Spit as a study site held both practical and conceptual advantages. The practical advantage was that Parks Canada has collected a variety of data for Sidney Spit (such as topography, bathymetry, distribution of eelgrass, and locations of mooring buoys), and these data were made available for this research project. The conceptual advantage concerns coastal management considerations and how such considerations would apply to the geography of Sidney Spit. Coastal management efforts face the challenge of attempting to define the target of management strategies and plans, meaning defining the inland and seaward boundaries of where a strategy/plan is applied (Cicin-Sain, 1993). In terms of inland boundaries, a sensible target area would be a coastal watershed, as this defines a catchment area that drains into inshore waters (Cicin-Sain, 1993). However, watersheds can encompass geographically expansive areas, which can be challenging to model at the level of detail involved in realistic geovisualizations.

Therefore, when creating a geovisualization for coastal management, in most cases, difficult decisions would need to be made as to where to ‘draw the line’ and define the area modelled. However, in the case Sidney Spit, the modelling focused on the Long Spit, and the entire spit was captured as the terrestrial area does not heavily extend inland. This did not preclude considerations around defining seaward boundaries, but it allowed for more straightforward modelling of the terrestrial component.

1.5 Methodology

The dissertation is composed of five manuscripts that have been prepared as standalone articles for submission to academic journals. Each manuscript details a study designed to support an aspect of the research objectives, and when complied, the studies provide a comprehensive investigation into the two research questions outlined above. Respectively, the five studies serve following purposes:

1. To develop a theory of geovisualizations as place-based tools;
2. To explore the theory in the coastal context;
3. To examine the relationship between sense of place and one’s mental visualization of place;
4. To develop a coastal geovisualization under place-based considerations and examine its capacity for connecting to sense of place;
5. To assess the geovisualization’s potential as a tool for inclusive coastal planning efforts.

Figure 2 illustrates how each of the studies fall within the scope defined by the research questions. The first study pertains to a broader exploration around geovisualizations as place-based tools and relates to all environmental contexts; whereas, the subsequent studies specifically relate to the coastal context. The dissertation was structured in this manner to (firstly) establish the broader theory and (secondly) narrow to more specific coastal investigations. In addition, as seen in Figure 2, the dissertation begins with review-based work, moves to empirical study, and concludes with applied research. Through such a design, the dissertation follows a logical progression from theory to application, and it comprehensively explores the research questions and objectives.

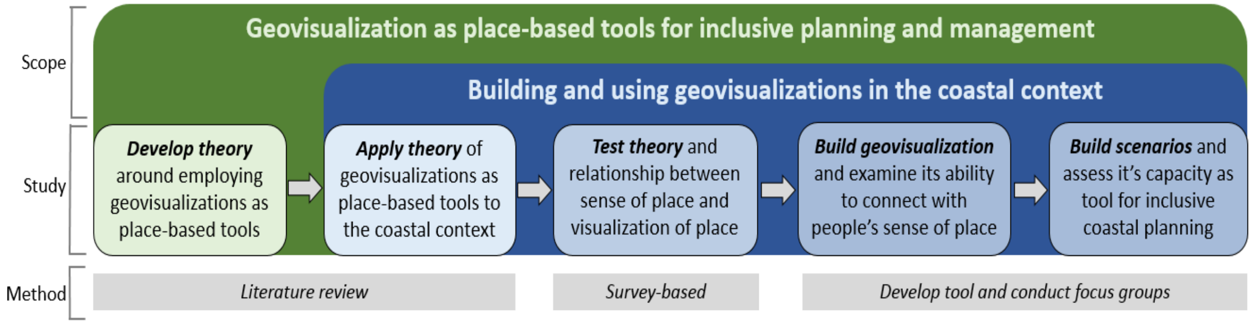

Figure 2. Graphical outline of doctoral research project

1.5.1 Developing a theory of 'place-based' geovisualizations

The first research question explores the human component of geovisualizations, i.e., how users interact with these tools and why (or why not) they are effective in planning efforts. The question specifically refers to the coastal context, asking how geovisualizations might interact with place-based values of various coastal users; therefore, it is premised on a notion that geovisualizations are place-based tools. However, as aforementioned, place theory and geovisualization research are very rarely explored within the same studies. Also, the works that have included both domains have not integrated these in a manner that formalizes a theory around human-geovisualization interaction in the planning context. Therefore, prior to engaging in the questions around the coastal context, a more general exploration is needed around the link between geovisualizations and place.

A theory of how geovisualization operate as place-based tools in planning efforts is developed in this dissertation through a literature review study. This work is featured in Chapter 2, and it draws from human-media interaction and sense of presence research to develop the theory. In addition, the work reviews previous landscape visualization research to provide evidence that geovisualizations operate in the manner proposed, i.e., as place-based tools.

1.5.2 Exploring the theory in the coastal context

Research on the development and application of geovisualizations in the coastal context is in its infancy, and this doctoral work aims to advance the state of knowledge around developing and employing geovisualizations in this environmental context. Accordingly, this dissertation includes research designed to illuminate considerations associated with building and using geovisualizations that specifically represent coastal places. This work is detailed in Chapter 3, and it builds on the theoretical research of Chapter 2 in that it regards geovisualizations a place-based tools. The study approaches its investigation from the 'user perspective', and it uses Thompson's (2007) coastal cultural model framework to define different coastal user groups. Through a structured literature review, the study examines how diverse coastal users, with varied place-based values and interests, might conceptualize coastal environments in different ways (based on their values/interests) and what the implications are in terms of how these users interact with visual representations of coastal places. The investigation provides insight on the particular considerations around developing and using geovisualizations for inclusive coastal planning efforts, and subsequently, the study gives recommendations for building these tools.

1.5.3 Testing the relationship between sense of place and visualization of place

Chapter 2 and 3 contributes to the dissertation by (respectively) establishing a theoretical foundation for the research and applying this theory to the coastal context. However, the studies were done through review-based work and thus were not supported with empirical analysis. This dissertation proposes a novel theory of geovisualizations (i.e., operating as place-based tools in inclusive planning efforts); therefore, empirical work is required to interrogate this theory. Such work was conducted, consisting of a survey-based study detailed in Chapter 4.

Chapter 3 posits that a relationship exists between sense of place and how people conceptualize coastal places. Following this discussion, Chapter 4 investigates this relationship and examines how sense of place influences the way people 'visualize' or 'imagine' coastal places. Such an investigation was designed to generate insight on how different visual elements might relate to different aspects of people-place relationships, which in turn, stimulates thinking around how different geovisualization elements (and scenarios featuring these elements) might interact with sense of place.

The theory developed through Chapter 2 integrates people-place theories with sense of presence research, and accordingly, the survey study also draws from these two fields of study. Surveys were employed to collect quantitative data on people's relationships to place in a manner commonly done in environmental psychology and human geography studies (e.g., Devine-Wright and Howes, 2010; Kelly and Hosking, 2008; Lee, 2011; Lai and Kreuter, 2012). In addition, these surveys collected data on how people might visualize or imagine place in a similar manner to previous sense of presence research (Turner et al., 2003).

The study area for the survey-based work was the Capital Regional District (CRD) of British Columbia (characteristics of this area are detailed in Chapter 4), and the survey was administered to a random sample of addresses located within this region. The CRD was selected for this study to maintain a degree of consistency with the applied research of this dissertation because as noted in *1.4 Geovisualization study area*, the applied studies involved developing geovisualization of Sidney Spit and this park is vicinal to the CRD. Administering surveys to CRD residents ensured that target population centers were nearby the geovisualization study site (see Figure 3).

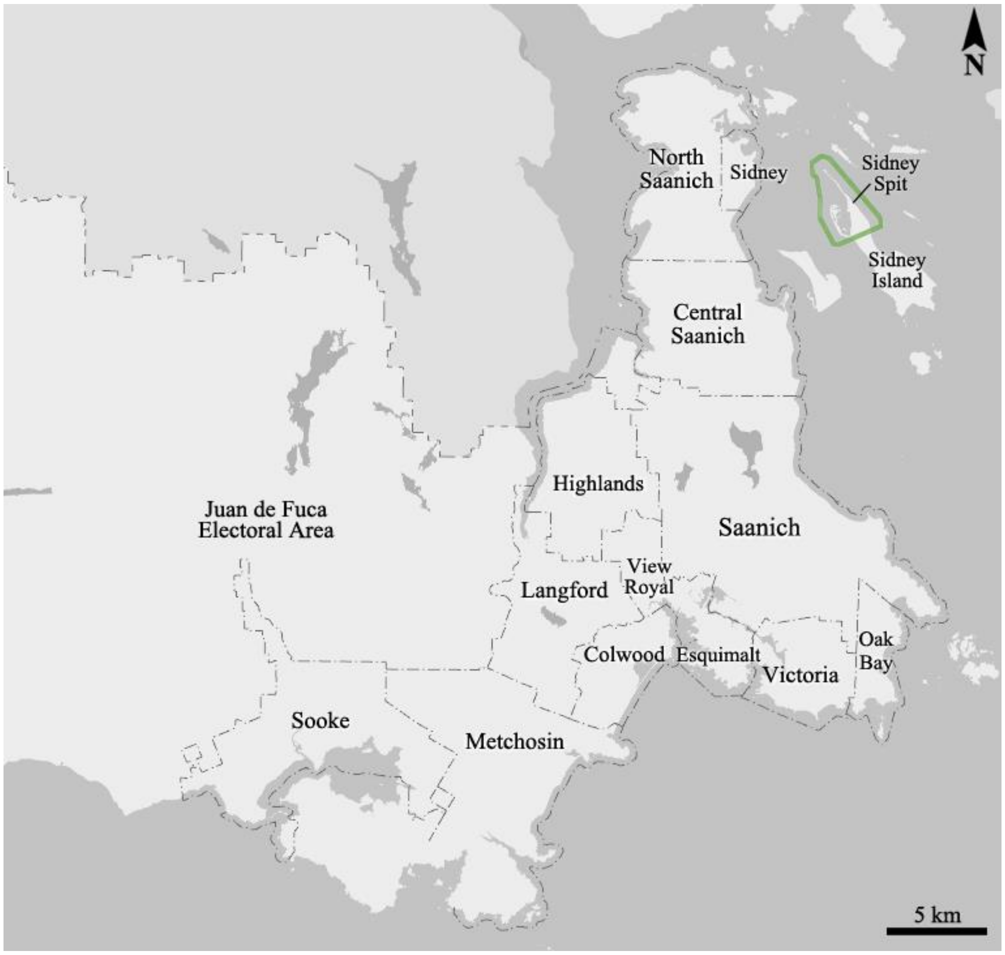

Figure 3. Map displaying Sidney Spit in relation to Capital Regional District municipalities

The maps were retrieved from the Capital Regional District Regional Map system, and Sidney Spit Park boundaries are displayed in green.

1.5.4 Developing a geovisualization as a place-based tool

The survey study of Chapter 4 tests aspects of the theoretical work described in the earlier chapters; however, the study does not actually examine people's interactions with a geovisualization. In order to fully understand geovisualizations as place-based tools, applied research was conducted, which involved developing a coastal geovisualization and then assembling focus groups to assess the tool's realism and ability to connect with sense of place. This work is detailed in Chapter 5, and as discussed in *1.4 Geovisualization study area*, it uses the Sidney Spit area of the GINPR as its study site.

The building of the geovisualization was informed by the recommendations produced through the review-based work detailed in Chapter 3. This resulted in a dynamic virtual environment, which can be navigated from the first-person perspective. The construction process involved a combination of ArcGIS (v10.3.1), Adobe Photoshop (CS5), Trimble SketchUp (2015), and Unity3D (v5.3.4) gaming engine. This combination of software was selected for the purposes of (respectively) building the model with spatial integrity, developing realistic textures, building three-dimensional objects, and incorporating dynamics and interactivity.

Once the geovisualization was developed, it was presented to a series of focus groups. The first group involved Parks Canada members, who specifically worked for the branch that is responsible for management of Sidney Spit. The following focus groups involved residents of the CRD, and these were selected in a similar manner to the survey study (i.e., invitation was mailed to a random sample of addresses), maintaining a degree of consistency between the studies. Participants were given time to explore the geovisualization, and following this, they provided comments on the extent to which it resembled a real-world environment, what aspects contributed to realism and sense of place, and what detracted from these qualities. This feedback was then analyzed to better understand the geovisualization as a place-based tool and its ability for connecting with sense of place.

1.5.5 Using the geovisualization for inclusive planning efforts

The study featured in Chapter 5 provides insight on geovisualizations as place-based tools by examining how they can interact with people's understanding of coastal places and sense of place; however, the study did not directly examine the capacity for geovisualizations to serve as tools for inclusive coastal planning and management. Such potential was examined through a final study, which involved building different management scenarios into the geovisualization and presenting these options to focus groups, similar that done in other visualization studies (e.g., Salter et al., 2009; Smith et al., 2012; Tress and Tress, 2003; Williams et al., 2012). This work is featured in Chapter 6 of the dissertation.

The scenarios that were developed were based on management issues that emerged through the Parks Canada focus group discussions. Once these issues were identified, potential management scenarios were built into the geovisualization by incorporating objects, textures and dynamics associated with the scenarios. This was done is such a way that geovisualization users could employ key commands to toggle between scenarios and explore different management options. Such exploration occurred within the local (CRD) resident focus groups, where participants assessed the scenarios and provided feedback on their preferences for the various management options. Participants also evaluated the usefulness of the geovisualization, commenting on how well the tool supported their assessment and decisions around scenarios. This feedback was analyzed, and it generated insight on the geovisualization's capacity for engaging diverse groups and (thusly) facilitating inclusive approaches to coastal planning and management.

1.5.6 Integration of the studies

The final chapter of this dissertation, i.e., Chapter 7, integrates the theories and findings of each of the studies to create cohesion among the various pieces of this research project and provide a coherent picture of how the studies collectively address the research questions. This integration is sectioned into three parts. The first part focuses on the relationship between geovisualization and sense of place (i.e., as per research question 1). The section begins by explicitly illustrating the relevance of the geovisualization theory that was developed and described in Chapter 2 to the structured literature review research described in Chapter 3. The section then explores linkages between the work of Chapter 3 and the survey study described in Chapter 4, specifically by showing how conceptualizations of coastal places (formulated in Chapter 3) are reflected in survey data. In particular, the survey data used were that involving mental visualizations of place and additional comments provided through a 'More thoughts to share?' space appended to the survey[7]. Following this, the section examines linkages between the survey study of Chapter 4 and the geovisualization study of Chapter 5 by comparing how people mentally imagine coastal places (i.e., survey study) with geovisualization elements that were found to contribute to or detract from realism and sense of place (i.e., geovisualization study). Finally, the section illustrates the relevance of the theoretical research to the applied research by discussing how the theory developed in Chapter 2 relates to the geovisualization study of Chapter 6, i.e., where CRD residents use the tool to assess management scenarios. This final discussion is supported with focus group feedback data, involving participant comments on the usefulness of the tool for scenario assessment.

The second part of Chapter 7 integrates findings from the different studies to examine challenges and opportunities around developing coastal geovisualizations (i.e., as per research question 2). The section brings forward the recommendations around building coastal geovisualizations that were developed in Chapter 3, and then examines the challenges and opportunities associated with these recommendations, which emerged through the geovisualization studies of Chapter 5 and 6. The discussion draws upon lessons learned during the construction process and through focus group feedback to elucidate considerations around (respectively) building and using coastal geovisualizations.

The third section of Chapter 7 reflects upon the geovisualization studies of Chapters 5 and 6, and discusses the geovisualization's utility as a tool for inclusive, collaborative approaches to coastal planning and management. The findings from these studies have produced valuable insights on the geovisualization's ability for engaging different people in coastal planning and management processes. From such insight, conclusions were drawn on the potential this tools has for facilitating inclusion and collaboration in such processes.

1.6 Ethical Considerations

The studies in this doctoral work involve minimal risk to research participants, as surveys and focus group were not designed to collect 'controversial' opinions that could be damaging to people's professional and/or community standing. Regardless, ethical considerations still exist due to the involvement of human participants, and thus, an ethical review was conducted. The

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[7] 'More thoughts to share?' data were not examined in Chapter 4, as this chapter features a paper prepared for publication and such analysis would have significantly increased the size of the manuscript.

review was approved by the University of Victoria’s Human Research Ethics Board (HREB), and copies of HREB Certificates of Approval are included in the Appendix A of this dissertation.

Letters of consent were provided to all participants to ensure that only data from informed and willing individuals were used in this research effort. Survey study participants were provided with a letter of implied consent, explaining that responding to the survey implies their willingness to participate in the research and that they are free to have their responses withdrawn from the study by contacting the researcher prior publication of results. Focus group participants were provided with a letter of informed consent, which they signed prior to engaging in the research. Sign copies were kept by the researcher, and participants were provided with unsigned copies for their reference.

Efforts were made to maintain the anonymity of the research participants. Names and addresses of survey respondents are not displayed within any part of this dissertation, and references to specific survey responses are done using survey identification numbers. Similarly, names and addresses of focus group participants are not displayed in this dissertation, and references to specific participants are done using participant identification numbers.

Chapter 2

Seeing, believing, and feeling: The relationship between sense of place and geovisualization research[8]

Abstract

Advancements in GIS and media technologies have created opportunities for developing realistic and geographically-accurate representations of the environment that can be recognized and related to as ‘real places’. In turn, these ‘geovisualizations’ can connect with the meanings, values, beliefs, and/or feelings people associate with places, i.e., their ‘sense of place’, which positions them as powerful place-based tools for inclusive and collaborative environmental management efforts. However, despite their place-based applications, geovisualization studies rarely explicitly incorporate place theories and concepts. This lack of integration is reflected in the current state of knowledge, as much of geovisualization research has advanced knowledge on technological capacity for processing and rendering images from spatial data, whereas knowledge on how people interact with and use these tools in collaborative management strategies has lagged behind. This research effort serves as a move toward addressing this knowledge gap by explicitly illustrating the relationship between sense of place and applications of geovisualizations in collaborative management. The chaper employs ideas from research on human-media interactions and conceptual models from research on sense of presence to synthesize a coherent theory on how geovisualizations can function as place-based tools. The chapter then reviews landscape visualization studies to provide evidence that geovisualizations can operate as place-based tools. Such evidence includes observations on geovisualizations’ ability to communicate ‘meaningful information’ on places, elicit responses reflective of particular place-based values, and evoke emotional responses associated with places.

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[8] This chapter was also published as:

Newell, R., & Canessa, R. (2015). Seeing, believing, and feeling: The relationship between sense of place and geovisualization research. *Spaces and Flows: An International Journal of Urban and ExtraUrban Studies 6*(4), 15-30. doi: 10.18848/2154-8676/CGP/v06i04/53779

2.1 Introduction

The relationships people form with their surroundings give rise to ‘places’, that is, subjective representations of geography that are shaped by meanings, beliefs, symbols and values associated with certain localities and/or environments (Botts et al., 2003). These relationships reflect how people understand and perceive their environment, which in turn influences aspirations for and behaviours toward said environment (Vaske and Kobrin, 2001). Accordingly, people-place relationships have been recognized as integral elements in designing and conducting effective inclusive and collaborative environmental management, as it is through understanding and acknowledging these relationships that different beliefs, interests, activities, and needs associated with an area targeted for management can be incorporated and/or addressed in plans and strategies (Cheng et al., 2003; Stocker et al., 2012; Williams and Stewart, 1998; Yung et al., 2003). However, the practicalities of incorporating place-based considerations into management strategies can present challenges. Places can have indistinct boundaries that can not always be defined and managed spatially (Collins and Kearns, 2010), and it can be difficult to account for place-based values in management efforts when it is not entirely clear to where certain meanings and values are ascribed (McLain et al., 2013). In addition, values for places can be expressed in vague terms, which can create uncertainty around how people’s aspirations might concretely manifest into environmental management outcomes and potentially result in conflict when enacting a management plan or strategy (e.g., Rockloff and Lockie, 2004). Thus, there is an evident need for tools that can capture and convey ‘place’ in a clear manner, as it is through such tools that people’s values and interests surrounding a particular place can be effectively understood, and socio-culturally sensitive, collaborative environmental management strategies can be successfully designed and employed in said place.

Advancements in GIS and media technologies have created new opportunities for developing place-based tools by providing the means for constructing (increasingly more) realistic and sophisticated geographically-accurate representations of real-world places. Through the use of these technologies, geographical data/information can be integrated with state-of-art three-dimensional visual simulation techniques, giving rise to what is referred to in this research as ‘geovisualizations’ (Canessa, 2008). Because they are georeferenced and simulated as a three-dimensional environments, geovisualizations can be constructed with both high spatial accuracy and low abstraction, allowing them to be easily recognized as built and non-built environments of real-world places; examples of these being realistic landscape visualizations (e.g., Schroth et al., 2011; Smith et al., 2012) or three-dimensional digital models of communities and/or parks (e.g., Salter et al., 2009; Grêt-Regamey et al., 2013). This approach to geovisualization can be used to communicate outcomes of potential environmental management strategies in a 'relatable' fashion, meaning that they provide people with vivid understandings of how they would feel about certain management outcomes or impacts if transpired in real places (e.g., Lewis and Sheppard, 2006). Sheppard (2001) evoked the metaphor of 'crystal ball gazing' to illustrate this communicative capacity, describing how visualizations essentially provide people with glimpses of potential futures for familiar places by displaying these places as they would appear if certain courses of action were taken. Accordingly, geovisualizations have been observed as having the ability to elicit strong emotional reactions from users in circumstances when dramatic (and in some cases, undesirable) modifications to personally known and valued environments were depicted (Salter et al., 2009; Schroth et al., 2009; Schroth et al., 2011; Sheppard et al. 2011). These observations indicate that visual information conveyed by geovisualizations can be internalized by users as actual possible fates for places of personal value and meaning, and in this manner, geovisualizations can connect with the meanings, values, beliefs and/or feelings people associate with places, collectively referred to as a person's 'sense of place' (Williams and Stewart, 1998).

As aforementioned, understanding and acknowledging place-based relationships enables inclusive and collaborative approaches to management as it allows for different place-based beliefs, interests, activities and needs to be addressed in plans and strategies. Similarly, by connecting with people's sense of place, geovisualizations can be used as tools for facilitating inclusive and collaborative management as they can be used to simulate different stakeholders' thoughts and concerns associated with the place-based relationships they have formed with areas targeted for management. Because geovisualizations can represent an environment and convey potential impacts/alterations to these environments in a salient and relatable fashion, they can be employed in stakeholder discussions and co-planning sessions to illuminate a variety of place-based insights, such as what different people perceive as significant components of a place, how people feel a place should appear and/or be managed, and what types of development and activities are desirable or undesirable within a place (e.g., Natori and Chenoweth, 2008; Schroth et al., 2011; Tress and Tress, 2003). Subsequently, this understanding can be used to guide environmental management strategies and plans in a manner that ensures that these strategies/plans address and include the local social realities, concerns and needs associated with the management area.

In concert with this line of thinking, previous research has posited that geovisualizations can be potentially powerful tools for collaborative planning and management strategies (e.g., Lewis and Sheppard, 2006; Salter et al., 2009; Schroth et al., 2009; Schroth et al., 2011); however, despite the clear place-based implications in this area of inquiry, geovisualization research rarely explicitly incorporates place theories and concepts. The lack of research integration is likely due to epistemological differences, as the two areas of research, i.e., geovisualizations and sense of place, have developed through distinctly different areas of scholarship. Geovisualizations essentially serve to make sense of abstract spatial data (Jude et al., 2007), and thus advancements in geovisualization research has been heavily driven by work in spatial sciences and data visualization (Nöllenburg, 2007). In contrast, place research has academic roots in humanistic geography, which is a discipline that seeks to understand how humans relate to the world through phenomenological approaches that treat humans as thinking and feeling beings (Tuan, 1976). The humanistic perspective emerged to overcome what was perceived as limitations in using predominantly spatial approaches for understanding geographical relationships and phenomena, and thus spatial sciences and place theory have traditionally rested within different academic camps (Agnew, 2011; Gold and Goodey, 1983; Kaltenborn and Williams, 2002). As a result, research on geovisualizations and thinking on sense of place also have evolved on separate sides of this disciplinary division with little integration.

The consequences of the lack of research integration are reflected through an observation made by Lewis et al. (2012), who noted that visualization research has made significant advancements in terms of technological capacity for processing and rendering images from spatial data, whereas research on how visualizations operate as effective tools for collaborative management and how users interact with these tools has lagged behind. This observation indicates that geovisualization research is advancing primarily through a spatial focus and a knowledge gap exists concerning the ‘human component’, meaning research is lacking on how geovisualizations operate within the social and cultural dimensions germane to environmental management plans and processes. The following chapter serves as a motion toward an integrated research agenda that would bridge this gap, and it lays a foundation for this form of research by explicitly illustrating the relationship between sense of place and the role geovisualizations play in collaborative environmental management.

Because this chapter discusses the concept of sense of place and examines its relevance to geovisualizations, there are several important considerations to note in order to clearly understand the specific purpose of this work. Firstly, the relationships people form with places are complex and integrative phenomena that are influenced by a variety of social, economic, cultural and environmental factors (Devine-Wright and Howes, 2010; Gosling and Williams, 2010; Scannell and Gifford, 2010; Vorkinn and Riese, 2001); accordingly, the study of sense of place has been explored through a variety disciplinary lenses, such as environmental psychology, human geography, sociology, architecture, anthropology and tourism studies (Lewicka, 2011. This work does not undertake an exhaustive review of sense of place as it is characterized through the comprehensive suite of disciplinary perspectives; instead, it draws upon perspectives developed through geography and environmental psychology in order to specifically examine the relevance of the concept to the application of geographically-accurate representations of real-world environments in collaborative approaches to environmental management and planning. Secondly, similar to sense of place research, studies on the development and application of three-dimensional virtual environments have been conducted in a range of disciplines for a variety of different purposes; for example, research has been done on visualizations of Building Information Models (BIM) within the fields of architecture and engineering (e.g., Johansson et al., 2015) and research has been done on virtual learning environments within the field of education (e.g., Lau and Lee, 2015). The current research effort specifically examines the growing field of literature around modelling outdoor environments (referred to in some studies as landscape visualizations) for the purposes of determining how such virtual representations can be used for collaborative management and planning efforts (e.g., Lewis and Sheppard, 2006; Salter et al., 2009; Schroth et al., 2009; Sheppard et al., 2011). With these considerations in mind, this chapter draw the connections between theoretical (and related empirical) work done on people-place relationships and the applied work done on geovisualizations (i.e., landscape visualizations), specifically in environmental management and planning context. The objective of drawing these connections is to create a precedent for geovisualization research that can benefit from both theoretical and applied areas of scholarship, allowing for comprehensive investigations that examine what is needed to create these tools, how they can be applied to collaborative management and planning scenarios, and why various stakeholders interact with and react to the tools in different ways.

To achieve the described objective the chapter begins with a discussion on ‘sense of place’, describing how the concept has been explored through disciplinary lenses developed through branches of geography and environmental psychology and the relevance each of these perspectives has to geovisualization research. The chapter then describes the capacity geovisualizations have for connecting with sense of place by discussing the cognitive processes involved in forming this connection and providing observations from previous environmental management research that indicate this connection can occur. The chapter concludes by providing examples on how integrating sense of place research and theory into geovisualization studies can result in research efforts that more comprehensively examine the role geovisualizations can have as tools for collaborative approaches to environmental management and planning.

2.2 Sense of Place

As noted above, sense of place has been explored extensively through multiple disciplinary lenses (Lewicka, 2011); however, this chapter describes the concept through three perspectives, selected specifically due to their relevance to the application of geovisualizations in environmental management. These perspectives are defined through the disciplines of perceptual and behavioural geography, humanistic geography and environmental psychology.

2.2.1 Perceptual and behavioural geography

Earlier research on people’s subjective interpretations of their environment includes Kevin Lynch’s (1960) seminal work of *The Image and the City*, which examined people’s perceptions of urban environments for the purposes of understanding what components of these environments contribute to their ‘legibility’ (i.e., ease in which a city can be imagined and/or understood). Lynch (1960) did not employ or develop specific terminology around ‘place’, per se; however, he did develop ideas that bear semblance to current understandings of the sense of place phenomenon, namely through the concept of the ‘environmental image’. Environmental images are mental representations of localities that are composed of both spatial aspects and emotional and functional meanings, and Lynch (1960) claimed that a coherent environmental image can lead to the sense of comfort and emotional security that comes with knowing one's surroundings. Therefore, even though this discussion did not explicitly refer to sense of place, it parallels the concept as it refers to the meanings and emotional associations that people form with places through developing familiarity with and understanding of these places.

Gould and White (1974) further explored the perceptual line of inquiry, and also added a behavioural component, through their work on 'mental maps'. Mental maps are cartographic representations of people's perceptions of places, and Gould and White (1974) posited that such representations can reflect preferences for certain areas and locations, which in turn, could be used to gain insight on migratory behaviour. Downs and Stea (1977) built on Gould and White's (1974) mental maps by developing the concept of 'cognitive maps', and it is through this work that the relationship between imagined cartography and sense of place can clearly be seen. Similar to mental mapping, cognitive mapping refers to mental representations people form of their environments, which subsequently, can guide spatial behaviour; however, Downs and Stea (1977) also described these maps as 'coat hangers' for memories and understandings of places, noting that they are distorted through experiences and interactions with these places. In this way, cognitive maps are reflections of people's senses of place because they react and are shaped by the meanings, values and significances people associate with places.

By convention, perceptual and behavioural research typically involves two-dimensional visual tools, such as mental maps (e.g., Gueben-Venière, 2011; McKenna et al., 2008); however, the principles and findings from this field of inquiry have clear applications to three-dimensional (and four-dimensional) geovisualizations. In particular, this disciplinary approach operates under the notion that people hold subjective imagery of their environment, meaning their mental conceptualizations include, exclude and/or distort certain aspects and elements depending on their perception of a place (i.e., Downs and Stea, 1977; Gould and White, 1974; Lynch, 1960). This is pertinent to geovisualization research because it indicates that the way people respond to inclusion/exclusion of certain elements in a visualization can provide insight on what people believe to be significant or meaningful components of a place. For example, Bishop and Rohrmann (2003) found that the realism of vegetation models in a virtual environment significantly contributed to whether people felt the virtual depiction accurately represented a 'real place', whereas the inclusion (or exclusion) of humans and animals did not. Albeit they did not specifically refer to sense of place in their study, these findings illustrate how particular elements of the virtual environment can coincide with certain people's mental conceptualizations of place, and such insight could be further interrogated to understand what people find significant (and 'of value') to a place.

2.2.2 Humanistic geography

Although perceptual and behavioural geographers developed ideas and understanding on how people subjectively relate to their environment, they did not formally conceptualize theories of place. This was instead done through the works of humanistic geographers, who rejected the notion that human beings could be characterized as rational objects located within space and argued that the relationships people form with the world are better understood through their interactions and experiences with their surroundings (Cresswell, 2009; Kaltenborn and Williams, 2002). Through the humanistic perspective, place is fundamentally a function of lived experiences and 'existing' within an environment (Cresswell, 2009). Humanistic geographer, Yi-Fu Tuan (1977, 6), succinctly captured this perspective through his widely cited comment on place, noting that "undifferentiated space becomes place when we endow it with value". This comment essentially describes place as a transformation of the physical environment into geographies that are defined more by human meanings than spatial boundaries. Therefore, through the humanistic perspective, the way people 'sense' places can be viewed as a function of the experiences that catalyze space-to-place transformations and characterized through the meanings and feelings that define place-based geographies.

The humanistic perspective is useful for geovisualization research because, unlike perceptual research that regard subjective interpretations of the world as projections of or onto one's environment, humanistic geographers focus on the person and regards place as formed through personal experiences and interpretations (Tuan, 1975). In this light, sense of place is an egocentric phenomenon and place itself is essentially a manifestation of how a person 'makes sense' of and relates to the world around him or her. To provide an example, humanistic geographer, Edward Relph (1976), described sense of place in fundamentally egocentric terms by employing a metaphor of immersion, in where sense of place exists on a scale that ranges from 'existential insideness' (i.e., deep understanding and feelings of belonging to a place) to 'existential outsideness' (i.e., meaninglessness and feelings of alienation from a place). The reason why such a person-centered, egocentric characterization of sense of place is pertinent to geovisualization research is because sense of place can then be understood as feelings of what it is like to ‘be there’, or present within a particular place (Cresswell, 2004), and since geovisualizations are not physical locations, their effectiveness as place-based tools hinges on people’s ability to connect with these feelings in the absence of the place’s physical environment. Supporting this discussion is a study by Turner and Turner (2004) that employed Relph’s (1976) scale of insideness to compare placed-based experiences between real and virtual viewpoints of Prague. Albeit the study did not specifically examine environmental management applications of geovisualizations, Turner and Turner (2004) found that this methodological approach was useful for gaining insight on the ability virtual representations have for stimulating the same feelings and thoughts one would experience if presented with a real-world place.

2.2.3 Environmental psychology

Environmental psychology literature refers to sense of place as the collection of meanings, values, symbols and feelings people associate with their environment (Williams and Stewart, 1998). Because sense of place is referred to as inclusive of personal meanings and feelings, the environmental psychology perspective bears similarities to that of humanistic geography. Where the disciplines differ is in methodologies and approaches employed in studying people-place relationships and (as a result) the conceptualizations and theoretical models used in their respective literatures. While humanistic geographers employ qualitative phenomenological research approaches, environmental psychologists typically use quantitative methodologies that involve psychometric measures for assessing strengths and types of people-place relationships (Lewicka, 2011). Through psychometric approaches, environmental psychology studies often deconstruct people-place relationships into different aspects or dimensions such as ‘place identity’ and ‘place dependence’ (e.g., Kyle et al., 2004; Lee, 2011; Lai and Kreuter, 2012). Place identity refers to symbolic meanings people hold for places and can involve the emotional and/or spiritual significance associated with these places (Williams and Vaske, 2003). Place dependence refers to functional associations with place and reflects the potential a particular place has for satisfying a person’s interests and meeting their objectives (Williams and Vaske, 2003).

The environmental psychology perspective becomes relevant to studies on geovisualizations when this research is specifically designed to investigate how geovisualizations can be used as tools for facilitating environmental management efforts. Unlike perceptual and humanistic approaches, environmental psychology seeks to understand distinctions in the different types of relationships people form with places (i.e., functional or emotional) for the purposes of understanding the reasons behind people's preferences for how places are treated or managed (e.g., Kyle et al., 2004). Accordingly, this understanding of sense of place can be used in geovisualization research to gain deeper insights on why different stakeholders react positively or negatively to a depiction of a particular type of management scenario, as their reactions can be linked to certain values, interests and aspirations held for an environment.

2.3 Geovisualizations and Sense of Place

Although research on geovisualizations and sense of place is a relatively unexplored area of inquiry (especially in the environmental management context), other types of visual media have been investigated in terms of their ability for influencing place-based understandings and meanings for different landscapes and environments. For example, visual art has been noted for its power to stimulate imagination, and through this capacity, it has been argued that art can alter current perspectives on familiar environments and/or add layers of meaning and feeling to unfamiliar landscapes (Stocker and Kennedy, 2013). Other examples of visual media studied in the context of place include imagery used in tourism advertisements, such as in a case detailed by Carter et al. (2007) involving a marketing campaign designed to attract people to the rural areas of Sunshine Coast in Australia through crafting a place narrative that specifically catered to interests and aspirations typically held by middle-class urban dwellers for seasonal residence and rural tourism (e.g., fun, pleasure, relaxation, etc.). Both effective art and advertising have demonstrated the ability that visual media has for interacting with people's sense of place; however, the approach these types of media take in this interaction is not applicable to research on environmental management applications of geovisualizations, and thus different thinking is needed to examine geovisualizations' potential as place-based tools. Art and marketing use what Lewis et al. (2012) refer to as 'push' techniques, which is the use of visual tools for conveying particular messages and convincing people of specific 'truths' regarding a place. In contrast, geovisualizations must be designed as 'pull' or user-driven tools that encourage people to express their 'personal truths' on places (i.e., the meanings, values and understandings they ascribe to their environment) (Lewis et al., 2012). It is through the pull approach that insights can be gained on how different stakeholders value and relate to a place and that geovisualizations can be employed as place-based tools for inclusive and collaborative management strategies.

The process for developing pull-type visual media holds a different set of considerations than that of push-type media. Rather than deliberately attempting to manipulate a viewer's emotional state through provocative imagery (i.e., as in push-type media), pull-type visuals encourage people to mentally connect with a real-world place and experience the emotions and feelings they would if in that actual place. This requires them to feel what is referred to as a 'sense of presence', i.e., the sense or feeling of being within a particular environment without being physically situated in said environment (Carassa et al., 2004). It is through these feelings of 'being present' (or understanding what it is like to 'be present') that people can imagine a place and subsequently summon the meanings and feelings associated with that place. In this way, sense of presence enables the cognitive processes that allow geovisualizations to connect people's sense of place.

A logical assumption concerning sense of presence is that presence would increase the more a virtual environment coincides with the sensory experiences associated with the real-world environment; indeed, this was an assumption that dominated earlier research on presence (Biocca, 2003). However, the assumption is flawed due to the fact that certain types of media can evoke presence without reproducing these experiences of the evocated environment. Such a flaw is characterized through what is referred to as the 'book problem', which describes the ability for novels to elicit a sense of being within a story's setting even though the interface for the setting (i.e., paper and text) holds little to none of the sensory qualities of the actual environment that is imagined (Gysbers et al., 2004). To resolve this problem, Biocca (2003) suggested that presence operates through a three pole-model, consisting of virtual space, physical space and mental imagery space (referred henceforth as 'imagined space'). When applying this model to geovisualizations, the virtual space is the digital representation of an environment (i.e., the geovisualization), the physical space consists of the structure and setting of the location where a person interacts with the representation (i.e., the room where a geovisualization is used), and imagined space is comprised of a person's mental images, memories and imaginings of environments and places. According to this model, a person's sense of presence can oscillate between the three domains, and spatial and place-based cues from one domain can influence, merge with or distort experiences in other domains (Biocca, 2003).

Through the three-pole model of presence, geovisualizations can be regarded as a method for connecting with sense of place and maintaining particular place-associated thoughts and feelings. In interacting with a geovisualization, the ‘virtual place’ (i.e., virtual environment) produces place-based cues that influence and merge with ‘imagined place’, shaping it around thoughts and memories of the real-world place that is depicted through the visual representation. Imagined place will then contain particular place meanings associated with the real-world place, which reflexively can serve as place-based cues that influence and merge with presence in the virtual place and (psychologically) layer the virtual environment with a specific place-based context (see Figure 4a). In accordance with Biocca’s (2003) three-pole model, a user of the geovisualization will likely oscillate presence between the virtual and imagined place; however, in this case, both the virtual and imagined are aligned and complementary. Through this ‘coupling’ of the virtual and imagined, the user is able to consistently engage with thoughts and feelings associated with the place represented through geovisualization.

When shifting presence from the virtual place to interact with people in ‘physical place’ (i.e., as would occur in stakeholder discussions or co-planning sessions), a person is no longer present in the virtual place; however, since their imagined place has aligned with virtual place, oscillation between the physical and imagined can allow for discussions that can be guided by thoughts and feelings associated with the place represented by the geovisualization without actually interacting with the geovisualization. Ultimately, due to a lack of place-based cues from the virtual environment, presence in imagined place likely will diminish eventually (see Figure 4b), or at least change in nature (i.e., what is ‘imagined’); however, this presence can be regained by shifting attention back to the virtual place and once again aligning the virtual with the imagined. In this way, geovisualizations can allow people to maintain a certain level of presence in a place in which they are not physically situated. Previous research supports this supposition, namely a study conducted by Baños et al. (2005) on the ability virtual environments have for sustaining sense of presence. They found that an imagined presence could be induced without the use of visual aids (i.e., using mental exercises that encourage people to vividly imagine a setting); however, maintaining this sense of presence was best done by exposing people to virtual representations of the imagined setting.

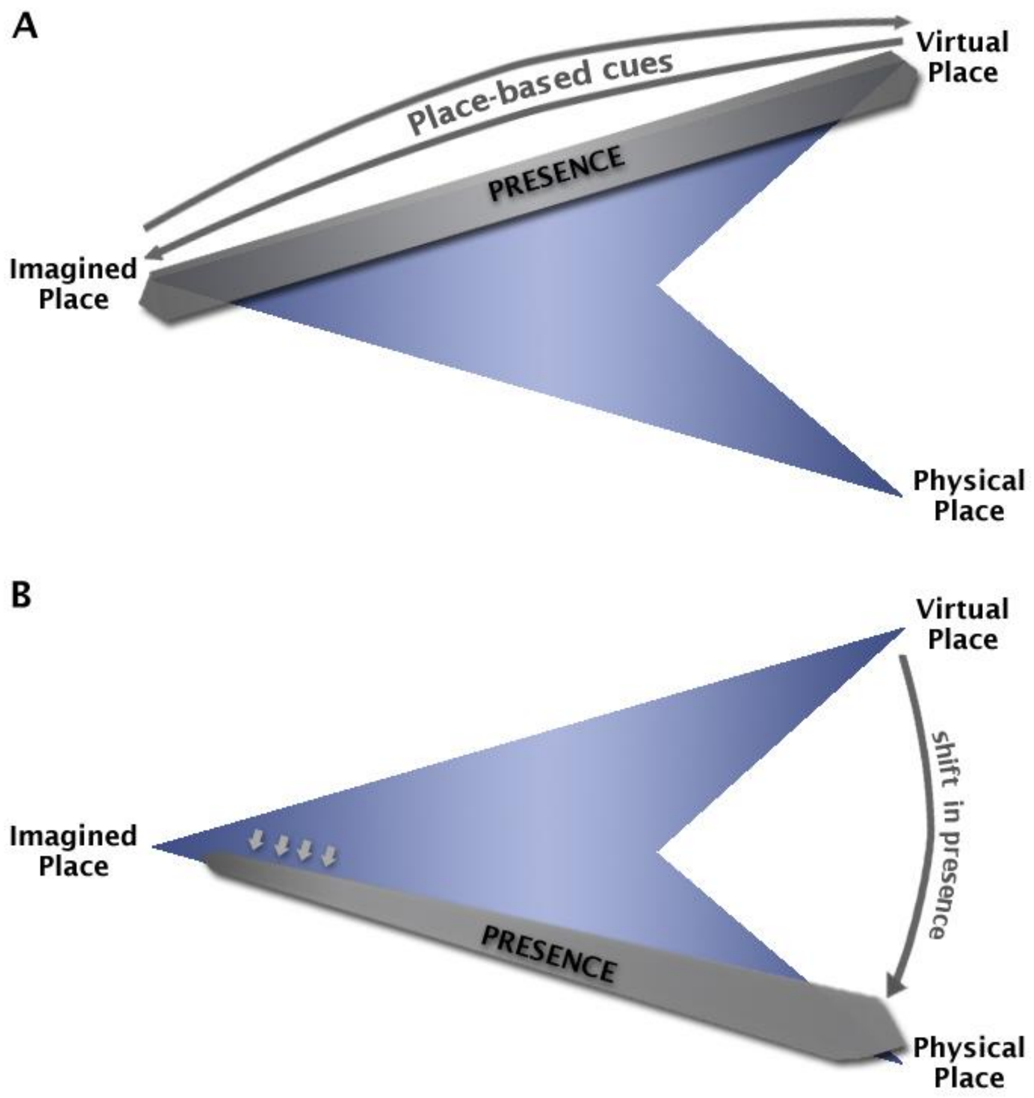

Figure 4. Interactions with geovisualizations and presence within virtual, physical and imagined place

The models has been adapted from Biocca's (2003) three-pole model of presence. Figure 4a represents a user interacting with the geovisualizations. Figure 4b represents user shifting attention from the geovisualization and engaging in discussion with others in the room.

If geovisualizations operate as suggested above (i.e., virtual and imagined places reflexively exchanging place-based cues), this would suggest they have a greater ability to evoke presence and connect with sense of place if the user is familiar with the represented environment. In cases of high familiarity with places, users presumably would have more salient memories and understanding of these places, which would allow them to draw from more coherent place-based cues when interacting with a virtual representation. Supporting this notion is a study by Bishop and Rohrmann (2003), which found that people rated a virtual environment’s ability to emulate a real-world place more positively after visiting, experiencing and becoming familiar with the actual place. In the context of environmental management, this role place familiarity has in increasing geovisualizations’ capacity to represent places and connect with sense of place has positive implications. Effective collaborative management consists of inclusive, participatory approaches that involve stakeholders that are affected by management decisions (Poe et al., 2014; Trimble and Berkes, 2013), and said stakeholders are typically people that have relationships (and thus familiarity) with places targeted for management strategies (Poe et al., 2014). Therefore, geovisualizations can be considered as particularly effective for connecting with sense of place in collaborative management process, which supports the position that they operate (or at least have the potential to operate) as place-based tools when employed in environmental management efforts.

2.4 Evidence for Geovisualizations as Place-based Tools

Although place concepts and theories are rarely incorporated into geovisualization research, previous research has provided evidence that geovisualizations can act as place-based tools without making explicit reference to said concepts and theories. This evidence includes observations on the ability visualizations have for communicating ‘meaningful information’ on places. To elaborate, previous research has shown that visualizations have capacity for communicating potential environmental changes (i.e., outcomes from landscape management, development, environmental issues, etc.) in a relatable fashion that allows people to vividly envision and imagine impacts on real-world, familiar places. Exemplifying this capacity is Lewis’s and Sheppard’s (2006) study on comparing realistic landscape visualizations with conventional maps in terms of the abilities these tools have for communicating potential riparian and forest management outcomes to local community members of Cheam First Nation (Fraser Valley, BC, Canada). Lewis and Sheppard (2006) observed that the community members favoured (for the most part) the visualizations, noting them to be much more ‘real’ than maps. This reference to ‘real’ indicates that the visualizations were prompting people’s thoughts on actual environments and places, stimulating meanings and feelings associated with their respective senses of place. In fact, one of the study participants made a direct reference to these feelings, noting that the visualizations provided “a way better understanding [that is] almost a feeling" (Lewis and Sheppard, 2006, 308). In another example, Sheppard et al.'s (2011) made similar observations with residents of south Delta (BC, Canada) in an investigation on the use of realistic visualizations for communicating localized effects of climate change. In this study, Delta residents expressed how the visualizations "hit home" (Sheppard et al., 2011, 408), meaning that these visual tools contextualized climate change issues in a manner that allowed for vivid and personal understandings and feelings of the implications of climate change on familiar and meaningful places.

In addition to exhibiting capacity for communicating meaningful place information, previous research has also found that visualizations can elicit responses reflective of particular place-based values, thereby implying that they are capable of connecting to sense of place. Such research includes studies that investigate people's preferences around landscape management and industry development by presenting them with visual media that depicts different management and/or development scenarios and then examining their reactions to these scenarios. Because sense of place encompasses the meanings and values held for a place, it also is strongly related to how a person believes a place should be managed or developed (Yung et al., 2003).Therefore, it follows that particular reactions to certain visual depictions of management and/or development scenarios applied to a representation of a place are driven by people's beliefs and values for the actual place, which implies that the visual tool is connecting with these people's sense of place. For example, Natori and Chenoweth (2008) presented a series of landscape images depicting different approaches to rice paddy management to group of study participants in Niigata Prefecture (Japan), and they found preferences for the imagery differed depending on whether a participant was identified as a farmer or naturalist. Farmers exhibited a stronger preference for landscape imagery that depicted more productive and easier to manage rice paddies, whereas naturalists preferred landscape imagery that displayed higher levels of biodiversity (Natori and Chenoweth, 2008). These observations clearly indicate that the visual preferences for landscape imagery were strongly driven by (and thus reflective of) values, interests and meanings encompassed within the different people's respective senses of place. In another example, Tress and Tress (2003) investigated the preferences local and nearby residents of a rural place in Denmark had for local development by presenting them with altered images of the place, depicting different potential development directions (i.e., farming, recreation, conservation or residence). They observed that people residing locally were strongly in favour of the farming scenario, whereas people residing nearby strongly favoured the tourism scenario (Tress and Tress, 2003). Such observations demonstrate that people’s place-based values, particularly their place dependence or functional values, played a central role in their responses to the visualizations, which in turn exhibits the potential geovisualizations have for connecting with sense of place.

Perhaps the most salient evidence for the notion that geovisualizations can connect with sense of place is observed through research that has found visualizations capable of evoking emotional responses. Sense of place includes the feelings and emotional significances people hold for place (Cresswell, 2009); therefore, a tool or device that stimulates or activates place-related emotions must be connecting with sense of place in order to achieve this activation/stimulation. For example, Salter et al. (2009, 90) presented residents of Bowen Island (BC, Canada) with a visualization depicting potential outcomes of increased local housing density, and they found that the visualization created a sense of ‘unease’ with one participant noting that “[s]eeing the visible impact makes me uneasy”. This denotes that the visual representation produced a negative emotional reaction associated with disruption of the character or nature of a familiar and valued place, and thus is interacting with place-based values and meanings. Another example includes Schroth et al.’s (2009) study on a community planning process in Kimberley (BC, Canada), which employed geovisualizations to convey potential impacts of local wildfires. They reported that the local Kimberley residents participating in the planning processes exhibited strong emotional reactions when viewing the spread of wildfire through the visualization, indicating that these visuals stimulated imaginings of the actual places (i.e., Kimberley neigbourhoods) being consumed by fire. In both the Bowen Island and Kimberley examples, emotional responses resulted from the visual representations of alterations and impacts to places that hold personal meaning and significance, indicating that through interacting with the visual tools, people could imagine the actual possibilities of disruptions to said meanings and significance. This is a clear indication that geovisualizations hold capacity for connecting with sense of place and acting as place-based tools when employed in collaborative management.

2.5 An Integrated Research Agenda

This chapter has explicitly illustrated the relationship between research on sense of place and studies on applications of geovisualizations in collaborative management, and it has done this for the purposes of moving toward an integrated research agenda. In this fashion, the chapter provides precedent for future research that can integrate methodology, theories and knowledge from diverse disciplines, such as spatial sciences, perceptual research, human geography and environmental studies. Such research has the potential to lead to a comprehensive understanding of how to build a geovisualization, what situation (and with whom) a particular geovisualization would be best applied, and how to interpret the results of user interactions with a geovisualization. As an example, a potential area where this type of integrated research approach could be applied is in investigations on how to facilitate collaborative planning around controversial offshore windfarm proposals. Previous research related to collaborative wind energy planning has included studies such as examining methods for developing interactive wind turbine visualizations (e.g., Bishop and Stock, 2010), exploring the role that visualizations have for facilitating collaboration among proponents of and opponents to proposed offshore windfarms (e.g., Phadke, 2010), and investigating how place relationships can influence the ways different communities and socio-economic groups perceive (and accept) proposals for local offshore wind energy developments (e.g., Devine-Wright and Howes, 2010). By integrating thinking and/or research approaches from these different types of studies, a research effort could comprehensively examine offshore windfarm visualizations, producing valuable insight on how to develop said visualizations in a manner that they can be applied in contentious stakeholder planning sessions and on nuanced interpretations of the reactions to various windfarm scenarios as they differ among communities and socio-economic (and cultural) groups.

Another way in which an integrated research agenda would benefit geovisualization research is by using knowledge on how people value and form relationships with places to inform what elements to include within a visualization. Real-world environments are highly complex, and as Appleton et al. (2002, 147) succinctly states, “reality will always exceed our ability to simulate it”. Builders of geovisualizations cannot feasibly capture all the elements and features found within a real-world environment; therefore, these builders need to be selective in what they include. In terms of building geovisualizations for collaborative management, such a selection process could be informed through sense of place and place attachment investigations, as such research has the ability to shed light on what aspects of a place are considered by different stakeholders as particularly important. For example, in a place attachment study involving Appalachian Trail hikers, Kyle et al. (2004) found that hikers with a higher place identity type attachment held different expectations for the social and environmental conditions of the trail than people with higher place dependence, and part of these expectations involved a different tolerance for ‘crowding’ from other hikers. This suggests that potential increases in human traffic could be an important aspect of how different people and/or communities respond to a proposed management plan for local parks and trails. Accordingly, simulated increases/decreases in presence of people could be a key feature to include in geovisualizations when researching their application in the collaborative management of public parks and trail systems.

In addition to being able to provide deeper understanding on how users interact with geovisualizations, an integrated research agenda could also provide insight on influences and personal ‘biases’ experienced by builders of a geovisualization when developing these tools. Geovisualizations are not ‘objectively’ built, meaning the process of translating data into realistic environmental representations is subject to the geographical understanding and interpretations of the builders (Lewis et al., 2012); therefore, comprehensively examining how geovisualizations can be built and used in collaborative management also requires an understanding of the ‘human’ factors on the builder-side that can influence their development. These factors can be elucidated through methods used by environmental psychologists and human geographers to investigate people’s sense of place, as such methods can provide data on how builders interpret and understand a place’s environment prior to developing a virtual model of said environment. For example, sense of place can be examined through semi-structured interviews (e.g., Gunderson and Watson, 2007), and a geovisualization research effort could include a component where those building and contributing to the development of a geovisualization can be interviewed in such a manner. In turn, this interview data can be analyzed to better understand the decisions (conscious and subconscious) involved in developing the geovisualization that extend beyond purely data and technological considerations, such as why certain elements are included and others excluded in a geovisualization (i.e., when data availability is not an issue) or why certain aspects seem to be prepared with more attention to detail than others (i.e., when technological limitations are not issues).

2.6 Conclusion

The lack of incorporation of place theories and concepts into geovisualization research appears surprising when examining the clear convergence in these research areas (i.e., as it exists in the environmental management context); however, as aforementioned, this deficiency is likely more associated with epistemological differences. It is possible that if humanistic geography emerged and produced its seminal theories on place in more recent decades (when technology has allowed for the development realistic, immersive visualizations), geovisualizations and sense of place would be investigated frequently in the same studies. Referring back to Tuan's (1977, 6) comment that "undifferentiated space becomes place when we endow it with value", this is similar to how geovisualization researchers describe visual tools as having the capacity to transform abstract data into salient and meaningful information concerning familiar real-world places (e.g., Jude et al., 2007; Lewis et al., 2012; Sheppard et al., 2011). In other words, the building of recognizable textures and objects in a geovisualization can be seen as a method for creating the conditions for people to 'endow' visual imagery with place-based values. Such a perspective positions geovisualization research as a type of 'humanistic geomatics', which due to disciplinary divisions, many geographers might regard this term as an academic oxymoron. However, in actuality, the term characterizes a complementary and suitable fit between applied research (i.e., geovisualization studies) and theoretical framing (i.e., place theory), which is a fit that has been alluded to previously but not sufficiently explored.

By illustrating the relationship between sense of place and applications of geovisualizations in collaborative management, this work lays a foundation for future research that can bridge spatial sciences, perceptual research, human geography, and environmental studies. Potential examples of such research have been detailed in this chapter; however, these examples simply represent initial thinking and further exploration in this line of research will open opportunities for a variety of geovisualization studies that will benefit from diverse areas of scholarship and disciplinary perspectives. Ultimately, it is through such interdisciplinary approaches that we can effectively address complex real-world problems (Dale and Newman, 2005), allowing us to better understand how to sustainably manage and live within the planet's valuable and vulnerable places.

Chapter 3

Picturing a place by the sea: Geovisualizations as place-based tools for collaborative coastal management[9]

Abstract

Effective coastal management is integrative and aims to incorporate the wide variety of user needs, values and interests associated with coastal environments. This requires understanding how different user groups relate to coastal environments as ‘places’, imbued with values and meanings, rather than simply ‘spaces’. Accordingly, tools and techniques that can capture and convey place-based information have potential for supporting coastal management strategies. This suggesting a role for geovisualizations that inclusively reflect the range of values and meanings through immersion and realism. This chapter aims to advance coastal geovisualization research by firstly, examining relationships with, understandings of, and behaviours toward coastal places, and secondly, using this insight to create recommendations for building geovisualizations that can effectively facilitate collaboration among conflicting user groups. The chapter identifies different coastal user groups using a cultural model framework, and through a review of previous research on coastal communities, it examines how the values and interests of these user groups influence understandings and perceptions of coastal places. Recommendations for geovisualizations emerging from this research include full navigability, dynamic elements, and flexibility in the way that they allow for continual modification and scenario building.

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3.1 Introduction

Effective coastal management requires integrated approaches, which recognize that coasts consist of complex land-to-ocean environments and are layered with interacting ecological, social, economic and cultural dimensions (Bowen and Riley, 2003; Christie, 2005; Fletcher and Potts, 2008; Sorensen, 1997). Engaging in such integrated approaches requires that competing values, interests and associated lifestyles must be addressed and reconciled collaboratively by bringing stakeholders together (Bowen and Riley, 2003), while also ensuring that people are cognizant of the fact that coasts comprise interconnected terrestrial and marine environments (Sorensen, 1997). Such considerations are interrelated because different values, interests and lifestyles can affect how people relate to coastal environments in terms of its land and ocean properties (Shackeroff et al., 2009). Therefore, in order to enact effective coastal management strategies and governance approaches, one must understand how different users' values, interests and needs influence their perspectives and understanding of these marine-terrestrial environments. This requires thinking of these environments as ‘coastal places’, rather than simply ‘coastal spaces’.

‘Place’ is a subjective representation of a locality that captures the values, meanings and identities ascribed to that locality (Bott et al., 2003). ‘Space’, or the physical dimensions of a locality, becomes a place when it is imbued with values and meanings (Tuan, 1977). It is through the place perspective that people form understandings of and feelings toward their environment, or their ‘sense of place’, and these understandings/feelings frame their behaviour toward and within the environment (Bott et al., 2003). Therefore, in terms of coastal management and governance, considering coastal environments as ‘places’ is necessary for identifying different understandings of the coast, which in turn, is essential for determining how to reconcile the range of user needs and interests in a manner that is sustainable for both coastal communities and ecosystems. However, capturing place-based values in coastal management can prove challenging. Places can have ‘fuzzy’ boundaries, creating difficulties for defining exactly where certain values are ascribed to, and such values can be expressed in vague terms that do not necessarily translate to concrete management outcomes (Newell and Canessa, 2015). Thus, developing innovative tools that capture and communicate place-based information is important for advancing coastal management practices and governance approaches.

Conventional maps have the ability to clearly communicate spatial information; however, they can be abstract and ineffective in characterizing and conveying place-based meanings and understandings and (thus) do not always encourage inclusivity in management approaches (Lewis and Sheppard, 2006). Capturing and communicating place information requires the use of more sophisticated visualization techniques that allow diverse groups to understand geographical representations and relate to the represented environmental settings. Advancements in three-dimensional technology have created new opportunities for creating immersive, realistic visualizations that allow people to recognize environments in terms of being a ‘place’ (Newell and Canessa, 2015) and provide first-person perspective glimpses of different scenarios applied to a familiar locality (Sheppard, 2001). This form of visual media interacts with people's sense of place, which positions it as a potentially powerful tool for facilitating collaborative resource planning and management (Newell and Canessa, 2015). Previous research supports this notion by observing that realistic geographical visualizations, i.e., geovisualizations, have shown promise for functions, such as effectively communicating resource development outcomes with local communities (Lewis and Sheppard, 2006), collaborative climate adaptation planning (Schroth et al., 2009; Sheppard et al., 2011), and stimulating discussion among stakeholders regarding future land-uses in the face of changing landscape conditions (Schroth et al., 2011).

Although geovisualization research has demonstrated that such tools have potential for facilitating collaborative planning, insights gained and lessons learned from this work thus far have been primarily in the terrestrial context and research on the use geovisualizations in the coastal context is currently in its infancy. The coastal context differs from the terrestrial in that it involves varying place relationships with different aspects of the marine-terrestrial continuum; therefore, lessons/insights from terrestrial work are not directly applicable to coastal geovisualizations. This chapter aims to address this research gap by investigating the considerations that are specific to the coastal context when developing and using geovisualizations as tools for collaborative planning among diverse stakeholders. The research takes a place-based approach by examining different needs and interests associated with coastal places, how these needs/interests influence perspectives around and behaviour toward coasts, and how geovisualizations can be developed and used for enhancing coastal understandings and facilitating collaboration among conflicting user groups. The study employs Thompson’s (2007) coastal cultural model framework to define different user groups, and uses these defined groups to examine how values and interests can influence understandings and conceptualizations of coastal places. These understandings and conceptualizations were then examined to elucidate considerations around developing geovisualizations as tools for effectively facilitating collaborative coastal planning, which subsequently informed recommendations for features that should be incorporated into these tools.

3.2 Methods

This study employed structured literature review methodology (Armitage and Keeble-Allen, 2008), involving a review of studies that were strategically selected through the use of pre-defined conceptual framework. The conceptual framework consisted of Thompson’s (2007) seven cultural models of coastal property, and it was selected because Thompson specifically developed these models to illustrate how different values and interests for coastal places can lead to coastal user conflicts. Due to this capturing of coastal social diversity and (resulting) conflict, the framework served an appropriate point of departure for a place-based study focused on developing tools (i.e., geovisualizations) for reconciling varied interests and increasing collaboration in coastal management efforts.

The review process began by identifying the key features of a given cultural model as described by Thompson (2007), in terms of coastal values and interests that are expressed through the model. These features were cross-referenced through a review of Stocker and Kennedy (2009), who applied Thompson’s (2007) cultural models to the Australian context. Once the features were identified, a literature search was conducted to identify theoretical and empirical works that discuss and provide examples of the different user groups (as defined through the cultural models). The literature was reviewed, and this enabled syntheses of coherent ‘impressions’ of the ways different coastal users understand and relate to the coast.

After understanding how user groups understand/relate to the coast, ‘conceptualizations of coastal places’ were developed for each of groups, which refers to the ways different user groups imagine or mentally ‘visualize’ coastal places. This approach allowed for framing and interpreting relationships with place in a manner that captures geometric and structural perceptions of coastal environments, and thus it was deemed appropriate for an exploration on geovisualization. The conceptualizations were developed by qualitatively analyzing the results of the literature review in terms of functional and/or symbolic associations coastal users form with various physical aspects of coastal environments, and then determining what the perceptual foci and conceptual inclusions/exclusions of different coastal features might be based on this analysis.

Once the conceptualizations were developed, they were compiled into a table and examined in terms of them representing the ‘imagined places’ of different stakeholders within coastal planning sessions. The examination specifically involved identifying where potential conflicts and tensions could arise due to different ways the coast is imagined among different user groups, deficiencies or gaps in perceptions of what constitutes a coastal environment, and misalignment between imaginings of coastal places and (possible) coastal management objectives. This analysis elucidated several considerations around developing coastal geovisualizations as a tools for supporting planning processes and addressing said conflicts/tensions, which in turn, led to development of recommendations for building coastal geovisualizations.

In order to better illustrate the findings and recommendations from the research, sample images of a geovisualization case study are included in this chapter. The geovisualization was built as part of a larger research project on coastal geovisualizations, and it modelled the coastal environment of a Canadian national park located in British Columbia (see Figure 5) using a combination of ArcMap (v. 10.3.1), Adobe Photoshop (CS5), Trimble SketchUp (2015), and Unity3D (v. 5.3.4). The specific location and geographical context of the modelled area are not discussed in detail here because the sample images serve as visual complements for recommendations that are intended for geovisualizations that represent a variety of coastal places.

Figure 5. Map of case study area
Base map retrieved from the Capital Regional District Regional Map system.

Several considerations arise when employing this methodology that are important to note as they affect how the results of this study are interpreted and applied. Firstly, cultural models are not mutually exclusive, meaning that an individual can hold characteristics associated with multiple cultural models (Thompson, 2007), and in some cases, certain cultural models can ‘overlap’ (i.e., have a strong relationship) with other models (examples discussed below). Therefore, the purpose of employing a cultural model framework in coastal management research is not to partition and classify coastal populations by personalities or worldviews, rather it allows for better understanding of social characteristics that can play a role in the conflicts and discourse within coastal management and governance. Secondly, Thompson’s (2007) work is not exhaustive of all coastal users, and thus there are certain conceptualizations of coastal places that will not be captured in this study. This being said, the framework is relatively comprehensive and has proven useful in other research as a guide for considering a wide range of coastal behaviours and understandings (Stocker and Kennedy, 2009); thus, it is deemed as sufficient for the purposes of this work. Thirdly, Thompson’s (2007) framework was developed in the American context and applied by Stocker and Kennedy (2009) to the Australia context;

accordingly, the literature review conducted for this work focuses on Western examples (i.e., US, New Zealand, Australia, Ireland) and it should be noted that this is the scope of the research. Fourthly, although readers of this chapter might have anecdotal evidence (personal or otherwise) that could suggest adjustments or alterations to a given conceptualization of coastal place, conceptualizations are developed through the process defined above for the purposes of conducting this review in a systematic and consistent manner; that is, they begin with an examination of Thompson's (2007) cultural models and then build conceptualizations on this basis.

3.3 Cultural Models of the Coast

Thompson (2007) defined seven cultural models associated with coastal places – landscape, community, ecological, moral order, sovereignty, productivity, and commodity. The following sections use these models to discuss how the values, attitudes, and beliefs of different user groups can lead to different conceptualizations of coastal places. Outcomes from this analysis are summarized in Table 1.

Table 1. Summary of coastal cultural models, coastal values, and conceptualizations of coastal places

Cultural model	Coastal value	Spatial focus/foci	Conceptualization of coastal place
Landscape	Ocean view	Ocean surface and the terrestrial elements that serve as foreground to an ocean view	Centers on the visual perspective from land out to ocean horizon (i.e., 'seascape view').
Community	Social connection	Primarily terrestrial spaces (i.e., beaches, inland spaces)	Focuses on spaces of human activity and contains human elements and structures; in some cases, might be restrictive of the amount of these human elements and structures (i.e., level of tourism and development)
Ecological	Ecosystem processes	Terrestrial and marine spaces; includes spaces above and below ocean surfaces	Consists of a dynamic environment comprising interconnected marine and terrestrial elements that are linked through ecosystem processes.
Moral Order	Spiritual/religious significance	Terrestrial landscape and seaward spaces; focuses on space above ocean's surface	Imagines coasts as vast, sublime seascapes/landscapes, predominately consisting of natural character and little to no human development
Sovereignty	Autonomy	Limited terrestrial space (and ocean surface associated with views from this space)	Focuses on space occupied by personal property; imagines coastal spaces as stabilized and developed according to personal preference
Productivity	Coastal resources	Terrestrial and marine spaces; includes spaces above and below ocean surfaces	Is inclusive of both surface and subsurface elements and dimensions of the marine environment; can also include human structures when associated with the community model
Commodity	Buying/selling	Terrestrial spaces imagined in terms of lots and tracts (includes some ocean surface associated with views from these spaces)	Focuses on terrestrial places and maps these places in terms of tradable real estate; can contain imaginings of coastal places related to other cultural models that are targeted as property buyers

3.3.1 Landscape

Through the landscape cultural model, the value of the coast is strongly associated with the view of the ocean (Thompson, 2007). This value holds a distinct financial counterpart as ocean views typically add a premium to property prices (Thompson, 2007). In monetary terms, the value of coastal property is directly linked with the ability to visually consume the ocean, meaning property values decrease with visual obstruction and distance from the water (Benson et al., 1998), and in some cases, simply the potential for obstruction to occur (i.e., space for potential development exists between property and ocean) can decrease value (Fraser and Spencer, 1998). Landscape culture does not solely associate visual values with financial assets, as scenic appreciation is also a distinct characteristic of this model (Thompson, 2007). However, the monetary way that coastal properties are valued is illustrative of how spatially demanding view-based interests can be, as such interests can require a large amount of space between terrestrial viewing points and the shoreline to be devoid (and remain devoid) of natural or built elements (Thompson, 2007). In addition, previous research has found that coastal property values can be influenced by the visual character of beaches in line of an ocean view (Pompe and Rinehart, 1999). In terms of visual values and appreciation, this indicates that enacting landscape culture also can require maintaining particular aesthetics for the terrestrial features in the foreground of an ocean view, as well as maintaining the ocean view itself.

User groups defined through the landscape culture model typically are resistant to development that would disrupt the scenic nature of their ocean view (Thompson, 2007). In some cases, the scenic beauty of the ocean view can be a core aspect of place attachment and identity, and development that interferes with this beauty can threaten visual values that contribute to sense of place (Devine-Wright and Howes, 2010; Phadke, 2010). For example, Devine-Wright and Howes (2010) describe a proposed windfarm development in North Wales as potentially disruptive to some of the local residents' place attachment, as the ‘industrial’ scale of wind operations interferes with the natural character of the place. In this example, the visual character of the ocean view in North Wales forms an essential element to local values, and any adulteration to this visual character holds the potential of disturbing these values.

Since the values and interests of landscape user groups are highly visually-oriented, it follows that their conceptualization of coastal place is associated with vivid imagery. However, it is important to note that this imagery is focused on looking seaward from land-based vantage points, which is a perspective commonly associated with the conventional ‘seascape’ image or the ‘picture of the view to the sea’ (Hill et al., 2001). Therefore, this conceptualization is limited in the way that it does not include subsurface elements, being that it focuses on the natural beauty of the ocean surface and horizon. In addition, because the conceptualization centers on distinct seaward focal points, it only captures the terrestrial elements within the visual field from the vantage points to the shoreline, and thus does not contain extensive inland geography.

3.3.2 Community

Human societies tend to gravitate to the coast for residence and recreation, and thus coasts are areas of high social importance (Martínez et al., 2007). The community cultural model emerges from this social dimension, and user groups defined through this model view coastal areas as spaces for social interaction and opportunities to embed in social networks (Thompson, 2007). Accordingly, the coastal values and interests of the community user groups are associated with local interpersonal relationships and connections, indicating that their sense of place holds a strong social bonding component. This aligns with Manzo and Perkins’s (2006) discussion on place attachment that described people's relationship with place as intertwined with their ‘sense of community’, and through this perspective, community and its corresponding social networks can be regarded as significant elements of place. Accordingly, for coastal user groups defined through the community model, human relationships and bonds can be considered as part of the architecture of their coastal places.

Sociality is a foundational component of the community cultural model; therefore, conceptualizations of coastal places formed through this model likely include structures and elements that support human interaction and connection. Kelly and Hosking’s (2008) study of coastal communities in South Western Australia supports this notion, as they observed that place attachment among seasonal residents was strongly associated with sense of community, and it led to community supporting behaviours such as increased local expenditures and membership in local community groups. These findings suggest that community-focused user groups value human presence on the coast, and thus their conceptualizations of coastal places include human elements, such as developments that support recreation, businesses and other forms of social interaction. In addition, since sociality is a cornerstone to community culture, conceptualization of coastal places likely focuses on spaces where social interaction is possible, i.e., terrestrial areas. It can be argued that certain communities form identities associated with aquatic-based activities, such as water sports (Augustin, 1998) and resource harvesting (Jacob et al., 2005), and consequently marine components can be incorporated into these community members' conceptualizations of coastal places. However, as terrestrial species, social-bonding and relationship-forming is land-based. Thus, engaging in aquatic interactions is not necessarily a function of enacting the community model; rather, it is better explained through overlapping aspects of other cultural modalities and interests (e.g., as discussed with the productivity model below).

An important consideration of the community cultural model is that it can elicit a desire to protect the character of a community, and such a desire can lead to a resistance toward high levels of development and large influx of seasonal residents and tourism (Collins and Kearns, 2013; Carter et al., 2007). Tourism is not altogether rejected by coastal community culture; however, this can mean maintaining an ‘acceptable’ level of tourism that provides economic benefit to locals without resulting in over-development and commodification of the local coastal place (Carter et al., 2007). Through this perspective, conceptualizations of coastal places (in their ideal state) will still incorporate human structures and developments, but will also include limitations on these structures and developments.

3.3.3 Ecological

The ecological cultural model involves the perspective that coastal environments are interconnected water and land systems linked through ecosystem processes and humans living in these spaces must understand and respect that they too are connected to (and exert an influence on) the greater biotic community (Thompson, 2007). This perspective is biophysically inclusive and process-focused; thus, it recognizes that coasts are highly dynamic environments and (as a consequence) rejects perspectives that characterize coasts as static, controllable spaces. For example, Collins and Kearns (2013) discussed the opinions of an opponent to a housing development proposed for Ngunguru spit (Northland, New Zealand) who described the sandspit as an inappropriate site for development due to its dynamic geographical properties (e.g., flooding, advancing sand dunes). The opponent exhibited concerns around how the development will attempt to stabilize and disrupt natural processes, specifically referring to this as ‘unnatural’ (Collins and Kearns, 2013). By referring to coastal stabilization as not-of-nature, this oppositional reaction illustrates the dichotomous positioning between ecological views that understand the biophysical reality of coasts (as dynamic and unstable environments) and non-ecological views that imagine coastal places as lands that can be stabilized and made static.

The ecological cultural model presents as the best fit perspective for facilitating effective coastal management, as it recognizes the dynamic and complex relationship between land and sea elements of the coast and thus aligns with the integrated perspective that coasts comprise a continuum of terrestrial to marine spaces (Sorensen, 1997). In addition, the ecological model recognizes that humans have an influence on the biosphere and a responsibility to conduct themselves in a manner that does not severely reduce the integrity of coastal ecosystems (Thompson, 2007), which coincides with conservation objectives that are also key features of integrated approaches to coastal management (Christie, 2005; Cicin-Sain and Belfiore, 2005; Ehler, 2003). However, ascribing to the ecological model requires a cognizance of the multitude of complex relationships that exist within coastal environments, which are difficult to ascertain, let alone maintain a constant awareness around (Hofmeester et al., 2012; Stocker and Kennedy, 2009). Therefore, even if someone holds an ecological appreciation and desire to maintain coastal ecosystem health, it can be difficult for people to fully assume the ecological perspective due to lack of expert knowledge on marine systems (Stocker and Kennedy, 2009). Accordingly, Thompson (2007) admits that this is the most poorly developed and least widely shared of the cultural models.

The ecological perspective requires recognition of coastal places as integrated, interconnected spaces, which implies holistic thinking is involved in this perspective. Therefore, cultures that have developed concepts that support holistic thinking on coastal ecosystems hold perspectives that align with that of the ecological model. For example, Indigenous groups of Australia have developed the concept of ‘Sea Country’ or ‘Saltwater Country’, which refers to coastal, island and marine environments acting as inseparable estates and playing an important role in the identities of humans and their relationship to biosphere (Smyth, 2008). Artistic representations of Sea Country are rarely simplistic depictions of natural scenes, as they often exhibit the interconnectedness between traditional stories, human activities and biological spaces (Stocker and Kennedy, 2013). This suggests the concept of Sea Country can contribute to complex ecological conceptualizations of coastal places that include inland, shoreline, surface, water column and seafloor elements, as well as human dimensions. However, it is important to note that the intention of this discussion is not to identify Indigenous Australian culture as part of the ecological model (in fact, Stocker and Kennedy (2009) specifically identified these groups as a separate cultural model); rather, this discussion aims to provide insight on the types of thinking and concepts that can contribute to ecological perspectives.

3.3.4 Moral order

The moral order cultural model associates spiritual and/or religious significance with coastal places and regards these environments as testaments to a higher order (Thompson, 2007). Oceans are vast geographical features that can be visually overwhelming and impossible to spatially conceptualize, and this can evoke a sense of awe and feelings of being in midst of the sublime (Stocker and Kennedy, 2009; Stocker and Kennedy, 2013). In this sense, moral order culture attempts to reconcile with the spatial immensity by ascribing spiritual attributes to an incomprehensibly vast geographical body.

Endowing the coast with spiritual significance can lead to a desire for protecting the aspects of these environments that give them their sense of the sublime, namely their natural beauty and character (Thompson, 2007). Therefore, similar to landscape culture, development that disrupts the natural aesthetics of the coast can evoke strong oppositional reactions in moral order coastal user groups. For example, Phadke (2010, 13) observed that opponents of a Nantucket Sound windfarm proposal referred to the proposed development site as “sacred” and “one of the world's most beautiful and pristine seascapes”. The use of words ‘sacred’, ‘beautiful’, and ‘pristine’ draws a relationship between (respectively) sanctity, natural beauty and unadulterated landscape, indicating that human interference would disrupt the sanctity of these natural environments. Other studies on oppositional reactions to coastal developments have observed similar usage of terms, such as ‘pristine’ (Collins and Kearns, 2013), to describe certain coastal places as ‘special’ because they have been unspoiled by human development. This suggests that the moral order conceptualization of coastal places likely includes little to no human elements or structures (i.e., development). This is not to say that moral order user groups do not reside in or associate with nearby coastal communities (and thus interact with human development in coastal places); however, unlike community culture, moral order conceptualizations of coastal places are more likely to focus on undeveloped nature rather than the human elements.

Moral order user groups view the ocean as vast, awe-inspiring seascapes, which suggests that their conceptualizations of coastal places focus on the ocean surface and do not include subsurface elements (Thompson, 2007; Stocker and Kennedy, 2013). In this sense, the moral order conceptualizations bears semblance to that of landscape conceptualizations; however, they differ in how terrestrial features are incorporated. Landscape user groups focus on the view from land to sea, which only includes the limited terrestrial features between the viewing point and the shoreline. In contrast, those who hold the perspective that the coast is ‘sacred’, or of spiritual significance, will not necessarily limit this significance, and its related meanings, to ocean geography but can also include associated terrestrial landscapes (Collins and Kearns, 2010; Panelli et al., 2008). This suggests that moral order conceptualizations can encompass a broader view of the coastal place that includes both seaward and inland geographies.

3.3.5 Sovereignty

The sovereignty cultural model focuses on the private property rights held by coastal property owners (Thompson, 2007). A fundamental characteristic of private property is that it endows the right to exclude others from accessing a locality (Rose, 1986). In the case of the coast, this sort of exclusion can be a great source of controversy as it spurs debate between the public right to be able to access the shore and the private right to maintain privacy in one's own home (Kaltenborn et al., 2001). By defending the right to private property, sovereignty user groups develop a mentality that Thompson (2007, 215) describes using the metaphor of “a man's home is his castle”, where a person's has dominion over their land and “[n]eighboring parcels are separate, autonomous domains”. Therefore, through this perspective, the values and interests of the coast are strongly associated with the desire for (or expressed right to) autonomy (Thompson, 2007).

The perspective that coastal property is autonomous space can potentially lead to ‘command-and-control’ type coastal interactions, due to the view that a person holds dominion over a property and thus the space should conform to personal development visions. Consistent with this notion is Nordstrom’s (2003) discussion on the behaviour of shoreline property owners, describing a tendency for these groups to attempt to stabilize coastal environments for the purposes of making property easier to manage and develop as close to shoreline as possible. Stabilization of coastal property often involves the use of sea defences (Tsvetanov and Shah, 2013), and private property owners employ these sorts of structures to maintain property stability

(Cooper and McKenna, 2008). Such behaviour indicates that the sovereign conceptualizations of coastal places (or at least their ideal image thereof) is that of a static, stable environment, which potentially contains engineered structures (such as sea defences). In addition, due to the perspective that coasts are composed of autonomous parcels of land, it is likely that the sovereignty conceptualization of coastal place primarily focuses on personal property and (thus) is spatially limited.

3.3.6 Productivity

Coastal resources are used by coastal and inland communities alike, and many coastal users form their livelihoods from fisheries and other coastal resource industries (Chuenpagdee and Jentoft, 2009; Mahon, 2008; Pomeroy, 1996). User groups such as these develop values associated with the coast's capacity for producing resources, and these values form the basis of the productivity cultural model (Thompson, 2007). Because these user groups rely on coastal environments to support their objectives and needs, they develop a functional relationship with coastal environments that takes the form of a resource-based place dependence, a form of attachment to place that has been observed to occur with other resource-based livelihoods such as farming (Cross et al., 2011; Lai and Kreuter, 2012). Therefore, considering sense of place captures experiences, meanings and values associated with a physical setting (Bott et al., 2003; Tuan, 1977), people with high coastal place dependence will relate to coastal places in reference to this dependency, which can lead to conceptualizations that contain subsurface dimensions and water column elements. For example, Sáenz–Arroyo et al. (2005) observed that fishers residing around the Gulf of California held vivid memories of local fish population, which accurately coincided with measured levels of fish stock abundance and depletion, indicating that the fishers had a strong cognizance of elements that exist in the water column of marine spaces. As another example (but in a freshwater context), McKenna et al. (2008) observed through a mental mapping exercise that fishers of the Lough Neagh (Northern Ireland, UK) were able to accurately assess bathymetry of aquatic environments they frequently navigated through and harvested from, indicating that they included (or at least have a strong awareness of) subsurface dimensions in conceptualizations of their environment.

It is important to note that, because communities can be shaped through the industry that supports the community members, the productivity cultural model can often overlap with the community model (Jacob et al., 2001). This is common in terms of fishing communities, as fishing activities influence the historical narratives, heritages and identities of fishery-dependent coastal communities (Jacob et al., 2005). For example, Panelli et al. (2008) discussed how the local oyster harvesting activities shaped the community identity of Bluff (South Island, New Zealand), and this has resulted in cultural activities such as an annual oyster festival. Therefore, although the productivity model has separate characteristics from the community model, these models can be tightly linked, and through this linkage, productivity conceptualization of coastal places can include human elements and structures.

3.3.7 Commodity

The commodity cultural model regards coastal spaces in terms of property investments; thus, this model is enacted through the buying and selling of coastal land (Thompson, 2007). Through the commodity lens, coasts are opportunities to bolster investment portfolios. Therefore, similar to the landscape cultural model, commodity user groups can be cognizant of the value of ocean views and how position to the ocean and clarity of view can contribute to this value (Benson et al., 1998; Bourassa et al., 2005). However, unlike the landscape model, the commodity cultural model does not necessitate a personal value for accessing an unobstructed seascape view; rather, it simply recognizes the financial opportunities resulting from the fact that others value this form of visual consumption.

Thompson (2007, 227) identifies commodity culture as a coastal user group that "metaphorically maps understandings from buying and selling personal property onto real property". This means that, through the commodity perspective, coastal spaces are comprised of parcels of land with associated trade value, and thus it follows that commodity conceptualization of coastal place is highly focused on the terrestrial aspects of the coast. Because ocean views directly relate to property value, some consideration of the ocean's surface might be incorporated into the commodity conceptualization of coastal place; however, the quality of an ocean view is mostly a function of the land (i.e., distance from the coast, elevation above sea level, obstruction to views) (Benson et al., 1998; Bourassa et al., 2005; Pompe and Rinehart, 1999; Fraser and Spencer, 1998). As a result, the commodity conceptualization primarily focuses on terrestrial features.

The commodity cultural model is unlike the other cultural models in the manner that (in some cases) commodity user groups must be cognizant of the values and perspectives of other cultural models in order to ensure that they sell housing units. When marketing coastal housing developments, commodity user groups are essentially selling a ‘coastal lifestyle’, and thus, through marketing campaigns, they attempt to generate narratives and corresponding imagery around lifestyles that coincide with perspectives on what constitutes an idyllic coastal place (Carter et al., 2007). Consequently, coastal developers might employ rhetoric to promote certain aspects of a residential development such as the social benefits (Collins, 2009) and/or the rich cultural heritage of the development site (Jacob et al., 2005), attempting to appeal to those of the community culture model. Alternatively, they might promote the natural beauty and discuss plans for conserving the local ecology (Collins and Kearns, 2013), attempting to appeal to the ecological model or (in terms of scenic beauty) the landscape model. What this suggests is that commodity user groups can develop a layered conceptualization of coastal places that, at the core, focuses on coastal land as property parcels, but also incorporates imagery that would appeal to target selling audiences.

3.4 Developing Coastal Geovisualizations

The cultural model analysis (and resulting constructs of coastal places conceptualizations) has elucidated a series of considerations when developing geovisualizations as tools for facilitating coastal management and planning. Firstly, this study found that certain coastal cultural models hold values strongly associated with aesthetics and scenic beauty (i.e., landscape and moral order), and these visual qualities serve as key aspects of conceptualizations of coastal places. This suggests a powerful role for geovisualizations, as these tools have demonstrated capability to clearly convey visual outcomes of management scenarios (Lewis and Sheppard, 2006; Schroth et al., 2009; Sheppard et al., 2011). However, in previous research on the application of visualizations in resource and land-use management efforts, visual media often has consisted of a series of static shots presenting limited perspectives and lines of vision within a viewshed (Lewis and Sheppard, 2006; Schroth et al., 2011). Considering the significance the viewshed has to certain coastal users, such an approach to visualization would likely be inadequate in the coastal context, particularly when using visualizations to display scenarios where ocean views are affected.

Secondly, the analysis conducted in this chapter has demonstrated that most conceptualizations of coastal places exclude features below the ocean's surface, with the exceptions of the ecological and (potentially) productivity models. This is not surprising considering humans are terrestrial beings, and thus ocean environments (for most) consist of extra-perceptual places (Goodey, 1974) that can appear to people as foreign and/or ‘alien’ (Helmreich, 2009). However, effective coastal management requires that people develop an understanding of coasts as interconnected terrestrial and marine environments (Sorensen, 1997) and (thusly) inclusive of underwater places. Therefore, geovisualizations need to be constructed in a manner that clearly conveys this interconnectedness and presents the marine and terrestrial environments as integrated spaces/places.

Thirdly, as many coastal conceptualizations exclude the marine environment, it follows that gaps exists in people's understanding of the various ecological interactions and species interdependencies that occur across the land-sea interface. Such gaps can lead to misconceptions around what constitutes a healthy coastal environment and how it ‘should look’. Coastal geovisualizations thusly should be built with the capacity to display interactions between different elements to provide a better picture of the relationships among and between terrestrial and marine ecosystems.

Fourthly, the study identified a distinct need for communicating the dynamic nature of coastal environments. This research found that enacting certain cultural models can lead to a poor understanding of the coast as a dynamic place, which can contribute to ecologically harmful development practices. For example, coastal user groups with values heavily associated with property interests (such as with the commodity and sovereignty models) can assume perspectives that coastal places are controllable and can be stabilized (Collins and Kearns, 2013; Nordstrom, 2003). Such perspectives are contrary to the biophysical reality of dynamic coastal environments; thus, they can lead to property manipulation and control practices that disrupt natural processes and only provide short-term solutions to property stabilization objectives (Cooper and McKenna, 2008).

Fifthly, implications from the analysis suggest that certain coastal values can be expressed in similar terms among different cultural models, but ultimately translate to different conceptualizations of coastal places. Such ambiguities in the meanings surrounding a ‘coastal value’ has the potential to result in user conflicts when attempting to enact management strategies and realize coastal aspirations. For example, coastal user groups of the landscape, moral order and ecological cultural models could be described, in vague terms, to have a ‘value for coastal nature’. However, interests associated with this value differ from group to group, leading to different conceptualizations and understandings of the coast. Landscape coastal users value coastal nature for its aesthetic qualities related to seascape view, and thus their value for nature is associated primarily with ocean surface features and an undisrupted ocean horizon. Moral order coastal users value coastal nature for its spiritual quality, and their value for nature is associated with ‘pristine’ quality of natural places that have not yet been spoiled by human development. Ecological coastal users value coastal nature as a component of the biosphere, and their value is associated with appreciation for ecosystem processes and functions. To provide an example of a potential conflict that could arise, the landscape values translate to unimpeded views of the natural beauty along the ocean surface to horizon, which could mean removing vegetation that could obstruct these views. If this vegetation consists of ecologically important flora, this could conflict with values for nature held through the ecological model. As another example, ecological values could lead to conceptualizations that include structures such as interpretive signage and spaces for environmental education (e.g., ‘nature houses’), as these can be used to support efforts in increasing public knowledge around the connectedness between marine and terrestrial environments and the impacts humans have on their surrounding coastal ecosystems. However, as these are human-made structures, this could conflict with the ‘pristine’ quality of natural places associated with the moral order model. In order for geovisualizations to support collaborative coastal planning, they must be designed in a manner that allows for disambiguation of nuanced meanings surrounding coastal values and clearer articulation of management visions among different user groups.

This chapter recommends that coastal geovisualizations are built with particular features based on the considerations detailed above. These features include navigability, dynamic elements and flexibility (specifically for the purposes of user-inclusivity). The following sections discuss and provide examples on how these features can address the considerations, and this work is summarized in Table 2.

Table 2. Summary of recommendations for coastal geovisualizations

Recommendation	Rationale (i.e., considerations)	Cultural model examples
Coastal geovisualizations should be built as **navigable** environments with the ability to 'walk', 'drive' or 'fly' through the virtual environment	a. Some cultural models hold place values strongly associated with ocean aesthetics and scenic beauty, and thus navigability within a coastal viewshed is required for adequately assessing the extent of the impacts to these values	a. Landscape and moral order
	b. Most cultural models do not recognize the coast as a terrestrial-to-marine continuum, and navigability could potentially increase such an understanding	b. All except ecological and (possibly) productivity
Coastal geovisualizations should incorporate four-dimensional properties and **dynamic elements**	a. Some cultural models regard coastal places as 'controllable'; incorporating four-dimensional proprieties is necessary for dispelling this notion and conveying the dynamic reality of coastal places	a. Commodity and sovereignty
	b. Most conceptualizations of coastal places do not strongly incorporate underwater elements, leading to poor understanding of the interdependencies between the terrestrial and marine realms; dynamic elements can be used to better illustrate interactions and relationships between the land and sea	b. Example cited below is community; however this applies to all cultural models with the possible exception of ecological
Coastal geovisualizations should be developed as **flexible, interactive** tools that allow for continual inclusion and exclusion of elements and scenario building	a. Values between different cultural models overlap, whereas how these values translate to conceptualizations of coastal places differ dramatically; including scenario building options allows for clearer articulation of management visions among different user groups and disambiguation of nuanced meanings surrounding coastal values	a. Landscape, moral order, and ecological cultural models (i.e., all have a 'value for coastal nature', but this value manifests differently in coastal conceptualizations)
	b. User input and scenario building can be used to build a 'collective image' of a coastal place, which can illustrate the degree of common understanding around the place-based geography of local coastal areas and provide a basis for developing common management visions	b. Productivity and ecological (i.e., common elements and values present in marine spaces)

3.4.1 Navigability of perspective views

Developing geovisualizations as static media and (thusly) limiting lines of vision could act as a source of conflict and controversy due to the fact that certain cultural models have values strongly associated with ocean views. For example, proposed offshore windfarm developments can generate strong opposition from local communities due the fact that wind turbines can disrupt or obscure the ocean views valued by coastal residents (Devine-Wright and Howes, 2010; Phadke, 2010). By limiting represented lines of vision, a visualization could either exaggerate (e.g., focus on a direct line of sight to the turbines) or belie (e.g., focus away from the turbines) the degree to which visual values will be affected at a site, depending on how they appear from different locations within the local viewshed. The result would be a visualization that either over- or under-represents a particular user group's perspective. Sheppard (2001, 194) noted in his work around developing a code of ethics for landscape visualization that “visualizations should represent typical or important views…of the landscape”. Consistent with this line of thought, coastal geovisualizations must accommodate multiple perspectives in order for geovisualizations to adequately capture ‘important views’, and show multiple aspects of scenarios as they appear at various points throughout the local viewshed. This requires geovisualizations to be navigable; that is, they must be equipped with the ability to change the horizontal/vertical viewing angles and the viewing distance to the extent that users can ‘walk through’, ‘fly through’, and even ‘dive through’ a virtual environment. This would allow users to examine an issue or management scenario from multiple angles, literally and figuratively.

Figure 6 illustrates the importance of allowing for navigability in coastal geovisualizations by displaying images from a wind energy scenario. For this scenario, three wind turbines were built with 90 m hub heights and 60 m blades, as per dimensions outlined by Jonkman et al. (2009), and positioned 2 km from the vicinal shorelines. The position was selected to fit within the extent of the geovisualization model and roughly followed minimum distances to shore examined in other offshore wind energy studies (Frandsen et al., 2005). In accordance with the recommendation above, the visualization is navigable in that the user can freely position themselves at any point of view within the model. Figure 6a shows two positions (labelled ‘1’ and ‘2’) where users can navigate to and view their surroundings. In the first view from position ‘1’ (see Figure 6b), both the turbines and the town are visible. In the second view (from position ‘2’) (see Figure 6c), no elements associated with human development are visible;

that is, the viewer sees a ‘natural’ ocean view that does not contain turbines or urban structures. By allowing users to navigate the visualization, they can see that ‘unspoiled’ ocean views still exist in a locality where wind turbines are nearby. In addition, they will be able see that certain views that contain the turbines would not necessarily be ‘pristine’ (i.e., devoid of human development) in the absence of the windfarm, as they would still feature urban structures (e.g., the nearby coastal town). This can allow for less contentious discussion around potential wind energy developments with user groups that have place-based values strongly associated with ocean views (e.g., landscape), thereby allowing for stronger collaborative processes.

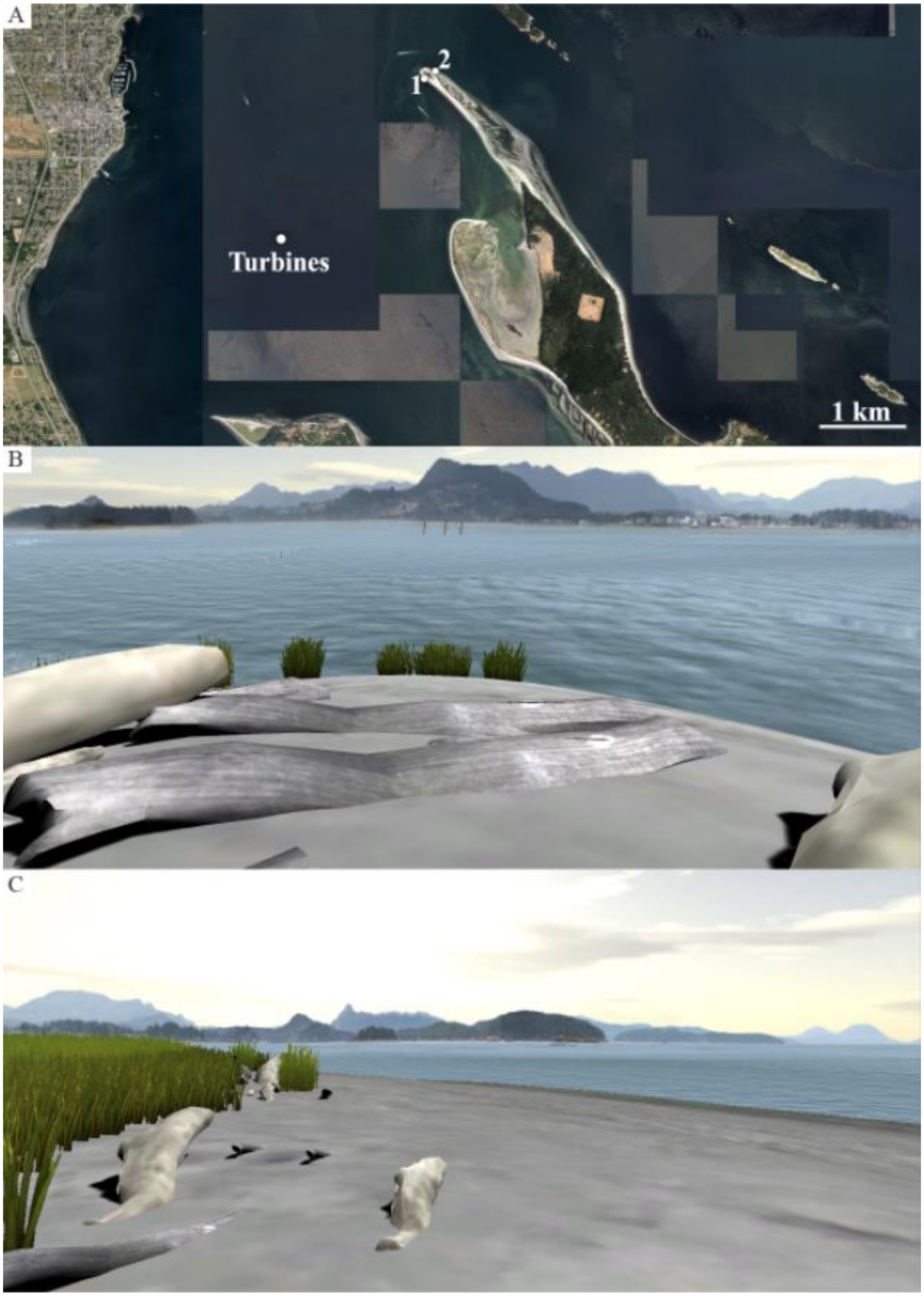

Figure 6. Wind energy scenario applied to the case study geovisualization

Figure 6a displays the locations of the wind turbines placed within the visualization and two viewpoints (base map retrieved from Capital Regional District Regional Map system). Figure 6b displays the view from viewpoint 1, facing southwest. Figure 6c displays the view from viewpoint 2, facing north.

Employing navigability in geovisualizations also holds the potential for enhancing people's biophysical understanding of the coast, as it allows geovisualizations to better convey coastal environments as a terrestrial-marine continuum. An understanding of coasts as interconnected terrestrial and marine environments aligns with the holistic thinking implicit of the ecological cultural model, but as aforementioned, this is not a widely shared model (Thompson, 2007) due to people's lack of knowledge on and familiarity with marine places (Stocker and Kennedy, 2009). Therefore, the challenge is to counteract conceptual compartmentalization of above surface and subsurface geographies by enhancing popular conceptualizations of coastal places in a manner that they contain marine elements integrated with (more familiar) terrestrial elements. Geovisualization navigability can potentially aid in this challenge by allowing a user to fluidly move from terrestrial to marine spaces (above and below the ocean surface), thereby presenting coastal places in a manner more consistent with integrated and holistic thinking.

3.4.2 Dynamic elements

Marine and coastal environments are dynamic places with complex interacting forces such as tides, waves, currents, erosion and accretion, as well as organisms that move due to or independently of these forces. Furthermore, the dynamic nature of marine and coastal environments operate at different temporal and spatial scales. Previous research has argued that accurately capturing the ‘reality’ of change and motion of coastal environments within geovisualizations requires incorporation of temporal or four-dimensional properties (Beegle-Krause et al., 2009). Referring back to Sheppard’s (2001, 194) discussion on a code of ethics for visualization, he noted that “visualizations should simulate the actual or expected appearance of the landscape”, which in the case of coastal places, this could mean capturing and communicating the dynamic nature of these environments. Aligning with this notion, the current research identified a need for communicating dynamics through coastal geovisualizations due to the fact that certain cultural models can assume perspectives that coastal places are controllable and can be stabilized, which is contrary to the biophysical reality. By employing four-dimensionality in coastal geovisualizations, the dynamic nature of coastal environments can be accurately conveyed and this subsequently will provide greater understanding of where and how to develop in coastal spaces.

Employing dynamics in coastal geovisualizations is also beneficial in that it allows for the incorporation of interacting elements, which is particularly useful for communicating the complex ecological relationships that occur within coastal environments. The ecological relationships between coastal species and between species and habitat can be unintuitive and difficult to ascertain (Hofmeester et al., 2012), especially for cultural modalities that have values strongly associated with terrestrial spaces and, thus, little inclusion of marine elements in their coastal conceptualizations. For example, the community model's value for the coast is associated with areas humans can reside, work and recreate, and this can lead to a view that beaches should appear ‘clean’ and ‘uncluttered’ to maximize human enjoyment of these spaces (Thompson, 2007). However, cultivating a ‘clean beach’ appearance can involve the practice of beach grooming (i.e., removing debris from the beach), which can lead to the removal of ecologically important materials such as macrophyte wrack (Defeo et al., 2009). Macrophyte wrack deposits serve as significant sources of food and places of refuge against desiccation for beach macroinvertebrates, and in turn, these macroinvertebrates comprise important prey items for higher trophic levels, such as coastal birds (Defeo et al., 2009). Consequently, coastal users groups that hold values for certain beach aesthetics can inadvertently impact local ecosystem health through promoting an image of what a beach ‘should look like’, and this not only affects ecological elements that these groups might find ‘unsightly’ (e.g., macrophyte wrack) but also elements that might positively contribute to their image of coastal places (e.g., costal birds). By incorporating interacting, dynamic elements, geovisualizations can better communicate ecological relationships between marine and terrestrial ecosystems, thus increasing understanding of what constitutes a healthy coastal environment and (ideally) aid in aligning people's image of what a coast ‘should look like’ with that of a healthy ecosystem.

Figure 7 complements the example above by displaying images of how a beach grooming scenario would appear if applied to the geovisualization. In this depiction, black-bellied plovers are featured as the ‘coastal bird element’ because they forage among and have been found to be positively associated with macrophyte deposits (Dugan et al., 2003). Thus, changes to macrophyte deposits on a beach influence the presence of black-bellied plovers; specifically, the removal of macrophyte deposits reduces the abundance of the plovers.

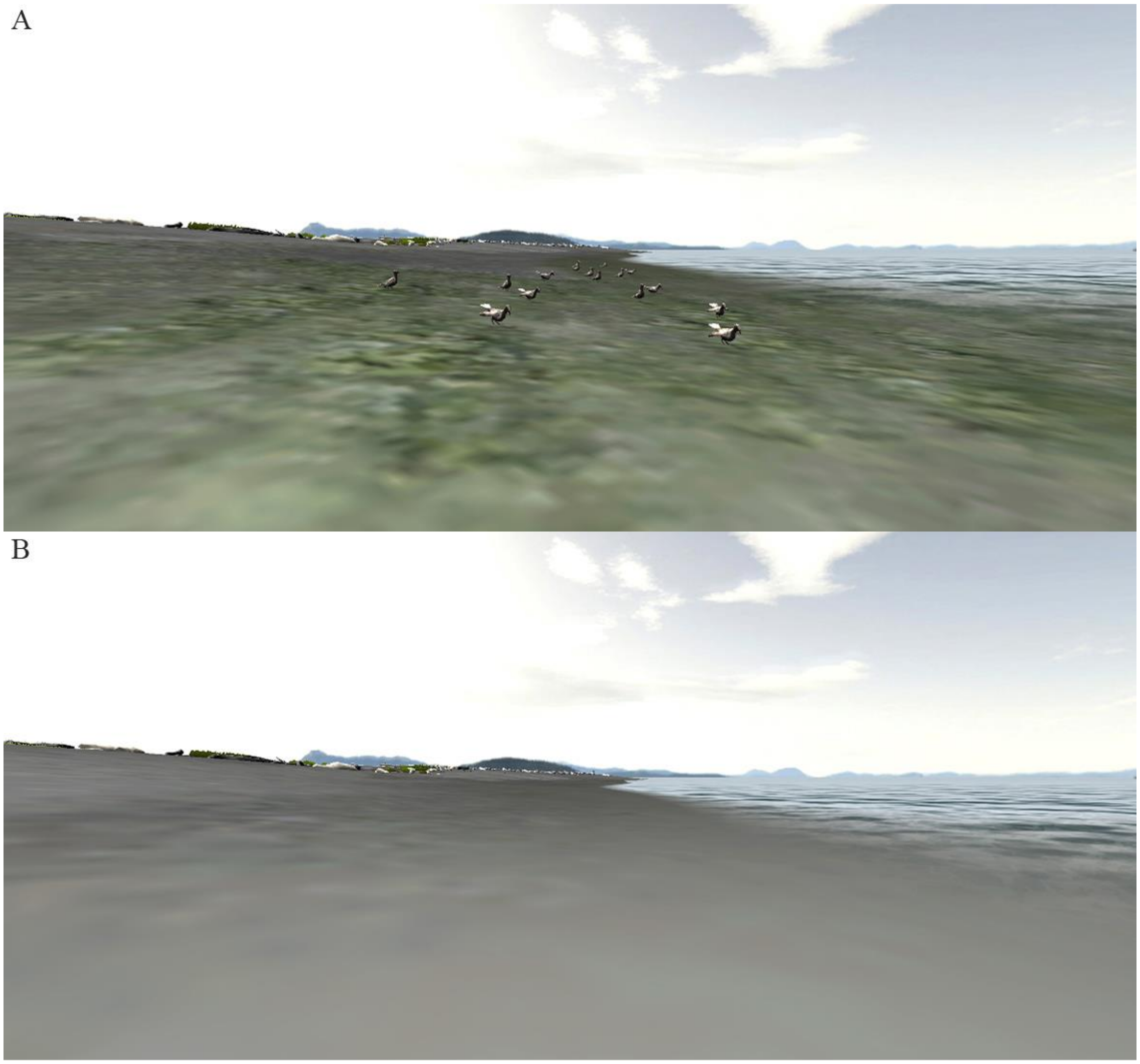

Figure 7. Beach grooming scenario applied to the case study geovisualization

Figure 7a depicts a beach that is not ‘groomed’. Macrophyte elements are included in the beach textures, and foraging black-bellied plover models are feature in areas with macrophyte textures. Figure 7b depicts a beach that has been groomed. Macrophyte elements are not featured in the beach textures, and black-bellied plover models are removed from the visualization.

It is important to note that Figure 7 attempts to illustrate the importance of including dynamics in coastal geovisualizations (ironically) through static pictures prepared for a printable article. The pictures do not capture key movements that convey the dynamics among plover populations and wrack deposits, that is, the foraging motions performed by the plover indicating they are feeding on organisms within the wrack. Showing motions such as these can better illustrate the unintuitive relationships between terrestrial, intertidal and marine systems, thusly allowing for more effective tools for facilitating planning among diverse stakeholders. Moving beyond static media to geovisualizations that incorporate motion presents a new set of challenges and considerations (e.g., making seagrass accurately sway in underwater currents, setting the rotor speeds for wind turbines, plotting the movement paths of nearby boats, etc.), and addressing these challenges could require software beyond GIS programs, such as gaming engines. However, these are necessary challenges to address and research on coastal geovisualizations should continually explore ways of incorporating motion in order to better convey the reality of dynamic and complex coastal environments.

3.4.3 Flexibility and interactivity

Previous research has found that collaborative coastal management faces the challenge of stakeholders expressing coastal values in broad, vague terms (e.g., value for ‘environmental protection’), which leads to conflicts during decision-making processes as ideas on how to support these values (and thus how these values manifest as management visions) can differ dramatically (Rockloff and Lockie, 2004). The current study has made similar findings observing that, while values among different cultural models overlap, how the values translate to conceptualizations of coastal places differ. For geovisualizations to be effective tools for facilitating collaboration in coastal management strategies, they must be flexible and interactive in their development, meaning they must allow for customised scenario building and the ability to include and manipulate (i.e., re-position, change orientation, add/remove items, etc.) a variety of elements associated with different conceptualizations of coastal places. This feature will allow for clearer articulation of management visions among different user groups and disambiguation of nuanced meanings surrounding coastal values. In addition, by integrating elements of different conceptualizations into a single platform, a geovisualization can capture a ‘collective image’ of coastal place, and this image can show the degree of common understanding around the geography of a locality, in a similar manner to a compilation of mental maps, i.e., layered series of memory-produced maps (Gueben-Venière, 2011; McKenna et al., 2008). Therefore, by interactively adding, removing or modifying elements (e.g., depiction, assemblage and arrangement of features) that differently reflect the same stated values, a geovisualization can provide insight on both spatial and place-based commonalities and incongruences among different conceptualizations of coastal place, which (ideally) can provide a starting point for conversation and fostering a common coastal management vision.

By way of example, values for fisheries development can conflict with values for coastal conservation (Ruiz-Frau et al., 2011), which respectively corresponds to potential conflicts between productivity and ecological cultural models. However, as observed through the analysis above, there are also commonalities; both productivity and ecological cultural models have conceptualizations that contain submarine geographies due to values for marine ecological elements (e.g., fish). Therefore, through the use of an interactive geovisualization, people with productivity and ecological perspectives can better ‘see’ the common ground in their understandings and aspirations for local coastal environments (e.g., healthy populations of marine life) and thusly work through their differences to achieve these aspirations.

Bringing this example to the context of the case study geovisualization, Figure 8 displays screenshots of scenarios that include fishing boats (i.e., an element of productivity coastal conceptualizations) anchored at locations off the western beach of the spit. In Figure 8a, the boat is anchored over a seagrass meadow, and the scenario shows potential damages meadows due to anchoring (e.g., Collins et al., 2010). Seagrass is ecologically important and many marine species rely upon seagrass meadows for food and habitat (Orth et al., 2006); thus, such a scenario would be in conflict with ecological values. In this manner, Figure 8a illustrates potential incongruences between productivity and ecological conceptualizations and conflicts that could occur when stakeholders view such a scenario in a collaborative planning session.

In Figure 8b, the scenario is altered through repositioning some elements and adding others. In this altered scenario, boat anchoring is not permitted in areas with seagrass meadows, and thusly the boat/anchor elements are repositioned outside of this area. As a result, the seagrass meadows appear as undamaged. Accordingly, elements depicting organisms that rely on these meadows are added; specifically, crab elements are added[10], as seagrass meadows can form important habitats for certain species during their juvenile stages (e.g., Dungeness crabs and *Zostera marina* (Dumbauld et al., 1993), which are the species modelled in Figure 8). As crabs are a part of marine ecosystems and some crab species are desirable for harvesting (e.g., Dungeness crabs), they can be potentially important elements of coastal conceptualizations formed through both the ecological and productivity cultural models. Therefore, it follows that a

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[10] The example solely serves to illustrate the power of incorporating flexibility and interactivity into coastal geovisualizations. The intention is not to use this example as evidence for cases of significant correlations between anchoring practices and populations of a particular species of crab.

visualization scenario that depicts the healthy crab populations and inclusion of crab elements could align with both productivity and ecological conceptualizations. In this manner, the flexibility of the geovisualization (i.e., ability to reposition elements and add/remove other elements accordingly) can lead to greater understanding on where place-based values for different perspectives converge and coastal management actions that align with the aspirations for all user groups involved (e.g., restrictions around anchoring in seagrass meadows).

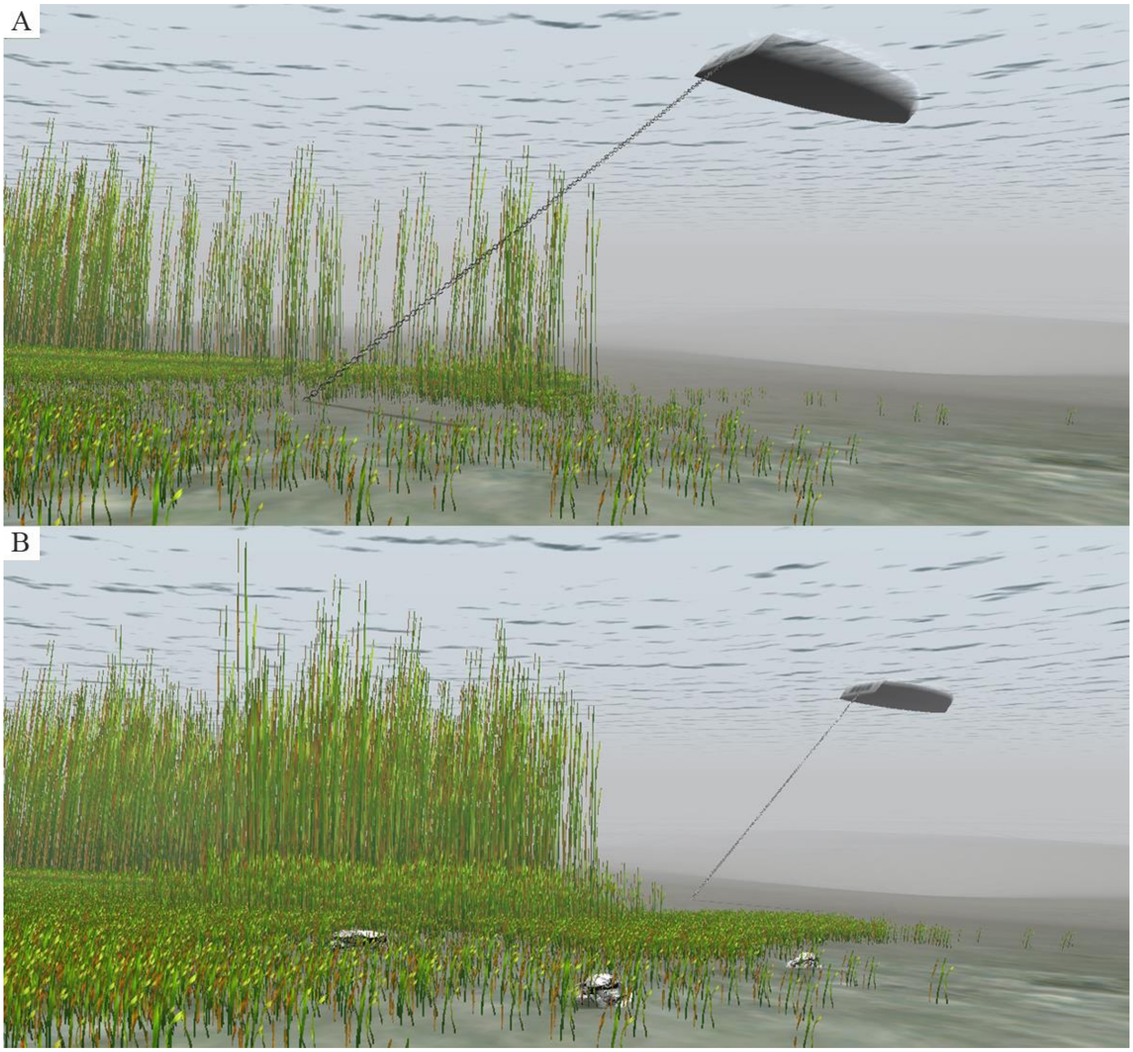

Figure 8. Boat anchoring scenario applied to the case study geovisualization

Figure 8a depicts a marine scene with seagrass populations damaged by boat anchors and an absence of crab elements. Figure 8b depicts a marine scene in the same location with boats positioned away from the seagrass meadows, healthy seagrass populations and the presence of crab elements (modelled from images of Dungeness crabs).

It could be argued that flexibility and interactivity are useful features for geovisualizations of all types of environments (i.e., beyond coastal places); however, these features are particularly important for the coastal geovisualizations due to the geometric and biophysical complexity of these environments. As illustrated in example above, elements positioned above the ocean surface can interact with and influence subsurface elements, but these ‘cross-surface’ interactions might not immediately observable due to visual obscuring from the reflection/colouration of the water surface. Therefore, a degree of flexibility is particularly useful when working across the land-sea interface to be able to continually refine plans for coastal places.

3.5 Conclusion

Research on the use of immersive, realistic geovisualizations in coastal planning and management is currently in the infancy. This chapter aims to address this gap and advance the state of knowledge by investigating considerations around developing and employing geovisualizations in coastal contexts. Examining different perspectives and understandings associated with coastal places illuminated such considerations, including the significance of viewshed elements for certain coastal users, the need for emphasizing that coasts consist of marine as well as terrestrial environments, the need for conveying that coasts are dynamic places, the benefits of presenting interactions between marine and terrestrial elements, and the value of allowing different users the ability to input and help guide representations of these complex environments. From such considerations, recommendations were developed, consisting of the ability to navigate within the viewshed and across the land-sea interface, the incorporation of dynamics and elements that interact with one another, and the ability for users to contribute to building of scenarios and manipulate geovisualization elements.

Approaching the research from the ‘user perspective’ was useful for exploring geovisualizations in the context of place-based tools for collaborative planning; however, the study was limited in the manner that it generalizes conceptualizations of place among user groups defined through a specific coastal cultural model framework. The reality is that an individual's relationship with place is highly personalized and can differ dramatically from individual-to-individual (rather that from group-to-group) (Vorkinn and Riese, 2001). Therefore, the study does not account for place relationships that can form through niche-group activities, such as place attachment to underwater environments formed through frequent SCUBA diving (e.g., Moskwa, 2012). In addition, this discussion is visually-focused and does not account for the fact that place information is also communicated through other sensory inputs such as smell, sight, sound and touch (Arnspang et al., 2002; Lindquist and Lange, 2014). However, considering the little amount of research that has been done in the area of coastal geovisualizations, the recommendations and findings of this chapter serve as a useful basis for future research around developing geovisualizations for collaborative coastal planning and management.

The place-based approach employed in this study will (ideally) encourage further thinking and research on how to develop geographically accurate and visually realistic tools with a cognizance around the place information they capture and convey. The meanings, values, beliefs and attitudes people ascribe to place define how people relate to and value their environment, which in turn, can provide insight on how to design and implement effective ecosystem and resource management (Williams and Stewart, 1998). Therefore, as coastal geovisualization research progresses, it is important to continually understand the coast as a ‘place’ that is seen and experienced differently by different people and user groups. It is through this understanding that we will be able to foster a common vision for a coastal place that can support and sustain both human societies and the biosphere for years to come.

Chapter 4

From sense of place to visualization of place: Examining people-place relationships for insight on developing geovisualizations[11]

Abstract

Effective resource planning incorporates people-place relationships, allowing these efforts to be inclusive of the different local beliefs, interests, activities and needs. 'Geovisualizations' can serve as potentially powerful tools for facilitating 'place-conscious' resource planning, as they can be developed with high degrees of realism and accuracy, allowing people to recognize and relate to them as 'real places'. However, little research has been done on this application context; that is, the place-based applications of these visual tools are poorly understood. This study takes steps toward addressing this gap by exploring the relationship between sense of place and 'visualization of place'. Residents of the Capital Regional District of BC, Canada, were surveyed about their relationship with local coastal places, concerns for the coast, and how they mentally visualize these places. Factor analysis identified four sense of place dimensions - nature protection values, community and economic well-being values, place identity and place dependence, and four coastal concerns dimensions - ecological, private opportunities, public space and boating impacts. Visualization data were coded and treated as dependent variables in a series of logistic regressions that used sense of place and coastal concerns dimensions as predictors. Results indicated that different aspects of sense of place and (to a lesser degree) concerns for places influence the types of elements people include in their mental visualization of place. In addition, sense of place influenced the position and perspective people assume in these visualizations. These findings suggest that key visual elements and perspectives speak to different place relationships, which has implications for developing and using geovisualizations in terms of what elements should be included in tools and (if appropriate) depicted as affected by potential management or development scenarios.

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[11] This chapter has been submitted for publication to Heliyon:

Newell, R., and Canessa, R. (In review). From sense of place to visualization of place: Examining people-place relationships for insight on developing geovisualizations. *Heliyon*.

4.1 Introduction

It is widely recognized that incorporating people-place relationships into resource planning is important for ensuring that these efforts are inclusive of the different beliefs, interests, activities and needs associated with areas targeted for management (Cheng et al., 2003; Stocker et al., 2012; Thompson and Prokopy, 2016; Yung et al. 2003). The way local stakeholders relate to place reflects their values and ways of life (e.g., Carter et al., 2007; Panelli et al., 2008; Urquhart and Acott, 2014); therefore, cognizance of these relationships allows for more holistic and socio-culturally sensitive resource management approaches (Poe et al., 2013), enabling inclusion and (ideally) collaboration (Williams and Stewart, 1998). However, albeit important, this incorporation can be difficult to achieve in practice. The relationships people form with places comprise complex and integrative phenomena that are influenced by a wide variety of human and environmental factors (Devine-Wright and Howes, 2010; Gosling and Williams, 2010; Vorkinn and Riese, 2001). In turn, place values are nuanced, and attempting to finely characterize the range of different values can be a complicated task (Cheng et al., 2003). Compounding the challenge is the fact that places can have indistinct boundaries that can not always be spatially defined (McLain et al., 2013), which leads to difficulties around determining exactly to which places that certain values are associated. These challenges bring to light a need for tools that can capture and convey ‘place’ in a clear manner and provide better understanding of the people-place relationships that are relevant to particular management plans and strategies.

Realistic and geographically-accurate representations of real-world places, referred to here as ‘geovisualizations’, can serve as potentially powerful tools for addressing the aforementioned challenges and allow for resource planning that better incorporates people-place relationships (Newell and Canessa, 2015). Due to their realism, geovisualizations can provide people with vivid understandings of how they would feel about certain management outcomes or impacts if transpired in real places (Lewis and Sheppard, 2006; Sheppard et al., 2011), and as a result, these tools have been found to elicit strong emotional reactions from users when substantial modifications to familiar places (see Figure 9) are depicted (Salter et al., 2009; Schroth et al., 2009; Schroth et al., 2011). Such emotional responses imply that the visuals are connecting with people’s ‘sense of place’, i.e., the meanings, values, beliefs and/or feelings people associate with places (Williams and Stewart, 1998), and through this connection, geovisualizations can be used to gain valuable insight on local people-place relationships. For example, these tools can be used to better understand what different people perceive as significant components of a place, how people feel a place should appear and be managed, and what types of development and activities are desirable or undesirable within a place (e.g., Natori and Chenoweth, 2008; Schroth et al., 2011; Tress and Tress, 2003). Subsequently, this insight can inform plans and policy in a manner that ensures local social and cultural values are included within land-use and resource management.

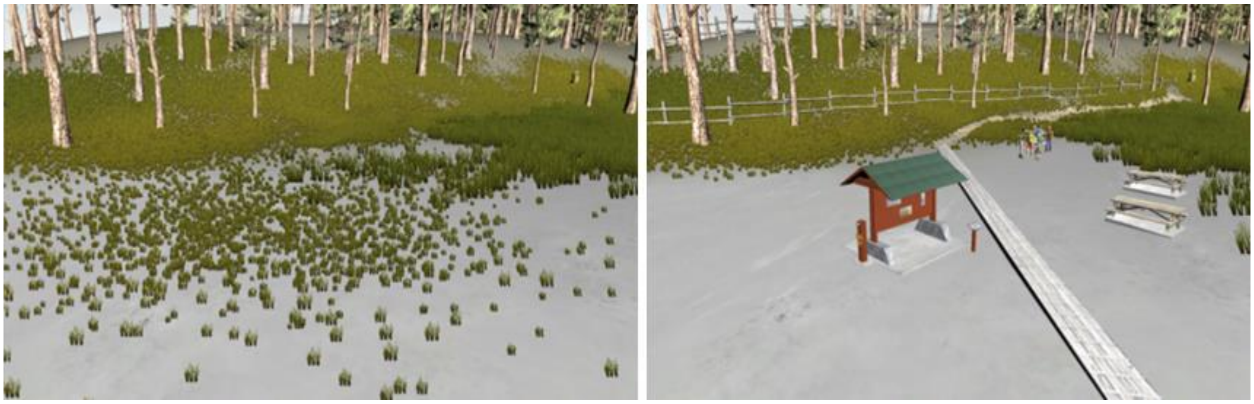

Figure 9. Example of realistic geovisualization depicting potential modifications to an environment

Place-based applications of geovisualizations appear promising; however, this application context is not well understood as geovisualization and sense of place research are very rarely explicitly linked and explored in the same studies. Newell and Canessa (2015) have taken the initial steps toward integrating the two fields of research by developing the theory (through a review-based study) that geovisualizations operate as place-based tools. This study aims to advance this research agenda through empirical work, specifically by pursuing two objectives. The first objective is to establish that a relationship between sense of place and 'visualization of place' (i.e., how people visualize place) can be observed using methods that have been developed and well-established through previous place research. Once established, the second objective is to explore how different visual elements might relate to different aspects of sense of place and how this insight can be used to inform the development of a geovisualization.

4.2 Research Context

The current study is part of a larger research project that explores geovisualizations as place-based tools specifically for coastal management and planning. This research follows two review-based studies that (respectively) uncover areas of convergence between place theory and applications of geovisualizations (Newell and Canessa, 2015) and explore place-based considerations around building coastal geovisualizations (Newell and Canessa, 2017). The findings from this study and the review-based work informs applied research on developing and employing a geovisualization of a particular coastal place located in the Capital Regional District of British Columbia, Canada (Newell et al., 2017). Accordingly, this study focuses on residents living in coastal British Columbia, and it examines the place and visual relationships that said residents form with the local coastal environment.

4.3 Characterizing and Measuring People-Place Relationships

People-place relationships have been studied through many disciplinary lenses; however, methods for characterizing and measuring these relationships arguably has been most heavily pursued and developed through the disciplines of environmental psychology and human geography (Bott et al., 2003; Lewicka, 2011). This body of work commonly expresses people-place relationships through the concepts of place attachment and the aforementioned sense of place. Albeit closely related, the concepts can differ in connotation and generality. Place attachment specifically refers to the psychological bonding that occurs between people and their environment (Scannell and Gifford, 2010). Sense of place can be considered as broader concept, which does encompass attachment but also captures factors such as social and cultural contexts (Campelo et al., 2014).

In studies involving the measurement of place attachment and sense of place, people-place relationships will often be characterized as consisting of sub-components or dimensions[12] (e.g., Devine-Wright and Howes, 2010; Kelly and Hosking, 2008; Lee, 2011; Lai and Kreuter, 2012). Williams and Roggenbuck (1989) defined place attachment as consisting of two distinct

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[12] This methodology is appropriate for this study and its objectives; however, it is important to recognize that the use of such quantitative methods in place studies have been critiqued for their limitations in terms of missing nuanced meanings that do not fit within a particular measurement framework (Gunderson and Watson, 2007).

dimensions - place identity and place dependence. Their discussion of place identity refers to Proshansky et al.'s (1983) work, who defined place identity as a sub-structure of self-identity that comprises the cognitive connection between a person and locality, built from personal meanings, attitudes, feelings and preferences associated with a place. In contrast, place dependence refers to the value a person holds for a place in terms of supporting his or her goals and objectives, and it is associated with the utility of the place such as the resources and recreational opportunities found there (Williams and Roggenbuck, 1989). Williams and Vaske (2003) describe to these two dimensions of place attachment as emotional attachment (place identity) and functional attachment (place dependence).

Jorgensen and Stedman (2001) described sense of place as consisting of three dimensions - place attachment, place identity and place dependence, and they paralleled these dimensions to the three psychological components of attitude - the affective (emotional), the cognitive (meanings and values), and the conative (behavioural inclination). This conceptualization contrasts with Williams and Roggenbuck's (1989), as it treats place attachment as distinct from identity and dependence, rather than as a 'second order' or overarching concept (Kyle et al., 2004). However, regardless of whether place attachment is characterized as first or second order, sense of place appears as a broader concept. Sense of place encompasses the bonds people form with place, while also capturing other qualities that make a locality a 'meaningful place' (Butz and Eyles, 1997; Hay, 1998). Accordingly, some studies investigating sense of place will examine items beyond place identity and place dependence dimensions and explore other meanings and values associated with place. For example, Cross et al.'s (2011) study of landowners residing in Colorado and Wyoming included conservation ethic as a sense of place dimension. As another example, Kaltenborn and Williams's (2002) study of tourists and locals in southern Norway identified values for local culture and history as elements of sense of place. These examples illustrate how sense of place can be considered in terms broader than solely bonds formed with a particular locality, and can capture feelings associated with worldviews and societal values (e.g., environmentalism and care for culture and heritage).

4.4 Sense of Place and Visualization of Place

The relevance of place theory to applications of geovisualizations becomes apparent when considering the relationship between sense of place and how places are visualized. Sense of place is associated with meanings and values people hold for certain localities; therefore, it captures beliefs on how places should be managed or developed (Yung et al., 2003). Accordingly, the way people react to a visual depiction of a management and/or development scenario can be regarded as based on their sense of place and how the visualized elements of a scenario interact with their place meanings and beliefs (Newell and Canessa, 2015). An example of this can been seen through Natori and Chenoweth's (2008) study, in which they prepared a series of landscape images depicting different rice paddy scenarios and presented these images to farmers and naturalists. They found that the farmers showed preference for images of larger paddies with regular patterning (i.e., uniformity among vegetation and paddy shapes), as these images depicted productive easy-to-manage crops. Whereas, the naturalists' preference was toward images of smaller paddies with irregular patterning, as they felt these images conveyed a higher degree of biodiversity. These observations demonstrate how certain visual elements in the landscape imagery (e.g., vegetation, paddy geometry) can interact with the values, interests and meanings associated with place, meaning that the landscape visualizations are interacting with sense of place.

The example above demonstrates how people can consider visual depictions of certain scenarios to be favourable and other depictions as less desirable, which indicates that the different visual representations are either aligning or conflicting with sense of place. Another way of framing this would be that the visual depictions are aligning or conflicting with people's 'visualization of place', that is, their perspectives of what places 'should look like' and the key visual elements that provide these meanings (e.g., vegetation). Such a proposition is premised on the idea that people hold mental imagery of places, which is a notion developed through earlier work in perceptual geography such as Lynch's (1960) *The Image and the City*. Lynch (1960) employed the term 'environmental images' to describe how people form spatial perceptions of urban environments. He noted that these images are comprised of both structural (i.e., physical dimensions) and meaning (i.e., emotional or practical relationships) components due to the fact that they are spatial in nature but also embody personal understandings. Downs and Stea (1977) built on this line of thinking and proposed the term, 'cognitive mapping'. They described this as the process of a person constructing a mental representation of an environment as he or she navigates through and experiences it, and noted that this representation is inextricably linked to his or her memories and self-identity. Both works employed a more cartographic treatment of imagined geography than what is proposed here with the term, ‘visualization of place’; however, they ultimately support the underlying notion of the visualization of place concept, which is that people develop mental images of places and these images can be based on experiences, meanings and beliefs. Accordingly, it follows that visualization of place is born from sense of place, and the form and character of this visualization is determined through the qualities and strengths of different aspects of sense of place.

The current study explores the relationship between the sense of place and visualization of place for the purposes of advancing a research agenda that integrates place theory and geovisualization studies. There are two ways of approaching this exploration, and these are presented through the analytical framework displayed in Figure 10. The first and most straightforward approach is to examine sense of place dimensions (see *4.3 Characterizing and measuring people-place relationships*) for their particular influence on visualization of place. The second approach involves using factors related to sense of place as a sort of proxy for place relationships, in particular place-based concerns. Many studies around sense of place and place attachment are conducted in the context of local concerns, and these concerns illuminate relationships between sense of place and reactions to possible alterations to place. For example, Devine-Wright and Howes (2010) described how concerned reactions of Llandudno (Wales, UK) residents toward a proposal for developing windfarms in nearby coastal waters were related to high local place identity. As another example, Kyle et al.’s (2004) found users of the Appalachian Trail with high place identity expressed more concern for issues such as crowding from people, environmental impacts from trail use and encroachment from human development. In a similar vein, geovisualization studies often elucidate people’s concerns for place through how people react to depictions of undesirable management and/or development scenarios. For example, Salter et al. (2009) observed that a visualization depicting increased housing density on Bowen Island (BC, Canada) generated a sense of ‘unease’ in some local residents. This was expressed through concerns around housing encroachment and loss of the ‘character’ of local place, which indicates that the visualization (and depicted housing scenario) was interacting with concerns associated with place. Ultimately, the examples above illustrate that place-based concerns relate to both sense of place and responses to geovisualizations; thus, they present a viable option and alternative route for examining the relationship between sense of place and visualization of place.

The analytical framework displayed in Figure 10 is useful for outlining the approach of this investigation; however, it is important to recognize that it does not capture all factors pertinent to place relationships and studies. In particular, demographic factors can influence people-place relationships, and accordingly, many studies on sense of place and place attachment include in their analyses variables such as age and gender (e.g., Cross et al., 2011; Kelly and Hosking, 2008; Soini et al., 2012). In addition, relationships with place are shaped by the richness and depth of experiences a person has with their environment (Tuan, 1975); therefore, the location and length of residence also can exert an influence on people-place relationships and some studies will include these types of variables in their analyses (e.g., Brown and Raymond, 2007; Carter et al., 2007; Scannell and Gifford, 2010). In recognition of this previous research, the current study also examines factors such as age, gender, location and length of residency in the analyses, even though these are not featured in Figure 10.

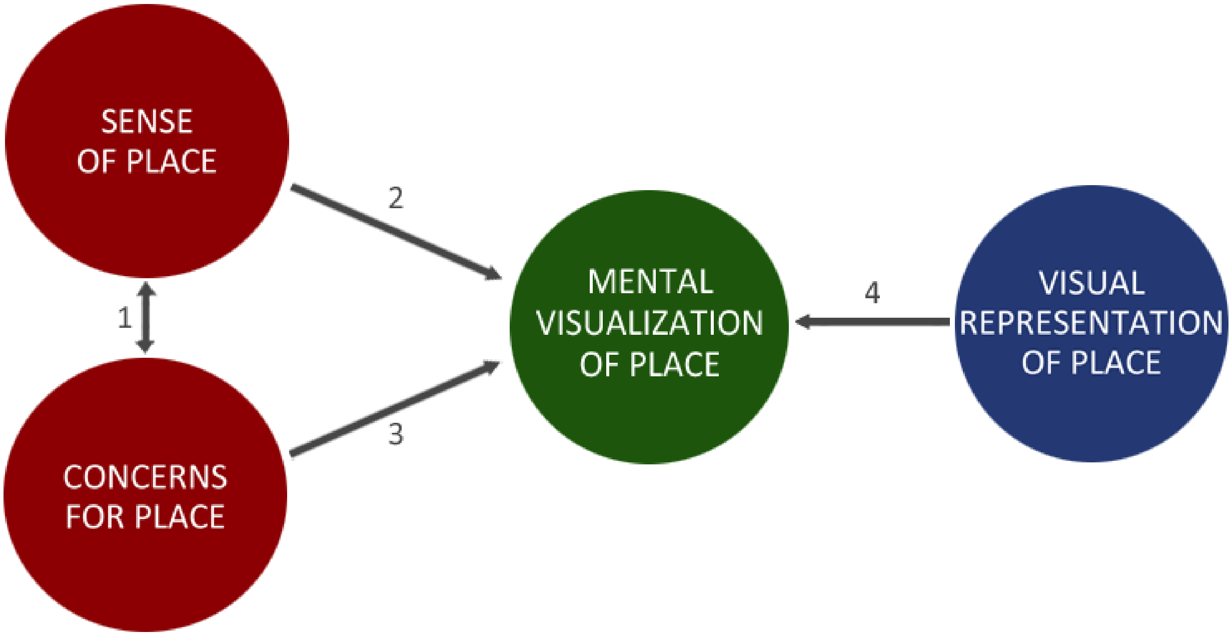

Figure 10. Framework for examining relationship between sense of place and visualization of place

The labelled arrows refer to the following - (1) the meanings and values people hold for places relate to their concerns for these places, (2) sense of place shapes mental visualization of place, (3) place-based concerns influence mental visualization of place, and (4) geovisualizations align or conflict with a person’s mental image of place.

4.5 Methods

4.5.1 Study area

The study was conducted in the Capital Regional District (CRD) of British Columbia, Canada. The CRD surrounds the provincial capital of Victoria and is located at the southern end of Vancouver Island. It is comprised 13 municipalities, and three electoral areas (see Figure 11).

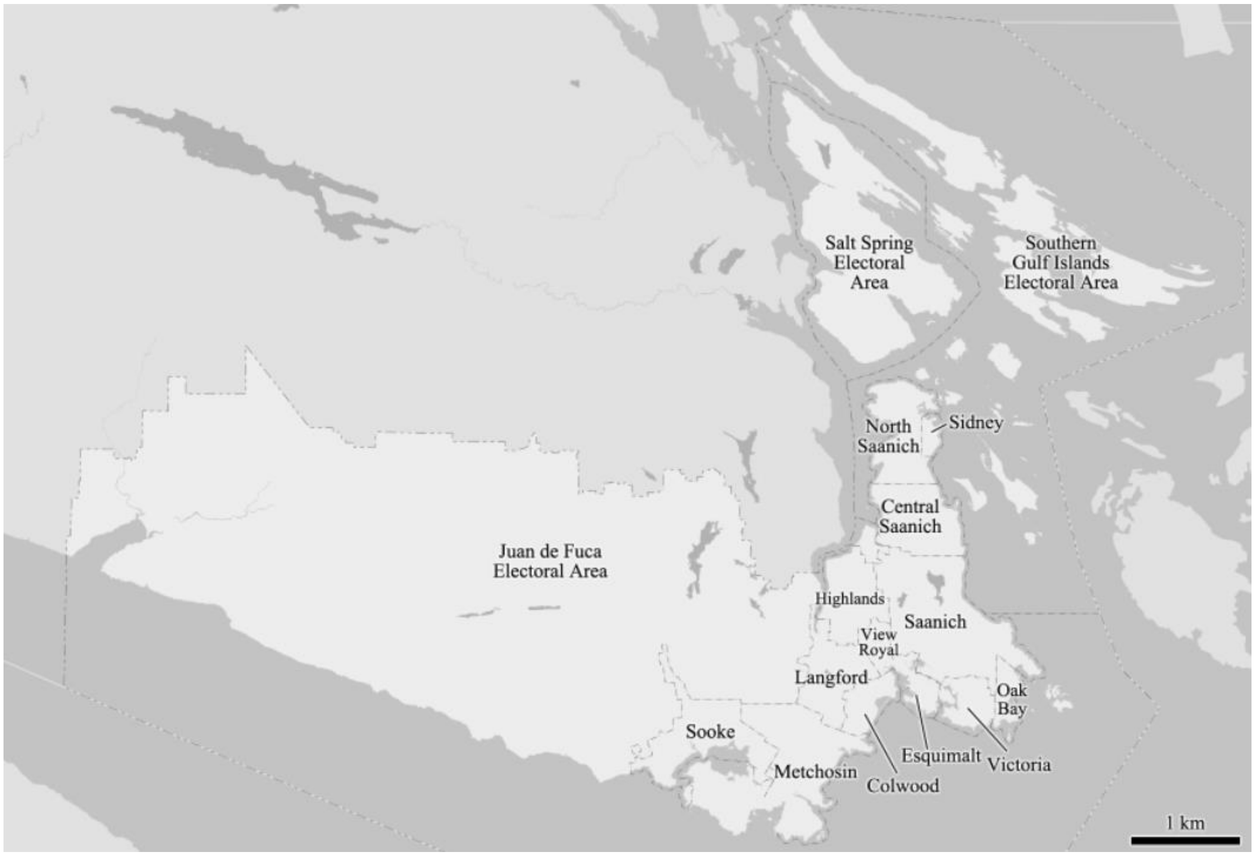

Figure 11. Map of the Capital Regional District in British Columbia
Base map retrieved from the Capital Regional District Regional Map system.

The entire CRD has an area of 2,370 km^2 (CRD, n.d.); however, this study excludes the Juan de Fuca Electoral Area, resulting in a study area of 868 km^2. This exclusion was done because the Juan de Fuca Electoral Area has a disproportionately high land area to population ratio. The area encompasses approximately two thirds (i.e., 1,502 km^2) of the CRD's total area (CRD, 2010); however, approximately 93% of the CRD's population lives in the 13 municipalities (i.e., 7% in the electoral areas) (BC Stats, 2014). The population is concentrated near the capital, with the most populous municipalities being Victoria and the neighbouring city of Saanich (respectively housing 22% and 30% of the total) (BC Stats, 2014.). Removing the Juan de Fuca Electoral Area from this research allowed for a study area where participants are more geographically concentrated and (thusly) have similar to access to local coastal places, which in turn increased chances that responses referred to similar and/or vicinal coastal places.

4.5.2 Data collection

Data were collected through a mail-out survey that was delivered to a random sample of residents throughout the CRD (see Appendix D). The survey was tested through a pilot, which was administered to 100 people and resulted in a response rate of 16%. Similar to other survey-based sense of place studies, the survey was developed further based on the results of the pilot (e.g., Soini et al., 2012). The final survey was administered to a random sample of 1,500 people, and the response rate was 18.8% (n = 283). Albeit low, the response rate was comparable to that of other survey-based sense of place studies (e.g., Carter et al., 2007; Moskwa, 2012), as well as was the sample size (e.g., Gosling and Williams, 2010; Jorgensen and Stedman, 2001).

The first section of the survey collected demographic data, including gender and age. Gender distribution was relatively equal with 49.1% (n = 139) identifying as male and 48.1% (n = 136) identifying as female (2.8% did not identify their gender). This is comparable to the gender distribution of the CRD as reported through the 2011 Census of Canada (Statistics Canada, 2012), which was reported to be 48.0% males and 52.0% females. Age distribution was skewed to older demographics with 52.7% (n = 149) of respondents over 65, 26.1% (n = 74) of ages 55 to 65, 11% (n = 31) of ages 45 to 54, 5.7% (n = 16) of ages 35 to 44, and 0.4% (n = 1) of ages 19 to 24 (4.1% did not identify their age). Because the 19 to 24 age group contained only one respondent, the data were combined with the 35 to 44 group during the analyses to form an ‘under 45’ group (n = 17). The age distribution of the sample differs from that of the 2011 Census, which reported only 22.6% of the adult (i.e., over 19) population to be 65 and over (Statistics Canada, 2012), whereas this comprised over half of the survey respondents. Due to ages distribution differences and the low response rate, the sample is not considered to be representative of the CRD’s population; however, the study does not aim to characterize this particular population. Rather, the study is more concerned with collecting a diversity of different coastal place relationships to understand how these can influence mental visualizations of place in different ways, and the sample size is sufficient for these purposes.

The first section also collected information on how long people have resided in the CRD. Participants were asked where (and for how long) they lived prior to living in the CRD to account for whether the participant lived in a nearby coastal area (e.g., a community on Vancouver Island that is north of the CRD) or whether his or her previous place of residence was significantly different from a BC coastal environment (e.g., a desert or prairie community). In addition to length of residency, location of residence data were collected and used to develop datasets for two different variables. One such variable involved using addresses to determine how close respondents lived near the shoreline[13] by geocoding addresses in Google Earth (v. 7.1.5.1557), importing into ArcGIS (v. 10.3.1) as point data, and then calculating nearest distances to CRD shoreline (vector data for shoreline was obtained from Statistics Canada, 2011). The other variable involved using addresses to categorize respondents into groups of those who reside on the larger Vancouver Island land mass and those who live in smaller island communities within the surrounding Gulf Islands, which respectively resulted in groups that were 88.4% (n = 251) and 11.6% (n = 33) of the total sample population. This latter variable was included in the analysis to examine any potential effects surrounding being more tightly bounded by coastline (for example, living on a smaller land mass might increase one's exposure to local coastal places).

The second part of the survey collected data on how people visualize coastal places and the type of elements they include in their mental imagery. This section was purposely positioned prior to questions concerning sense of place as to not unduly influence the respondents' mental imagery. The pilot survey employed methodology similar to previous studies that examined people's mental models of the environment by asking study participants to sketch pictures related to their models (e.g., Moseley et al., 2009; Shepardson et al., 2009). However, the pilot revealed inconsistencies in how people participated, as some sketched a picture, some provided photographs that they felt represented their mental image, and others wrote a description of their

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[13] The purpose of including this variable is to examine the affects better access to the coast and/or views of the ocean might have on people's mental visualization of place. However, it is important to recognize that this variable simply consists of distance between home and shoreline, and it does not take into account factors such as whether people have mobility issues and/or whether people living near the ocean have unobstructed views.

image. This created difficulties for devising a consistent method of identifying and coding elements of the mental visualizations, which was necessary for running regressions and examining the relationships between sense of place data and imaginings of place (see *4.6.4 Sense of place*). Accordingly, the survey was revised, asking participants to describe their image solely through words. This revised methodology drew from Turner et al.'s (2003) study, in which participants were asked to provide written descriptions of a real-world place for the purpose of qualitatively assessing how these descriptions can be interpreted in the context of sense of place. However, unlike Turner et al.'s (2003) work that allowed participants to write descriptions as a free-form narrative, this study asked participants to write five 'things' that they visualize (with space to include more, if they wish) in order to collect data that can be easily coded.

Participants were also asked whether they imagined themselves within their mental picture and (if so) how are they positioned and oriented. Such information is important in the context of this study, as the research aims to provide insight on geovisualizations and these forms of visualizations can be developed as egocentric (i.e., viewed from 'inside' a virtual environment) or exocentric (i.e., viewed from 'outside' the modelled environment) experiences (Orland et al., 2001). Participants were also asked whether they were imagining a specific coastal place or whether they were imagining a place with a 'typical' local coastal environment.

The third part of the survey measured sense of place using Likert items, in a similar manner to that performed in previous research on people-place relationships (e.g., Cater et al., 2007; Devine-Wright and Howes, 2010; Jorgensen and Stedman, 2001; Kaltenborn and Williams, 2002; Vaske and Kobrin, 2001). The survey used an even-numbered scale to reduce ambiguity around interpreting neutral responses (Raaijmakers et al., 2000). Responses were on a 6-point scale, and they ranged from 'strongly disagree' (i.e., 1) to 'strongly agree' (i.e., 6).

Some of the sense of place items were derived from previous research on place attachment (Lai and Kreuter, 2012; Kyle et al., 2004), and these items were typically presented in the first person voice (e.g., "I feel connected to the local coastal environment"). Other items were designed to explore broader aspects of sense of place, such as people's beliefs around how the environment should be treated and managed (Yung et al., 2003). These items were presented in the third person voice (e.g., "It is important that coastal places are protected to maintain the health of local nature").

The final section of the survey collected data on concerns for local coastal places. Similar to sense of place, the data were collected through Likert items measured on a 6-point scale. Survey participants were presented with a series of events or circumstances that could occur in coastal areas and were asked to rate the extent to which they feel these would be cause for concern if experienced in local coastal places. Responses ranged from ‘not concerned’ (i.e., 1) to ‘a top concern’ (i.e., 6).

4.6 Data Analysis and Results

4.6.1 Coding visualization of place

Visualization of place data were coded, allowing for a consistent way of identifying different visual elements among the survey responses. The coding framework was based on a literature review study conducted in previous research that examined how different coastal user interests and needs can influence perceptions of coastal places (Newell and Canessa, 2017), and it was refined through the knowledge gained through building a coastal geovisualization (i.e., what types of visual elements can be modelled, added and manipulated) (Newell et al., 2017)[14]. In total, 86 codes were applied to the data, and in an approach similar to thematic coding (Seidel and Kelle, 1995), this number was reduced to 33 by identifying common themes among the coded elements and grouping them accordingly (see Table 3).

As discussed above, participants were asked to list at least five items that they ‘see’ within their mental images of coastal place; however, it is important to note that a particular listing could be coded with more than one code. For example, a respondent that lists ‘people socializing with one another’ would be coded with both ‘people’ and ‘social interaction’. In addition, some respondents would list multiple items in one listing (e.g., two or more types of wildlife), and accordingly, these items would be associated with multiple codes.

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[14] The literature review study is the work featured in Chapter 3, and the knowledge on building a coastal geovisualizations was gained through studies detailed in Chapter 5 and 6.

Table 3. List of types of visual elements and codes used to identify these element types

Visual element type	Codes
Ocean surface	blue of water (n=12), reflection on water (n=7)
Viewshed	ocean view (n=23), general view (n=50), mountains (n=46), sunrise/sunset (n=8), islands in distance (n=20), open space (n=22)
Sky	clear sky (n=16), clouds (n=11), general sky (n=8)
Wildlife	land birds (n=15), eagles (n=15), land invertebrates (n=3), land mammals (n=4), sea mammals (n=46), “sea life” (n=20), fish (n=16), sea invertebrates (n=36), general birds (n=43), land birds (n=15), seabirds (n=26), waterfowl (n=5), shorebirds (n=7), herons (n=9), gulls (n=32)
Terrestrial wildlife	land birds (n=15), eagles (n=15), land invertebrates (n=3), land mammals (n=4)
Marine wildlife	sea mammals (n=46), “sea life” (n=20), fish (n=16), sea invertebrates (n=36)
Marine invertebrates	sea invertebrates (n=36), shells (n=12)
Domestic animals	cats (n=2), farm animals (n=2), dogs (n=11)
Birds	general birds (n=43), land birds (n=15), eagles (n=15), seabirds (n=26), waterfowl (n=5)
Land birds	land birds (n=15), eagles (n=15)
Aquatic birds	waterfowl (n=5), seabirds (n=26), shorebirds (n=7), herons (n=9), gulls (n=32)
Land plants	forest (n=122), land plants (n=38)
Boats	general boats (n=36), commercial boats (n=14), ferry (n=11), fishing boats (n=7), general large boats (n=17), recreational boats (n=24), sailboats (n=25), general small boats (n=25)
Large boats	commercial boats (n=14), ferry (n=11), fishing boats (n=7), general large boats (n=17)
Small boats	recreational boats (n=24), sailboats (n=25), general small boats (n=25)
Marine environment	underwater (n=3), fish (n=16), “sea life” (n=20)
People	people (n=47), children (n=11), tourists (n=7), social interaction (n=11), playing (n=9)
Human activity	social interaction (n=11), playing (n=9)
Recreation	general recreation (n=12), walking/hiking (n=26), playing (n=9), recreational fishing (n=20), surfing (n=5), swimming (n=17), recreational boats (n=24)
Land recreation	walking/hiking (n=26), playing (n=9)
Ocean recreation	recreational fishing (n=20), surfing (n=5), swimming (n=17), recreational boats (n=24)
Park structures	park amenities (n=9), camping (n=10), beach access (n=20), parking spaces (n=3)
Tourism	retail buildings (n=16), tourists (n=7)
Development	marina/docks (n=20), retail buildings (n=16), houses (n=35)
Tranquility	little development (n=27), tranquil/quiet (n=44)
Environmental quality	clean (n=48), floating garbage (n=1), garbage on land (n=4)
Intertidal area	foreshore (n=6), tidal pools (n=14), tidal movement (n=10)
Beach textures	general beach (n=102), sand (n=52), rocks (n=85)
Woody debris	logs on water (n=6), logs on beach (n=25), tree stumps (n=3)
Algae	“seaweed” (n=19), kelp (n=14)
Dynamics	breeze (n=38), general dynamic (n=28), tidal movement (n=10)
Non-visual senses	warm (n=11), cold (n=1), spray/wetness (n=2), sounds (n=23), smell (n=30)
Temperature	warm (n=11), cold (n=1)

Number of applications of a code is displayed next to the code in parentheses. Codes that contain the term ‘general’ refer to references that do not specify a particular type of an item. Codes displayed in quotation marks refer to responses that use a particular wording to identify an item.

4.6.2 Exploratory factor analysis

Exploratory factor analyses with varimax rotations were performed on both sense of place and coastal concerns data (see Appendix E) in order to reduce the number of variables and characterize the data in terms of sense of place dimensions and broader concerns for coastal places. Data were screened to address missing values prior to the analyses, and cases with large amounts of missing values (i.e., many questions that were not answered) were removed. This data screening followed methodology employed by Scannell and Gifford (2010), where cases missing 25% or more data were removed. This resulted in the removal of two cases from the sense of place dataset (i.e., n = 281) and three from coastal concerns dataset (i.e., n = 280). The remaining of missing values were imputed prior to conducting the factor analysis using an expected maximization approach, as per done in Scannell and Gifford (2010).

Following Raymond et al. (2010), items with factor loadings of 0.4 and greater were considered as potentially part of a factor; however, items that loaded on two or more factors at this strength were excluded unless one loading was significantly higher than the other(s) (i.e., 0.1 or greater). This approach resulted in the removal of one sense of place item and five coastal concerns items, meaning that data from one of the sense of place questions and five of the coastal concerns questions were not included in any of the factors.

The sense of place analysis resulted in the extraction of four factors (see Table 4). Factors 1 and 2 relate to participants' beliefs and values concerning coastal places, and they can be respectively described as 'nature protection values' (M = 5.60, SD = 0.76) and 'community and economic well-being values' (M = 4.73, SD = 1.27). Factors 3 and 4 roughly correspond to the place attachment dimensions of (respectively) place identity (M = 5.45, SD = 0.92) and place dependence (M = 4.58, SD = 1.24). The internal consistency of the nature protection values and community and economic well-being values scales were examined using Cronbach's alpha reliability coefficients, and these were 0.88 (nature protection values) and 0.85 (community and economic well-being values), 0.81 (place identity), and 0.82 (place dependence).

As seen in Table 4, Factor 4 also contains items related to social bonding, which other research has observed as a place attachment dimension separate from place dependence (Lai and Kreuter, 2012). However, as most of the items in the factor relate more to the functional values of place (e.g., recreational activities), the factor is described as place dependence. In addition, one of the social bonding items alludes to engaging in recreation with other people (i.e., "Local coastal areas are my favourite places to spend time with friends and family"); therefore, it is possible to interpret these results in the context of social opportunities being perceived as a part of the recreational opportunities and functions afforded by coastal places.

Table 4. Rotated factor loadings for factors extracted from sense of place items

	Factor			
Survey item	1	2	3	4
It is important that local coastal places are protected to maintain their special beauty	0.87			
It is important that coastal places are protected to maintain the health of local nature	0.85			
Coast should be protected so that our families, friends and communities can continue to enjoy these places	0.67			
One of the things I enjoy most about the coast is the local wildlife and nature	0.67			
Coasts are particularly valuable places for supporting wildlife and ecological processes	0.64			
It is important that the coast provides opportunities for local tourism		0.81		
It is important for the local economy that coastal places provide us with resources		0.71		
It is important local coastal places are protected to ensure that our economy can benefit from nature-based tourism		0.69		
It is important that the coast provides the local community with places to interact and socialize		0.59		
It is important that people have the opportunity to live by the coast and adequate housing and services are made available to allow for these opportunities		0.58		
It is important that local parks are established in coastal areas to provide opportunities for outdoor recreation		0.58		
I feel 'at home' living near the coast			0.77	
I would miss the coast if I moved away from it			0.69	
I feel connected to the local coastal environment			0.66	
One of the things I enjoy most about living near the coast is the view of the ocean			0.43	
Local coastal areas are some of my favourite places for activities I like to do				0.68
Local coastal areas are my favourite places to spend time with friends and family				0.66
One of the things I enjoy most about local coast places is the recreational opportunities they provide				0.52
I enjoy visiting local coastal areas more than any other type of place				0.50
The relationships I have formed with friends and neighbours in this coastal place (i.e., the CRD) are stronger than relationships I have formed elsewhere				0.50

The coastal concerns analysis also resulted in the extraction of four factors (see Table 5). Factor 1 is described as ‘ecological concerns’ (M = 5.04, SD = 1.24), as it primarily relates to concerns around environmental impacts and loss of biodiversity. Factor 2 is described as ‘private opportunities concerns’ (M = 2.69, SD = 1.61) because it contains items relating to restrictions around both property development and opportunities when on a privately owned vessel. Factor 3 is described as ‘public space concerns’ (M = 4.00, SD = 1.44), as it refers to issues such as access to shoreline and conflicts between public use and protection. Similar to Factor 1, Factor 4 relates to environmental impacts; however, Factor 4 is described as ‘boating impacts concerns’ (M = 3.80, SD = 1.41), as it contains items that specifically relate to impacts from boating and activities that are commonly conducted from boats (e.g., fishing). Cronbach’s alpha for the four place concerns scales respectively were 0.87, 0.81, 0.83 and 0.73.

Table 5. Rotated factor loadings for factors extracted from coastal concerns items

	Factor			
Survey item	1	2	3	4
Declining orca populations	0.89			
Declining salmon populations	0.78			
Loss of wildlife habitat	0.68			
Declining seabird populations	0.68			
Garbage in ocean	0.61			
Loss of eelgrass	0.51			
Coastal erosion and loss of beachfront	0.49			
Garbage on beaches	0.41			
Decreased private property rights in coastal areas		0.82		
Increased restrictions on commercial shoreline development		0.67		
Limited opportunities for recreational boating		0.66		
Limited recreational fishing opportunities		0.64		
Loss of recreational opportunities on the coast			0.80	
Decreased public access to shoreline			0.67	
Loss of tourism opportunities on the coast			0.60	
Conflicts between access/use and protection of the shoreline			0.52	
Impacts from people living aboard boats				0.65
Impacts from recreational boating				0.65
Impacts from fisheries				0.49

4.6.3 Correlation between factors

Correlations among and between sense of place and coastal concerns factors were examined (see Appendix F). Cases were removed prior to running the correlation analyses to account for cases of missing data in sense of place and coastal concerns datasets. As noted in *4.6.2 Exploratory factor analyses,* cases were removed from both sense of place and coastal concerns datasets prior to factor analyses due to missing data; however, the cases of insufficient data for sense of place and coastal concerns did not pertain to the same respondents (e.g., a respondent might have provided sense of place data but not sufficient coastal concerns data). Therefore, more cases were removed prior to the correlation analysis to ensure available data in the two datasets ‘matched’ one another. This resulted in a sample of 278 cases.

Sense of place and coastal concern variables were represented through factor scores in the correlation analysis, similar to that done in previous research such as Gosling and Williams (2010) and Scannell and Gifford (2010). This differs from how the factors are represented in *4.6.2 Exploratory factor analyses*, as these were presented as means of only items that loaded on a factor in accordance with a factor loading criteria. Such an approach was useful for being able to identify the nature of a factor, as it allowed for grouping of items and consideration around the commonalities among these items; however, for the correlation analysis (and the regression analyses described below), factor scores were used to weigh response data according to an item’s relevance to a particular factor (Scannell and Gifford, 2010). Factor scores were computed using the regression method, which standardizes the mean score to zero (DiStefano et al., 2009).

Only one statistically significant correlation was observed among sense of place variables. This consisted of a positive correlation between place identity and place dependence ($\rho = 0.17$, $p = 0.01$). Analysis of coastal concerns variables also produced only significant correlation, and this consisted of a very weak negative correlation between private opportunities concerns and public space concerns ($\rho = -0.04$, $p = 0.01$).

Several statistically significant correlations were observed between the sense of place and coastal concerns variables. Nature protection values positively correlated with ecological concerns ($\rho = 0.47$, $p < 0.01$) and boating impacts concerns ($\rho = 0.2$, $p < 0.01$), and negatively correlated with private opportunities concerns ($\rho = -0.21$, $p < 0.01$). Community and economic well-being values positively correlated with private opportunities concerns ($\rho = 0.26$, $p < 0.01$)

and (more strongly) public space concerns ($\rho = 0.46$, $p < 0.01$). Place identity exhibited correlation with only one concerns variable, and this was the ecological concerns variable ($\rho = 0.26$, $p < 0.01$). Place dependence exhibited positive (but weak) correlated with all concerns - ecological concerns ($\rho = 0.14$, $p = 0.02$), private opportunities concerns ($\rho = 0.22$, $p < 0.01$), public space concerns ($\rho = 0.15$, $p = 0.01$), and boating impacts concerns ($\rho = 0.17$, $p = 0.01$).

4.6.4 Sense of place

The relationship between sense of place and visualization of place was examined through a series of binomial logistic regressions, drawing from methodology used in Cross et al. (2011). Dependent variables consisted of presence/absence of a visual element type (V_i), coding presence with 1 and absence with 0. Predictors in the regression models consisted of the sense of place variables - nature protection values (P_1), community and economic well-being values (P_2), place identity (P_3) and place dependence (P_4). Demographic factors were also added to the model, including variables comprising gender (G), age (A_1, A_2, A_3), length of residence in local coastal place (L), distance living from shoreline (D) and whether residence is in a small island (i.e., Gulf Island) community (I). Cases were removed prior to regression analysis due to missing values, and the resultant dataset consisted of 264 cases.

Equation 1. Sense of place and visualization of place logistic regression model

$$V_i = \beta_0 + \beta_1 P_1 + \beta_2 P_2 + \beta_3 P_3 + \beta_4 P_4 + \beta_5 G + \beta_6 A_1 + \beta_7 A_2 + \beta_8 A_3 + \beta_6 L + \beta_6 D + \beta_6 I$$

A syntax file was prepared using SPSS (v. 23) to run regressions for all 33 visual element types (output for all regressions is displayed in Appendix G). The output was examined to identify models that were statistically significant at an alpha of 0.05 (e.g., Cooper et al., 2015). The odds ratios within these models were examined (e.g., Cross et al., 2011) to gain insight on which dimensions of sense of place increase (OR > 1) or decrease (OR < 1) the likelihood of a particular visual element being included in a person's visualization of coastal place.

As seen in Table 6, nature protection values increased the likelihood of marine wildlife (OR = 1.82) and wildlife in general (OR = 1.51) being included in visualization of place, while decreasing the likelihood of including non-visual sensory elements, specifically temperature (OR = 0.47). A similar pattern was noticed with place identity, meaning a positive relationship was observed with marine wildlife (OR = 1.77) and negative relationship was observed with temperature (OR = 0.54). Additional relationships were observed with place identity, and these included positive relationships with small boats (OR = 2.18), marine environment elements (OR = 2.75) and ocean recreation (OR = 1.76). Only one relationship was observed with place dependence, in which it increased likelihood of including marine environment elements (OR = 1.71) in visualization of place. No statistically significant relationships were observed with community and economic values in the regression models.

Some significant relationships were observed with demographic variables. Female participants were more likely than male participants to include land recreation (OR = 1.61) and woody debris (OR = 1.77) elements in their visualization of place. People under 45 were more likely to include plants (OR = 1.32), woody debris (OR = 1.53) and algae (OR = 1.65). People aged 45 to 55 exhibited a higher likelihood of including land plants (OR = 1.38), but were less likely to include aquatic birds (OR = 0.44). Location and length of residence also demonstrated an effect on visualization of coastal places. The length of time living in a place increased likelihood of including ocean recreation elements (OR = 1.47), but decreased likelihood of non-visual temperature elements (OR = 0.36). Distance living from the shoreline increased likelihood of including marine wildlife (OR = 1.36), marine invertebrates (OR = 1.74) and algae (OR = 1.80) elements; however, likelihood of including aquatic bird elements (OR = 0.67) decreased with distance. People living in small island communities were less likely to note types of beach textures or sediment (OR = 0.68), but more likely to mention land plants (OR = 1.42) and algae elements (OR = 1.66).

Table 6. Results of logistic regressions involving sense of place and visual elements variables

Semi-standardized odds ratios
β coefficient
Standard error

Visual element (V)	χ^2	P_1	P_2	P_3	P_4	G	A_1	A_2	A_3	L	D	I
Wildlife	21.03	__1.5**__	0.96	1.28	1.16	1.13	1.11	0.99	0.99	0.80	1.09	1.14
		__0.42__	-0.04	0.29	0.17	0.24	0.43	-0.02	-0.02	-0.01	<.001	0.41
		__0.16__	0.15	0.17	0.16	0.28	0.63	0.45	0.32	0.01	<.001	0.48
Marine wildlife	27.22	__1.8**__	0.99	__1.8**__	1.15	1.04	1.19	0.98	0.90	0.95	__1.36*__	1.16
		__0.62__	-0.01	__0.66__	0.16	0.08	0.70	-0.06	-0.24	-.002	__<.01__	0.47
		__0.23__	0.15	__0.23__	0.17	0.29	0.57	0.45	0.34	0.01	__<.001__	0.46
Marine invertebrates	22.36	1.56	0.82	1.41	0.87	1.05	1.36	1.33	1.09	1.16	__1.7**__	1.33
		0.47	-0.21	0.40	-0.17	0.10	1.30	0.89	0.20	0.01	__0.001__	0.40
		0.31	0.20	0.28	0.23	0.41	0.67	0.55	0.50	0.01	__<.001__	0.71
Aquatic birds	28.80	1.58	0.97	1.29	1.04	1.23	1.12	__0.44*__	0.89	1.07	__0.67*__	0.89
		0.48	-0.04	0.30	0.06	0.42	0.47	__-2.53__	-0.25	0.003	__<.001__	-0.37
		0.25	0.17	0.23	0.19	0.32	0.62	__1.05__	0.36	0.01	__<.001__	0.51
Land plants	22.72	1.07	1.00	1.12	1.06	1.11	__1.32*__	__1.38*__	1.25	0.87	0.86	__1.42*__
		0.07	-.003	0.13	0.07	0.21	__1.14__	__0.99__	0.51	-0.01	<.001	__1.10__
		0.14	0.14	0.15	0.15	0.27	__0.57__	__0.43__	0.31	0.01	<.001	__0.46__
Small boats	25.42	1.40	1.43	__2.18*__	1.08	1.18	0.88	0.66	0.86	1.32	1.14	1.08
		0.35	0.38	__0.90__	0.09	0.33	-0.53	-1.27	-0.33	0.02	<.001	0.25
		0.26	0.21	__0.35__	0.21	0.36	0.84	0.79	0.40	0.01	<.001	0.58
Marine environment	22.24	1.64	1.00	__2.75*__	__1.71*__	0.72	0.81	0.96	1.00	1.17	0.96	0.64
		0.52	<.001	__1.17__	__0.62__	-0.65	-0.87	-0.12	-.002	0.01	<.001	-1.41
		0.33	0.22	__0.50__	__0.27__	0.42	1.12	0.65	0.46	0.01	<.001	1.07
Land recreation	20.31	1.53	1.27	0.89	1.27	__1.61*__	1.11	0.58	0.97	0.83	1.24	0.95
		0.44	0.26	-0.13	0.28	__0.95__	0.42	-1.67	-0.07	-0.01	<.001	-0.17
		0.35	0.24	0.24	0.26	__0.43__	0.70	1.07	0.45	0.01	<.001	0.70
Ocean recreation	21.90	1.19	1.23	__1.76*__	1.02	1.02	1.00	1.07	0.98	__1.47*__	1.32	0.91
		0.18	0.22	__0.65__	0.028	0.05	-0.02	0.23	-0.05	__0.02__	<.001	-0.31
		0.23	0.19	__0.29__	0.19	0.34	0.73	0.53	0.40	__0.01__	<.001	0.67
Beach texture	24.04	1.11	0.79	0.80	1.21	1.04	1.23	1.16	1.24	1.14	1.12	__0.7**__
		0.11	-0.26	-0.26	0.22	0.08	0.87	0.47	0.49	0.01	<.001	__-1.23__
		0.14	0.15	0.16	0.16	0.28	0.63	0.46	0.32	0.01	<.001	__0.45__
Woody debris	26.16	1.47	1.18	1.41	0.91	__1.8*__	__1.53*__	__1.50*__	0.91	1.30	1.16	0.70
		0.40	0.17	0.39	-0.10	__1.14__	__1.73__	__1.25__	-0.23	0.01	<.001	-1.13
		0.37	0.23	0.31	0.24	__0.45__	__1.25__	__0.57__	0.54	0.01	<.001	1.10
Algae	29.24	1.37	1.03	1.24	1.49	1.15	__1.65*__	1.28	0.91	1.24	__1.8**__	__1.66*__
		0.33	0.03	0.25	0.46	0.27	__2.03__	0.76	-0.23	0.01	__0.001__	__1.60__
		0.34	0.24	0.46	0.29	0.46	__0.69__	0.65	0.59	0.01	<.001	__0.67__
Temperature	28.16	__0.5**__	0.73	__0.54*__	0.60	1.72	1.02	0.79	0.69	__0.36*__	0.68	0.002
		__-0.80__	-0.34	__-0.71__	-0.58	1.09	0.07	-0.75	-0.83	__-0.05__	<.001	<-10
		__0.27__	0.36	__0.33__	0.37	0.78	1.26	1.26	0.94	__0.03__	<.001	>10

Semi-standardized odds ratios (Menard, 2004), unstandardized β coefficients, and standard errors are displayed on different lines for each variable. Statistically significant coefficients are identified with asterisks (one for $p < 0.05$ and two for $p < 0.01$). The gender variable was coded as 0 for male and 1 for female. Age variables were dummy coded with A_1 representing under 45, A_2 representing 45 to 54, and A_3 representing 55 to 65. The over 65 group served as the reference category. Length of time residing in the local area was measured in years, and distance from the coast was measured in metres. Residence in a small island community variable was coded as 1 for those living on small islands and 0 otherwise.

The study only comments on regressions that were found to be statistically significant within the defined model structure, as this is in line with previous research (e.g., Cooper et al., 2015) and also provides a reasonable scope for analysis. However, it is worth noting that some coefficients were found to be significant albeit the overall model was not, and stepwise regressions would result in finding new significant models and coefficients (in this case, using a backward elimination approach). For example, the V_{people} model was not found to be significant at $\alpha = 0.05$ ($\chi^2 = 18.61$, $p = 0.07$), but the place dependence coefficient was significant and positively associated with people visual elements (OR = 1.60, $p = 0.01$). Future work might wish to take an approach where models are refined to generate more insights on the relationships, but this is out the scope of the current study.

4.6.5 Coastal concerns

Regressions were also conducted between concerns for coastal places and visualization of place. The model assumed a similar format to that of Equation 1, with the only differences being that ecological concerns (C_1), private opportunities concerns (C_2), public space concerns (C_3) and boating impacts concerns (C_4) were included, but sense of place variables were not[15]. As done with sense of place, the concerns models were run for all 33 visual element types using an SPSS (v. 23) syntax file (output for all regressions is displayed in Appendix F), and statistically significant models were examined (see Table 7). Fewer models were found to be statistically significant in the concerns analyses than in the sense of place analyses, and (unlike sense of place) no evidence was found for statistically significant coastal concerns regressions that feature land recreation, beach texture and temperature elements as dependent variables.

Equation 2. Concerns for coastal place and visualization of place logistic regression model

$$VEC_i = \beta_0 + \beta_1 C_1 + \beta_2 C_2 + \beta_3 C_3 + \beta_4 C_4 + \beta_5 G + \beta_6 A_1 + \beta_7 A_2 + \beta_8 A_3 + \beta_6 L + \beta_6 D + \beta_6 I$$

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[15] Coastal concerns and sense of place variables were not included in the same model to reduce multicollinearity effects.

Similar to nature protection values, ecological concerns increased the likelihood of including marine wildlife (OR = 2.05) and wildlife in general (OR = 1.73) in visualization of place. Ecological concerns also held a positive relationship with small boats (OR = 1.59) and marine environment (OR = 2.58) elements. Only one other concerns dimension exhibited a statistically significant relationship, and this was concerns around boating impacts, which held a negative relationship with ocean recreation elements (OR = 0.70).

Demographic variables displayed similar relationships to visual elements in the concerns regressions as they did in the sense of place regressions. Female participants were more likely to include woody debris elements (OR = 1.93), people under 45 were more likely to include algae (OR = 1.70) and woody debris (OR = 1.52), and people aged 45 to 54 had a higher likelihood of including land plants (OR = 1.38) but were less likely to include aquatic birds (OR = 0.47). Location and length of residence variables in coastal concern models also exhibited a similar pattern to that of the sense of place models. Length of time living in a place increased likelihood of including ocean recreation elements (OR = 1.62). Distance from shoreline increased inclusion of marine invertebrates (OR = 1.58) and algae (OR = 1.71), but decreased aquatic birds (OR = 0.67). Furthermore, similar to sense of place, coastal concerns models showed that people living in small island communities were more likely to include land plant (OR = 1.39) and algae (OR = 1.67) elements in there visualization of place.

A few differences were observed between coastal concerns and sense of place models. In the concerns models, age group 45 to 54 were more likely to include marine invertebrate elements (OR = 1.45) and length of residency positively correlated with inclusion of small boats; whereas, neither of these relationships were observed as significant with sense of place. Conversely, as noted in *4.6.4 Sense of place*, sense of place regressions produced significant relationships involving the under 45 age group and land plants and also the distance from shoreline variable and marine wildlife elements; whereas, these relationships were not found to be significant in coastal concerns regressions.

Table 7. Results of logistic regressions involving coastal concerns and visual elements variables

		Semi-standardized odds ratios β coefficient Standard error										
Visual element (V)	χ^2	C_1	C_2	C_3	C_4	G	A_1	A_2	A_3	L	D	I
Wildlife	25.03	__1.7**__	1.07	0.97	1.20	1.03	1.08	1.04	0.97	0.85	1.10	1.19
		__0.59__	0.08	-0.03	0.21	0.11	0.31	0.11	-0.06	-0.01	<.001	0.542
		__0.16__	0.16	0.16	0.17	0.29	0.65	0.46	0.33	0.01	<.001	0.50
Marine wildlife	27.15	__2.1**__	0.97	0.98	1.19	0.95	1.15	1.05	0.91	1.09	1.31	1.18
		__0.76__	-0.03	-0.02	0.20	-0.10	0.58	0.17	-0.21	0.004	<.001	0.51
		__0.20__	0.15	0.16	0.18	0.30	0.57	0.44	0.34	0.01	<.001	0.48
Marine invertebrates	22.92	1.57	0.82	1.06	1.38	0.91	1.40	__1.45*__	1.10	1.28	__1.58*__	1.19
		0.48	-0.23	0.06	0.38	-0.19	1.36	__1.16__	0.22	0.01	__<.001__	0.54
		0.27	0.23	0.23	0.26	0.42	1.16	__0.55__	0.50	0.01	__<.001__	0.73
Aquatic birds	28.63	1.45	0.91	1.05	1.25	1.15	1.14	__0.47*__	0.91	1.15	__0.64*__	0.92
		0.40	-0.10	0.05	0.26	0.27	0.54	__-2.35__	-0.21	0.01	__<.001__	-0.27
		0.21	0.17	0.18	0.20	0.34	0.64	__1.05__	0.36	0.01	__<.001__	0.52
Land plants	21.94	1.04	1.09	0.99	0.96	1.15	1.31	__1.38*__	1.24	0.88	0.86	__1.39*__
		0.04	0.09	-0.01	-0.05	0.28	1.09	__1.00__	0.49	-0.01	<.001	__1.04__
		0.15	0.15	0.15	0.16	0.28	0.58	__0.43__	0.31	0.01	<.001	__0.46__
Small boats	19.91	__1.59*__	1.10	0.95	0.73	1.29	0.81	0.65	0.86	__1.52*__	1.18	0.99
		__0.50__	0.11	-0.05	-0.37	0.51	-0.85	-1.33	-0.35	__0.02__	<.001	-0.02
		__0.23__	0.19	0.20	0.22	0.37	0.84	0.79	0.40	__0.01__	<.001	0.59
Marine environment	21.78	__2.6**__	0.84	1.35	1.45	0.66	0.87	1.06	1.06	1.38	0.86	0.70
		__1.01__	-0.19	0.34	0.43	-0.82	-0.54	0.18	0.13	0.02	<.001	-1.14
		__0.36__	0.34	0.24	0.28	0.43	1.13	0.64	0.48	0.01	<.001	1.09
Ocean recreation	19.95	1.18	0.81	0.99	__0.70*__	1.14	0.93	1.05	0.95	__1.6**__	1.33	0.81
		0.17	-0.23	-0.02	__-0.41__	0.26	-0.29	0.14	-0.12	__0.03__	<.001	-0.67
		0.19	0.19	0.19	__0.21__	0.35	0.75	0.52	0.40	__0.01__	<.001	0.68
Woody debris	30.58	1.12	0.66	1.36	0.74	__1.9**__	__1.52*__	__1.55*__	0.89	1.44	1.05	0.65
		0.12	-0.45	0.34	-0.35	__1.32__	__1.70__	__1.37__	-0.26	0.02	<.001	-1.38
		0.25	0.25	0.24	0.27	__0.47__	__0.75__	__0.57__	0.55	0.01	<.001	1.13
Algae	24.78	1.06	1.10	1.01	1.17	1.24	__1.7**__	1.34	0.95	1.25	__1.80*__	__1.67*__
		0.06	0.11	0.01	0.18	0.43	__2.16__	0.91	-0.12	0.01	__0.001__	__1.62__
		0.25	0.24	0.26	0.28	0.47	__0.72__	0.63	0.59	0.01	__<.001__	__0.68__

Results are organized in the same manner as Table 6 with semi-standardized odds ratios, unstandardized β coefficients, and standard errors displayed on different lines for each variable.

4.6.6 Location and orientation of mental imagery

Binomial logistic regressions were also conducted on responses to questions around whether people pictured themselves within their visualization of place (see Table 8). When regressing these responses on sense of place and coastal concern predictors, neither model was statistically significant. However, relationships were discovered when further examining the responses of the people that indicated that they were present in their mental image and then classifying the positions where these people located/imagined themselves. Nature protection values negatively correlated with people noting they pictured themselves on private property (OR = 0.46) and positively correlated with people noting they are looking seaward in their image (OR = 1.43). In addition, likelihood of people envisioning themselves on a boat in their mental image increased with place dependence (OR = 2.17).

Demographic variables also exhibited relationships with the position people placed themselves within visualization of coastal place. A higher tendency to imagine oneself looking seaward was found with female respondents in both models (sense of place: OR = 1.41, coastal concerns: OR = 1.47) and with people under 45 in the sense of place model (OR = 1.35). In addition, a negative relationship was found between distance residing from shoreline and tendency to imagine oneself on private property in both models (sense of place: OR = 0.22, coastal concerns: OR = 0.22).

Regressions were also conducted on responses to questions around whether people pictured a specific real-world location; however, only the sense of place model exhibited statistically significance. Within this model, place identity was found to increase likelihood of picturing a specific location (OR = 1.40), and distance living from coast decreased this tendency (OR = 0.69).

Table 8. Logistic regressions on environment and orientation of people's images of coastal place

Semi-standardized odds ratios
β coefficient
Standard error

	χ^2	P_1/C_1	P_2/C_2	P_3/C_3	P_4/C_4	G	A_1	A_2	A_3	L	D	I
Sense of place models												
On private property	34.49	**0.5****	0.88	1.15	0.69	1.79	0.01	0.003	0.57	0.58	**0.22***	1.04
		-0.82	-0.14	0.16	-0.43	1.17	< -10	< -10	-1.26	-0.03	**-.001**	0.12
		0.24	0.27	0.35	0.34	0.71	>10	>10	0.84	0.02	**0.001**	0.73
On a boat	21.52	0.72	1.18	1.05	**2.17***	0.76	1.22	0.003	1.34	1.23	0.74	0.92
		-0.34	0.18	0.05	**0.89**	-0.56	0.80	< -10	0.66	0.01	<.001	-0.28
		0.23	0.31	0.31	**0.36**	0.53	0.91	>10	0.53	0.01	<.001	0.83
Facing ocean	25.89	**1.43***	1.07	0.97	1.02	**1.41***	**1.35***	1.01	1.16	1.04	1.18	0.85
		0.37	0.08	-0.04	0.02	**0.69**	**1.22**	0.02	0.34	0.002	<.001	-0.50
		0.18	0.14	0.16	0.16	**0.27**	**0.59**	0.43	0.31	0.01	<.001	0.46
Real-world place	21.06	1.01	1.23	**1.40***	1.33	0.96	1.36	1.06	1.14	1.24	**0.69***	1.04
		0.01	0.22	**0.39**	0.33	-0.08	1.26	0.17	0.30	0.01	**<.001**	0.12
		0.16	0.17	**0.17**	0.18	0.33	0.82	0.49	0.39	0.01	**<.001**	0.54
Coastal concerns models												
On private property	27.31	0.54	1.38	0.73	1.04	1.76	0.01	0.003	0.74	0.53	**0.22***	1.00
		-0.65	0.36	-0.36	0.05	1.13	< -10	< -10	-0.69	-0.03	**-.001**	<.001
		0.36	0.33	0.35	0.35	0.73	>10	>10	0.72	0.02	**0.001**	<.001
Facing ocean	23.81	1.14	0.93	1.23	0.90	**1.5****	1.33	1.04	1.13	1.06	1.15	0.84
		0.14	-0.08	0.23	-0.12	**0.78**	1.17	0.13	0.28	0.003	<.001	-0.57
		0.15	0.15	0.16	0.17	**0.28**	0.61	0.43	0.31	0.01	<.001	0.47

P_i/C_i headings refer to either a P_i variable in the case of the sense of place models, or C_i variable in the case of the coastal concerns models. Results are organized in the same manner as Table 6 and 7 with semi-standardized odds ratios, unstandardized β coefficients, and standard errors displayed on different lines for each variable.

4.7 Discussion

The first objective of this study was achieved, as a relationship between sense of place and a person's mental visualization of place was observed. The presence of this relationship is supported by the fact that certain regression models resulted in intuitive (or expected) associations between variables, as this indicates that the findings produced from this novel methodology conceptually 'make sense'. For example, nature protection values increased likelihood of including wildlife elements within visualization of place, which is to be expected as wildlife is a conspicuous component of the natural world. In addition, ecological concerns were positively correlated to nature protection values, and they also led to inclusion of wildlife elements. These intuitive relationships are perhaps ‘less interesting’ in terms of understanding how sense of place influences visualization of place; however, they are important ‘confirmatory’ findings, which demonstrate that this novel application of methodology is effectively exhibiting an underlying relationship between sensing and visualizing places.

Given that a relationship between sense of place and visualization of place was observed, the study’s second objective was pursued, consisting of an exploration of the nuances within the relationship and their implications for building geovisualizations. Of particular interest are insights around which visual elements appear significant to certain groups or mindsets, as these can inform where attention should be given when building realistic geovisualizations. As noted by Newell and Canessa (2015, 25) “[r]eal-world environments are highly complex” and “[b]uilders of geovisualizations cannot feasibly capture all the elements and features found within a real-world environment; therefore, these builders need to be selective in what they include”. Studies such as the work done here can help inform what elements are essential inclusions and require attention, particularly when thinking about whether proposed scenarios hold implications for these elements. For example, place identity promoted inclusion of marine wildlife elements, but unlike nature protection values, it did not exhibit a significant relationship with the broader (i.e., ‘general’) wildlife visual element grouping. This suggests that place identity is more specific than nature protection values in how it stimulates visualization of wildlife, and it particularly focuses on ocean animals[16]. Accordingly, coastal geovisualization developers should recognize the importance of the general inclusion of wildlife when working with nature-conscious groups (e.g., environmental NGOs); however, they should also understand the particular significance of marine life elements when collaborating with stakeholders of high place identity, especially when featuring scenarios that might affect these species.

The purpose of the above discussion is to ensure that potential impacts to key visual elements that relate to place-based values are accurately shown, that is, to avoid misleading stakeholders by omission. However, it is also important to recognize that misleading can occur

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[16] Such a notion is further supported with the observation that place identity positively associated with the marine environment visual element grouping, which included codes such as ‘fish’ and ‘sea life’.

through exaggerating or highlighting impacts in a visualization in a deliberate attempt to evoke emotional responses (Shaw et al., 2009). To avoid such misuse, Sheppard (2001) proposed principles for developing visualizations, one such principle being that they are accurate in terms of actual or expected appearances of places. Given that modelling with complete accuracy (i.e., including everything) is not feasible, the aim here is to ensure (as much as possible) that potential impacts to valued place features are displayed accurately to avoid minimizing or omitting significant consequences associated with enacting a management or development plan. However, it also important to identify key visual elements that speak to place values in order to avoid inaccurately representing or exaggerating impacts to these elements in a manner that unduly evokes emotional responses and sways opinions.

In addition to providing insights on key visual elements, the findings also elucidate how different place relationships can influence perspectives taken in a visualization of place. Sense of place can be textured by the ways in which people interact with their environment and the activities they perform there (Shackeroff et al., 2009), and in the context of coastal places, this can include interactions with marine areas as well as terrestrial (e.g., Moskwa, 2012). The ‘texturing’ translates to forming different visual relationships with the coast and experiencing coastal elements from different perspectives (Newell and Canessa, 2017). In this study, both place identity and place dependence exhibited positive relationships with marine environment elements, which comprised primarily of items coded as ‘fish’ and ‘sea life’. This finding was complemented with observations of place identity also increasing likelihood of small boat and ocean recreation elements, as such elements relate to activities in where humans might interact with marine life. Contrastingly, place dependence did not exhibit a relationship with any other visual element type; however, it did greatly increase the likelihood of visualizing coastal places from the perspective of one positioned on a boat. This suggests that although both place identity and place dependence might lead to the visualizing of marine elements, these visualizations coalesce from different ‘angles’. Place identity promotes mental pictures that take the form of scenes where activities and elements that ‘belong’ (i.e., align with place meanings) can be viewed from various points within the scene. Such a notion is consistent with other research that has found certain activities commonly performed within community to form the basis of local place meanings and identities (e.g., Panelli et al., 2008; Urquhart and Acott, 2014). In contrast, place dependence does not appear to be contributing to this type of ‘scene perspective’; rather, it increases tendency for one to position him- or herself on a boat within the activity. This is consistent with the nature of place dependence as it relates to one's functional relationship with place and is often framed in terms of recreational activities (Kyle et al., 2004; Lee, 2011; Williams and Roggenbuck, 1989). Ultimately, what these findings illustrate is people's visual relationship with place can take different perspectives, and accordingly, geovisualizations should be equipped with the ability to experience them from multiple perspectives to adequately speak to people with different place relationships.

The example above illustrates how various place relationships can lead to different visual perspectives, and in some cases, these differences might allude to or be reflective of potential user conflicts. This was particularly the case when examining nature protection values and mental visualizations that included private property. In a study of cultural models associated coastal places, Thompson (2007) described a sovereignty model, in which coastal values are heavily associated with personally owned property, and he noted that this culture can potentially conflict with models focused more on ecological values (i.e., ecological model). Thompson (2007), and later Stocker and Kennedy (2009), explained that these conflicts can arise due to potential impacts private property development can have on ecosystems. The current study found evidence of a potential sovereignty culture existing within the surveyed population, as some respondents identified their visualized perspective as to be from private property[17]. Coinciding with the sovereignty-ecological conflict described above, the nature protection values sense of place dimension negatively associated with the tendency to visualize the coast from a private property vantage point. If this observation is indeed reflective of the sovereignty-ecological conflict, it further supports the notion that geovisualizations should be developed in a manner that allows for multiple points-of-view (e.g., the ability to experience from within and outside of property) in order to include diverse perspectives and allow differences (and potential conflicts) to be brought to the forefront in collaborative planning sessions.

In addition to generating new insights, the analyses also served to challenge hypotheses around relationships between sense of place and visualization of place, thereby improving understanding on how geovisualizations operate among diverse groups of people. For example, the authors expected that place identity would exhibit a significant relationship with viewshed

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[17] This tendency held a strong negative correlation with distance living from the coast (OR=0.22, p=0.03), further supporting the notion that this group consists of seaside property owners.

elements; however, this was not the case. Devine-Wright and Howes (2010) noted that the view of the ocean can form an integral component of local place attachment, and in line with this thinking, the survey item, “One of the things I enjoy most about living near the coast is the view of the ocean”, was found to be associated with the place identity factor[18]. Therefore, a reasonable hypothesis would be that place identity promotes visualization of viewshed elements, but contrarily, place identity did not appear to increase this tendency or promote mental images of place that assume a ‘looking toward the ocean’ perspective. A potential explanation for this lack of relationship presents itself when noting that survey respondents identified a diversity of viewshed elements (e.g., mountains across water, islands in the distance, sunrise, etc.) and these elements were present in a range of mental pictures of coastal places (i.e., coded in over two fifths of survey responses). These observations indicate that ‘views’ (as components of visualizations) can be composed of a large variety of elements and thusly can speak to a range of place relationships. The implications for geovisualization are that user responses to modelled viewshed components are likely not based one particular aspect of their sense of place, and scenarios that affect these components could elicit responses from a variety of people with different relationships to place.

As aforementioned, coastal concerns were hypothesized to be a potentially viable route for analysis (see *4.4 Sense of place and visualization of place*); however, the concerns regressions resulted in less insights than the sense of place analysis. Concerns regressions consequently did not serve well as an alternative analysis, but were somewhat useful as a complementary piece. For example, boating impact concerns exhibited a negative relationship with ocean recreation elements, which is a relationship that was not observed with any of the sense of place dimensions. Therefore, albeit sense of place is comprised of eco-centric dimensions (i.e., nature protection values), it is perhaps too broad to capture feelings toward specific environmental issues (and the related visual elements); whereas, a concerns analysis can uncover some of these nuances.

Places are shaped by our interactions with and activities within an environment, and thus they can be considered fundamentally a function of ‘lived’ experiences (Cresswell, 2009). In concert with this line of thought, the current study found that location and length of residency

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[18] It is important to note that this item was the lowest loading item in the place identity factor, and thus might not be highly representative of the sense of place dimension.

influenced how people visualize place. A person has more opportunity to engage in local activities the longer they reside in a place, and this study found that such activities can shape visualization of place. For example, length of residency increased likelihood of one including ocean recreation elements in his or her image of coastal place. In a similar vein, one's access to a place is (in part) dependent on how near one resides to the locality, and this proximity also appeared to influence visualization of place within this study. For example, the tendency to include aquatic birds decreased with distance living from the shoreline, suggesting that living nearer to the ocean increases interaction with and salience of these species. These findings bring to light the importance of recognizing that people's day-to-day experiences influence how they visualize the coast, and in terms geovisualization, some visual elements might be more significant to particular users, depending on the location and length of time they have lived within an area.

Some respondents identified non-visual elements in their imaginings of place, which reflects how sense of place can be influenced by a wide range of sensory inputs, including smells, sounds, temperatures, etc. (Tuan, 1975). Such an observation is significant to this research because (as the name suggests) geovisualizations are primarily visual tools, and it is important to understand the limitations of reaching people solely through visual stimuli. This being said, the current study produced relatively few insights around non-visual senses, as only two relationships were observed and these were both negative, i.e., nature protection values and place identity decreased likelihood of respondents commenting on temperature. In the case of former, it is possible that nature protection values are inherently visual in the way that they bring to mind a multitude of ecosystem elements that can be experienced through sight (i.e., plants, animals, habitat, etc.). In the case of the latter, place identity also increased tendency to visualize specific coastal places, and these might be places that respondents have experienced frequently in a variety of weathers and temperatures, which would reduce likelihood of identifying either 'warm' or 'cold' as a particular element of place. However, these interpretations are speculative and require further research to validate.

Although the only statistically significant non-visual element regressions were negative (i.e., nature protection: OR = 0.47; place identity: OR = 0.54), it is important to recognize that ultimately almost a fifth of respondents brought forward non-visual elements when specifically asked to note what they 'visualize' in their 'mental pictures' of coastal places. The fact that such visually-oriented terminology was employed in the survey instructions yet a fair number of respondents included items such as sounds, smells and temperatures is a strong indication that people relate to place through senses beyond solely the visual. This suggests that future geovisualization research should explore tools that interact with senses beyond just sight, and work has already been done in this area, such as with Bishop and Stock's (2010) interactive landscape visualization that allows user to locate windmills by direction of sound. Therefore, albeit this study did not observe any positive relationships between sense of place dimensions and non-visual elements, this is still an area of interest and should be explored further to better understand how to develop place-based tools that can effectively engage users through multiple senses.

4.8 Conclusion

Appleton et al. (2002, 147) noted that "reality will always exceed our ability to simulate it", meaning that the world is far too complex to model in its entirety. Consequently, when developing realistic geovisualizations, there are limitations in the number and types of elements that can be included and judgments need to be made around what is excluded. By understanding geovisualizations as tools that interact with people's sense of place, we can engage in studies that can guide these judgements by generating insight on key visual elements and perspectives that speak to different stakeholders. In many ways, this study serves as an invitation for sense of place scholars to collaborate with geovisualization researchers to develop better understanding of the 'human' aspects of these tools. This work purposely employed research methods commonly used by environmental psychologists and human geographers that study sense of place in order to illustrate how to bridge disciplines and conduct geovisualization research in the context of place theory. The intention of this approach is to encourage future researchers to build upon this work and methodology in order to advance an integrated research agenda. It is through such interdisciplinary approaches that we will be able to develop effective tools for managing our resources in a manner that is socially and culturally conscious, as well as environmentally and economically sound.

Chapter 5

Modelling both the space and place of coastal environments: Exploring an approach for developing realistic geovisualizations of coastal places[19]

Abstract

Effective coastal planning incorporates the variety of user needs, values and interests associated with coastal environments. This requires understanding how people relate to coastal environments as ‘places’, imbued with values and meanings, and accordingly, tools that can capture place and connect with people’s ‘sense of place’ have the potential for supporting effective coastal management strategies. Realistic, immersive geographical visualizations, i.e., geovisualizations, theoretically hold potential to serve such a role in coastal planning; however, significant research gaps exist around this application context. Firstly, place theory and geovisualizations are rarely explicitly linked in the same studies, leaving questions around how to model ‘coastal place’, as well as coastal space. Secondly, geovisualization work has focused on terrestrial environments, and research on how to realistically model coastal places is currently in its infancy. The current study addresses the research gaps by developing a coastal geovisualization under place-based considerations, and then examining its capacity as a tool for connecting with people’s sense of place. The research uses Sidney Spit in the Gulf Islands National Park Reserve (BC, Canada) as a study site, and a geovisualization was developed using a combination of ArcGIS, Adobe Photoshop, Trimble SketchUp, and Unity3D. Focus groups were assembled involving Parks Canada staff and residents of the Capital Regional District (BC, Canada), and the geovisualization was assessed in terms of its representation of a real-world coastal place and ability for connecting with sense of place. Findings from the study indicate that the presence of certain elements in coastal geovisualizations can contribute to realism and sense of place, such as people, dogs, birds, marine life, vegetation and boats; however, deficiencies in numbers and varieties of these elements can detract from realism and sense of place. In addition, incorporation of soundscape and viewshed elements both demonstrated to be significant to the tool’s ability to connect with sense of place, with the latter potentially being more significant among those with higher familiarity with the real-world place. Beach textures were also found to be important for the geovisualization’s ability to connect with sense of place; however, this ability can be compromised when running versions of the tool with lower graphical resolution.

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[19] This chapter was also published as:

> Newell, R., Canessa, R., & Sharma, T. (2017). Modelling both the space and place of coastal environments: Exploring an approach for developing realistic geovisualizations of coastal places. *Frontiers in Marine Science* 4, 87. doi: 10.3389/fmars.2017.00087

5.1 Introduction

Effective coastal planning and management is socially inclusive and recognizes the variety of user needs, values and interests associated with coastal environments (Bowen and Riley, 2003; Cicin-Sain and Belfiore, 2005). This requires understanding how people relate to coastal environments as 'places', layered with values and identities, rather than solely through its biophysical properties (Shackeroff et al., 2009; Poe et al., 2014). Accordingly, tools and techniques that can capture place and connect with people's 'sense of place', i.e., the meanings, values, beliefs and/or feelings people associate with places (Williams and Stewart, 1998), are integral for supporting effective coastal management strategies. Newell and Canessa (2015) posit that realistic, immersive geographical visualizations, i.e., geovisualizations, can serve such a role and act as place-based tools in inclusive approaches to management and planning. Due to their realism, geovisualizations can communicate outcomes of potential management strategies (or consequences of not enacting strategies) in a 'relatable' fashion, meaning that they provide people with salient understandings of how they would feel about outcomes/impacts if transpired in real-world places (Sheppard, 2001). Because they have this capacity, visualizations have shown promise for functions such as effectively communicating potential outcomes of resource management options with local communities (Lewis and Sheppard, 2006), providing community members with salient understanding of importance of and options around climate adaptation planning (Schroth et al., 2009; Shaw et al., 2009; , Sheppard et al., 2011), and stimulating discussion among stakeholders regarding future land-uses in the face of changing landscape conditions (Schroth et al., 2011).

Newell and Canessa (2015) argue that the utility of geovisualizations in collaborative planning stems from their ability to connect with people's sense of place, allowing them to serve as tools for gaining valuable insight on local people-place relationships and facilitating planning efforts that effectively recognize these relationships. By connecting with people's sense of place, geovisualizations can stimulate different stakeholders' thoughts and concerns associated with the place-based relationships they have formed with areas targeted for management or development, thereby providing a means for elucidating the socio-cultural realities, concerns and needs associated with these areas and enabling productive planning discussions (Newell and Canessa, 2015). This perspective on geovisualizations (i.e., as place-based tools) positions them as powerful tools for coastal planning efforts; however, it is important to recognize that aside from the literature review-based works of Newell and Canessa (2015) and Newell and Canessa (2017), place theory/concepts and geovisualizations have rarely been explicitly linked and explored in the same studies. Therefore, pursuing this line of thinking requires further (applied) research around the considerations and challenges associated with how to 'model place' as well as space. For example, Sheppard (2001) noted the importance of developing realistic visualizations with accuracy and minimal bias; however, while such criteria can be addressed when using primarily spatial approaches, engaging in place-based work presents complications. Place comprises subjective geography (Bott et al., 2003) that is shaped by our lived experiences (Stedman, 2003; Gunderson and Watson, 2007); therefore, the modelling process is inherently subjected to the architect's place-based experiences and biases. In addition, the relationships people form with places are influenced by a multitude of social, economic, cultural and environmental factors and (thus) can vary from person-to-person (Vorkinn and Riese, 2001); therefore, ambiguities arise around what is an 'accurate' depiction of place. Furthermore, sense of place is influenced by a range of sensory inputs, such as sound, smell, temperature, etc. (Tuan, 1975), which brings forward considerations around modelling the multisensory nature of places. However, as suggested by the name, the majority work on geovisualizations focuses primarily on the visual sense (Lindquist and Lange, 2014), while research on multisensory tools comprises a newer, evolving field[20].

Research that examines geovisualizations as place-based tools can greatly increase understanding around how to develop these tools for coastal planning; however, this line of inquiry faces a second major challenge, specifically surrounding the environmental context. Most geovisualization work has focused on terrestrial environments, and research on the coastal and marine contexts is currently in its infancy. Effective coastal management requires cognizance that coasts are comprised of interconnected marine and terrestrial environments (Cicin-Sain, 1993; Sorensen, 1997; Garriga and Losada, 2010); thus, coastal geovisualizations need to capture the continuum from land to sea. In addition, coasts are inherently dynamic (Jentoft and Chuenpagdee, 2009; Hofmeester et al., 2012), and while many terrestrial

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[20] Recent studies that have examined multisensory tools include research on incorporating sound into visualizations of a public walkway (Echevarria Sanchez et al., 2017), a park within an urban area (Lindquist and Lange, 2016), and wind farms (Manyoky et al., 2016; Yu et al., 2017).

visualizations consist of static images (e.g., Tress and Tress, 2003; Lewis and Sheppard, 2006; Schroth et al., 2011) or scenes (e.g., Salter et al., 2009; Smith et al., 2012), such formats would be inadequate for capturing the nature of coastal places. In light of these considerations, Newell and Canessa (2017) recommended that coastal geovisualizations be built with navigability (in order to move across the land-sea interface) and four-dimensional properties (to convey dynamism); however, their research was purely review-based and applied research is needed to better understand how to model such complex and dynamic places.

The current study addresses the aforementioned research gaps by firstly, developing a coastal geovisualization under place-based considerations, and secondly, examining its capacity as a tool for connecting with people's sense of place. The former activity involved selecting a coastal park in western Canada as a case study, where field data were collected and used to build a realistic dynamic geovisualization that can be navigated through the first-person perspective. The latter was done through focus group methodology, which involved participants evaluating the geovisualization in terms of how well it represents a real-world coastal place, thereby elucidating both how well the tool aligns with their sense of place and what aspects and/or potential place-based biases of the architect (i.e., researcher) might have affected this alignment. The current study is part of greater research project that investigates how geovisualizations can be used as place-based tools for collaborative coastal planning and the focus groups also used the tool to explore different management scenarios; however, this aspect of the research is not documented here and will be presented in other works[21].

5.2 Methods

5.2.1 Study area

The geovisualization in this study models the Sidney Spit area of the Gulf Islands National Park Reserve (GINPR) in British Columbia (BC), Canada. Sidney Spit comprises the northern most portion of Sidney Island and is located approximately 4 km east of the municipality of Sidney (see Figure 12a). The park contains a spit that projects 1.8 km northward (known as Long Spit) and is contiguous with hook-shaped spit (known as Hook Spit) that forms the border of a lagoon. The modelling in this work focuses on the Long Spit, and most of the geovisualization detail

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[21] The scenario assessment portion of the research is presented through Chapter 6 of this dissertation.

captures the area from the main dock at the southern end of the spit to the northern end (see Figure 12b).

Sidney Island contains critical habitat for variety of bird species and marine life, and the northern part of the island and adjacent waters were established as the Sidney Spit Provincial Marine Park in 1961 (Maurer, 1989). In 2003, this area became incorporated within GINPR, and current uses of the space consist primarily of recreational activities such as camping and walking (Parks Canada, 2012). The island is accessible by private boat or by a seasonal ferry, which typically runs from late-May to early-September (Parks Canada, 2012). Marine areas around the island are used by boaters, and some fishing activities are permitted in these spaces (e.g., Fisheries and Oceans Canada, 2014).

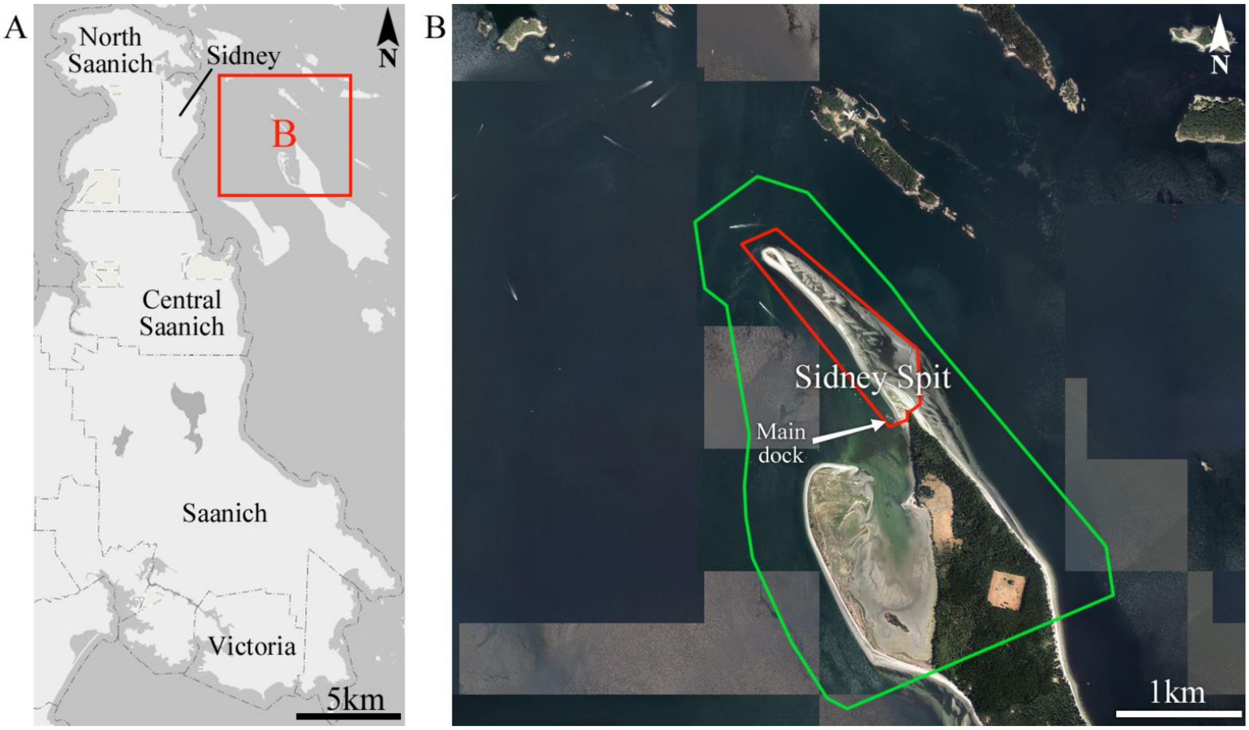

Figure 12. Map of Sidney Spit and surrounding area

Base maps were retrieved from the Capital Regional District Regional Map system. Figure 12a features a map of municipalities near Sidney Island, and Figure 12b features a map of Sidney Spit Park. In Figure 12b, park boundaries are displayed in green, and the area where geovisualization modelling was focused is highlighted with red line.

5.2.2 Geovisualization

The geovisualization was built using a combination of data retrieved from Parks Canada and collected through fieldwork. Fieldwork was conducted over 16 days, and field data captured different aspects of the parks such as types and locations of various beach sediment, positions of shoreline at different tidal levels, positions of different viewshed features, and numbers and locations of people, wildlife, plants and objects. The nature of field data varied depending on the item modelled; however, it primarily consisted of photographs collected using Canon T2i camera and spatial data collected using a Garmin eTrex 20 GPS device.

It is important to note that sense of place can be influenced by environmental conditions, which can vary depending on the time of year, e.g., changes in weather and temperature (Campelo et al., 2014). Therefore, when developing a realistic depiction of a place, decisions need to be made around what conditions will serve as the 'benchmark' for the simulation (O'Neill et al., 2005) and fieldwork needs to be planned accordingly. In the case of this study, the majority of the data were collected from late-July to early-September. This was deemed to be an appropriate benchmark because the geovisualization was designed as a tool for inclusive management and many visitors will access the park during the summer months when the seasonal ferry is running (see *5.2.1 Study area*).

Building the geovisualization involved a combination of ArcGIS (v10.3.1), Unity3D (v5.3.4), Adobe Photoshop (CS5), and Trimble SketchUp (pro 2015). ArcGIS allows for processing and organizing spatial data in order to ensure the geovisualization was built with spatial integrity. Unity is a gaming engine that was used to build the geovisualization and export the final product. Being a gaming engine, Unity allowed for a geovisualization that is dynamic and navigable, as recommended by Newell and Canessa (2017). In addition, the geovisualization was developed to be experienced from the egocentric or first-person perspective to create a sense of being 'on the ground' (Orland et al., 2001), and Unity is a powerful platform for developing such an experience. Photoshop and SketchUp were used to develop (respectively) textures and objects. Photoshop also served as an intermediate between ArcGIS and Unity, meaning maps created in ArcMap were exported to and arranged in Photoshop before importing into Unity in order to align them properly within the gaming engine environment.

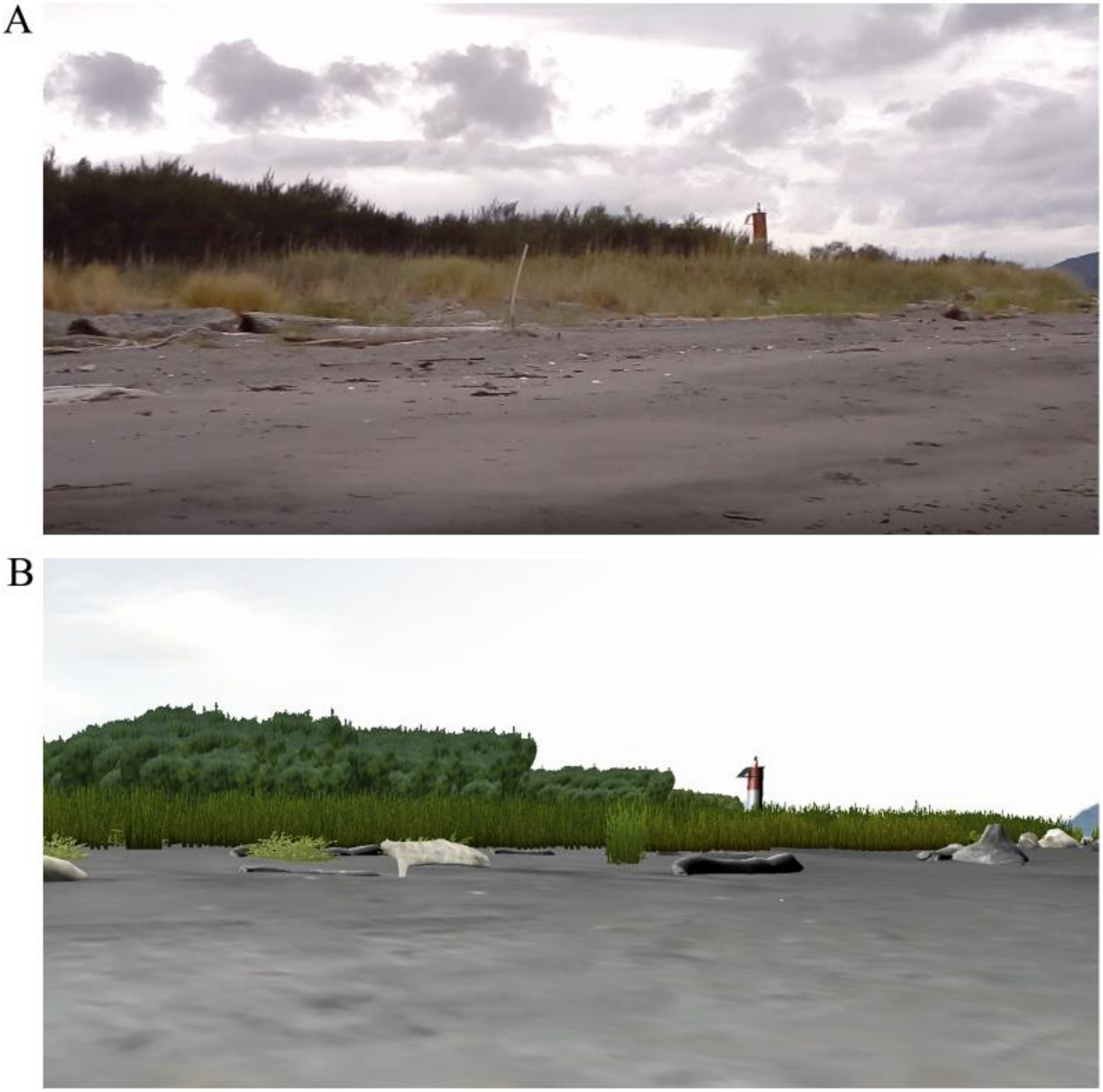

Figure 13. Photographic image of Sidney Spit and screenshot of geovisualization
Figure 13a features a photographic image taken at the north end of Sidney Spit (extracted from video footage). Figure 13b features a screenshot of the geovisualization taken from the same location and perspective as the photograph.

The modelling process first involved creating the land-to-sea surface by merging topographic and bathymetric data. Textures were mapped and applied to the surface to represent elements that comprise the beach and seafloor. A water surface was added and calibrated to different tidal heights. Vegetation (terrestrial and marine) was then added, as well as a variety of objects that represent different elements located within the coastal place (e.g., woody debris, human structures, wildlife, people, etc.). Viewshed imagery was incorporated into the model, representing ocean views seen from the park. A soundscape was also incorporated to represent sounds heard within the park. A detailed description of the modelling process can be seen in *5.3 Building the geovisualization*, and a video demonstration of the geovisualization can been seen on the project website: www.sidneyspitviz.com.

5.2.3 Focus groups

Focus group work was performed in two stages. The first stage was conducted in April 2016, and it involved a smaller group composed of six Parks Canada staff who worked within the branch responsible for the management of Sidney Spit. This group was recruited for the study because of their experience and familiarity with the park, thereby following methodology that employs small-sized focus groups comprised of people with expert knowledge (Onwuegbuzie et al., 2009). Professions within the focus group ranged, and included positions such as resource management, promotion, visitor experience, park ranger and park interpreter.

The session was held at the Parks Canada office in Sidney and lasted 2 hours; however, this chapter reports on only part of the session (see *5.1 Introduction*). The session began with a 15-minute presentation on how the geovisualization was built. The geovisualization was then presented on a 50-inch Panasonic TH-50PH12 screen, running the application from a Dell Precision T1700 computer with an NVidia Quadro K2200 graphics card and using external speakers for sound. The group was given a demonstration on navigating the virtual environment and viewing the various terrestrial and marine elements. We subsequently engaged in discussion around which elements contributed to realism and sense of place and which elements detracted from this sense (i.e., what was modelled incorrectly or was missing). The geovisualization was continually used during this discussion in order to stimulate comments and feedback around various aspects of the virtual environment and model elements.

In addition to sharing thoughts through discussion, participants were given a feedback form, which they used to provide written responses to three questions - (1) how does the geovisualization compare with the real-world environment overall, (2) what aspects contribute to realism and sense of place, and (3) what aspects detract from these qualities. The written feedback and notes from the discussion were entered into NVivo (v10), where it was thematically coded (Seidel and Kelle, 1995) and analyzed. Coding was based on the types of elements to which comments referred, and codes consisted of viewshed, driftwood, human constructions, vegetation, birds, people, dogs, boats, beach textures, marine environment and species, dynamics and sounds. Coding was also done to capture whether data refer to aspects that contribute to realism and sense of place or aspects that detract from this sense.

The second stage of the focus group work was held in July and August of 2016, and it involved residents of the Capital Regional District (CRD) of BC. Recruitment was done through letter mail sent to a random sample of 300 addresses located within the municipalities of Sidney and North Saanich. These municipalities were specifically selected as they are nearest to Sidney Spit, thus allowing the study to follow methodology of other visualization research which examines responses of local residents (e.g., Lewis and Sheppard, 2006; Salter et al., 2009; Schroth et al., 2009). However, further recruitment was needed for the study, and this was done through snowball sampling[22], which resulted in participants from other nearby municipalities. Ultimately, Sidney and North Saanich residents collectively comprised the majority of the participants (respectively 44.4% and 22.2%), but some of the participants resided in other municipalities, including Saanich (18.5%), Victoria (11.1%) and View Royal (3.7%)[23].

Focus groups were conducted over seven sessions, and they were held either in a conference room at the Mary Winspear Centre (Sidney, BC) or in the GIS Visualization Lab at the University of Victoria. Groups ranged in size, and (listed chronologically) consisted of seven, eight, two, two, two, five, and one[24] participant(s). Focus groups sessions were 2 hours in length; however, as with the Parks Canada group, this chapter only reports on part of the session (see *5.1 Introduction*). The session began with participants filling out a form that requested information

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[22] Snowball sampling consisted of recommendations from recipients of invitation letters, both from people who accepted the invitation and those who were unable to attend focus groups. In addition, some recruitment was done through professional networks. In particular, a connection with the District of Saanich's free local parks walking program allowed for recruitment of participants of the walking program.

[23] Due to the number of participants, it cannot be claimed that the sample size is representative of the entire population of the CRD; however, the number of participants is sufficient for conducting qualitative analysis on feedback collected from participants of a variety of different interests and views. The work follows other visualization research that has involved small numbers of participants and qualitative work (Lewis and Sheppard, 2006; Salter et al., 2009).

[24] The session with the singular participant was the only session held in August, and it consisted of a person who was scheduled for an earlier session but cancelled due to unexpected circumstances.

on age, gender and years residing in the CRD[25]. Age distribution consisted of 63.0% over the age of 65, 29.6% aged 55 to 65, and 3.7% aged 45 to 54 (the remaining 3.7% did not provide this information). Gender distribution consisted of 70.4% female and 29.6% male. The longest period of residence in the CRD was noted to be 70 years, the shortest was 2 years, and the median was 24 years.

Participants were given a brief presentation on the purpose of the research and a demonstration of the geovisualization. Similar to the Parks Canada session, the geovisualization was run on a Dell Precision T1700 computer and projected onto a screen, and it was used to demonstrate what can be seen and how to navigate the virtual environment. However, unlike the Parks Canada session, each participant also was provided with a Lenovo ThinkPad T530 laptop (and headphones) equipped with the geovisualization[26]. After the demonstration, participants were given information sheets detailing the user controls and allowed to explore the geovisualization on their own (see Appendix J). During this period, participants were given a feedback form, which they used to provide comments on both what contributed to and what detracted from realism and sense of place (see Appendix K). At the end of the session, a brief discussion was held, which also captured these points, and feedback form and discussion data were entered into NVivo and thematically coded. Coding was done in the same manner as with Parks Canada with the exception of an additional ‘user control’ code to capture the fact that participants could operate the geovisualization themselves using the laptops provided. Participants were also asked to rate how well the visualization resembles a real-world place on a scale of 1 (i.e., ‘not at all’) to 10 (i.e., ‘extremely well’), in similar manner to that done in other studies involving virtual environments (e.g., Bishop and Rohrmann, 2003; Baños et al., 2005).

Providing participants with laptops held the advantage of giving the users the ability to directly interact with the geovisualization and freely explore the environment. In addition, it

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[25] This information was collected using the survey designed for the study in Chapter 4. Participants were provided with the demographic information, sense of place and coastal concerns sections of the survey; however, only the demographic information was used for the research. The other collected data were not used due to methodological considerations (see *7.2.3 Imagined place and virtual place*).

[26] As noted in Introduction, the current study is part of greater research project that investigates how geovisualizations can serve as tools for collaborative coastal planning. To this end, local resident participants were provided with laptops and given the opportunity to use the tool to explore different management scenarios. The Parks Canada meeting differed in that it involved discussing management issues and developing scenario ideas; thus, user control was not necessary for this group.

allowed participants to work independently, creating more opportunity for everyone to provide comments. However, it is important to recognize that the Dell Precision T1700 is a much more powerful computer than the Lenovo ThinkPad T530; thus, the laptops were equipped with a lower resolution version of the geovisualization that performed much more slowly.

Unlike the Parks Canada staff, it could not be assumed that all local resident participants have previously visited Sidney Spit, and albeit they would be familiar with the type of coastal environment (being residents of the region), they might not be familiar with the specific place. This distinction is important because as argued by Newell and Canessa (2015), familiarity with the real-world place could affect how well a geovisualization connects with a user's sense of place. Accordingly, familiarity effects were investigated, and this took two approaches. The first followed Bishop and Rohrmann (2003) study on simulated environments, which noted that visiting a real-world place immediately before viewing a simulation of the place can positively influence users impressions of the simulation's realism. In the current study, such an effect was investigated by taking some groups out to Sidney Spit prior to exploring the geovisualization (groups n = 7, n = 8 and n = 1), while other groups either visited the park afterward (group n = 5) or not at all (groups n = 2, n = 2 and n = 2). The second method for investigating familiarity follows Tuan (1975) assertion that place is a function of the richness of experiences a person has with their environment. Participants were asked to indicate how many times they have visited Sidney Spit prior to the session (i.e., excluding the trip taken on the day of the session), and responses from those who had visited only once or not at all were classified as 'unfamiliar' and those who have visited multiple times in the past were classified as 'familiar'[27]. Following this classification, the feedback data from the two different groups were compared.

As this research involved human participants, an ethical review was conducted and approved by the Human Research Ethics Board of the University of Victoria (see Appendix A). Focus group participants were provided with a letter of informed consent that provided

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[27] Participants were also asked when they last visited Sidney Spit (aside from the focus group trip), and they were provided the options of 'within the last week', 'within the last month', 'within the last year' and 'over a year ago'. Ultimately, effects associated with recentness of visit were examined through the 'primed' classification of familiarity; however, for interest sake, six participants that had visited the park once previously were classified as 'unfamiliar' and only one of these had visited within the year. In contrast, four of the 14 participants classified as 'familiar' had visited Sidney Spit within the year.

information on the research and their participation (see Appendix I), and they signed these letters prior to engaging in the research. Signed copies were kept by the researcher, and participants were provided with unsigned copies for their reference. In accordance with the ethical review, names of individuals are not displayed in this chapter, and references to particular participants are done using identification numbers.

5.3 Building the Geovisualization

5.3.1 Modelling land-to-sea surface

The geovisualization captures the continuum from land-to-sea; thus, it was built upon a digital elevation model (DEM) of a seamless terrestrial-to-marine surface. This was created by merging topographic and bathymetric raster data obtained from Parks Canada. The topographic raster had a resolution of 2m and was generated through LiDAR data. The bathymetric raster had a resolution of 25m, and it consisted of a mosaic created from multi-beam data and a surface developed from contour and point data.

Previous research has noted that creating topo-bathymetric surfaces presents the challenge of reconciling vertical datums to ensure topographic and bathymetric data reference a common sea level (Myers, 2005; Bartier and Sloan, 2007). However, this challenge was irrelevant in the context of the current study, as the final exported geovisualization product did not ascribe to a particular geographical datum. Albeit spatial data informed the build of the geovisualization, the tool was designed for place-based analysis and ultimately assumed a ‘sandbox’ format, meaning that it focused solely on elements that users could see and interact with when located within a defined, bounded space. It was therefore sufficient to make the model spatially relative (i.e., objects have the same relative positioning and orientation as they would have in the real place), rather than maintaining coordinate data of modelled items. Accordingly, rather than defining a common datum for the two raster sets, the topo-bathymetric surface was created by simply vertically shifting the topographic raster cells to align with the bathymetric raster (using the raster calculator in ArcMap), resulting in a terrestrial-to-marine surface with the right ‘shape’. The amount of shifting was determined by calculating 20 elevation differences between topographic and bathymetric cells that overlapped in nearshore areas, and then ‘raising’ the topography by the average value.

Because the user experiences the geovisualization as one would if ‘on the ground’, it was important to maintain the maximum level of resolution in the DEM. Consequently, the 2m resolution of the topography was used to define the topo-bathymetric raster, as this allowed for better representation of terrain shape and more realistic place experience than would the 25m bathymetric resolution. This means that the bathymetry was artificially segmented into 2m cells; however, the geovisualization is not intended as a tool for computational spatial analysis and thus this segmenting was not a concern.

The topo-bathymetric raster was imported into Unity as a heightmap and used to shape terrain assets. Unity operates in arbitrary units, and when importing a heightmap into the program, the length, width and height extents of the terrain need to be defined. In this case, each unit was treated as a metre, and the model dimensions were 5,250m (length), 5,250m (width), and 117m (height), with the height dimension based on a maximum observed elevation of 48m and a minimum of -69m. After defining the extents, Unity extruded the terrain surface in accordance with the greyscale of the raster.

The workflow for using raster data to create three-dimensional terrain assets in Unity involved exporting the raster from ArcMap as a TIFF file, converting the TIFF to RAW format in Photoshop, and then importing the RAW file into a Unity terrain asset. As Photoshop served as an intermediate between ArcGIS and Unity, it could be used to ‘smooth’ the raster in a way that creates a better representation of what real-world terrain looks and feels like. Raster surfaces are composed of cells, and thus extruding these surfaces without smoothing can lead to ‘step-like’ terrain shapes (Appleton et al., 2002). However, a Gaussian blur can be applied to the raster map when in Photoshop, and this spreads grey shading across cell borders, leading to smoother terrain when imported into Unity (see Figure 14).

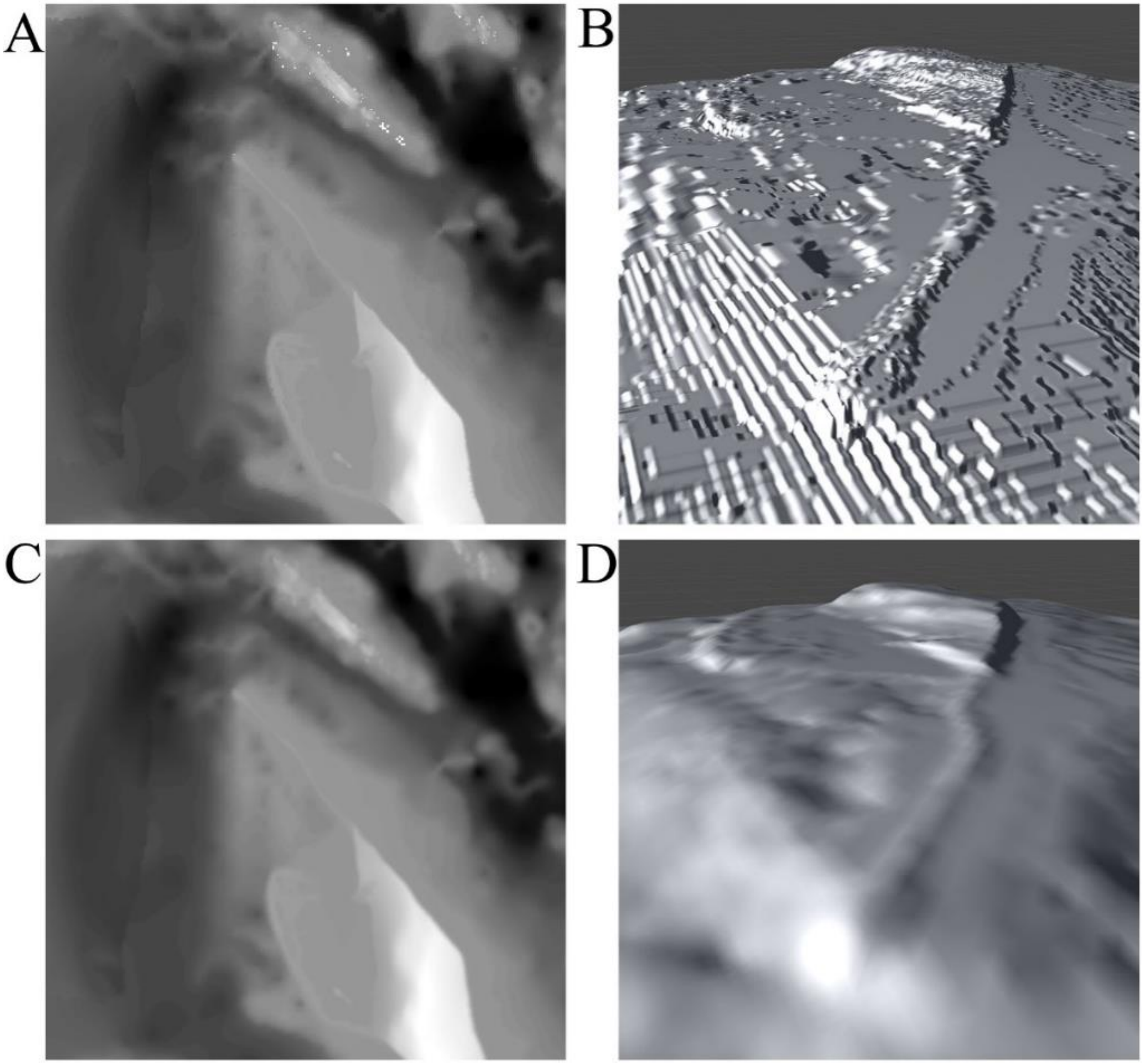

Figure 14. Differences in terrain assets between pre- and post-smoothing
Figure 14a displays the topo-bathymetric raster without smoothing effects applied, and Figure 14b depicts the unsmoothed raster used as a heightmap in Unity. Figure 14c displays the topo-bathymetric raster with a Gaussian blur applied in Photoshop, and Figure 14d depicts the smoothed raster used as a heightmap.

A higher level of detail was desired for surface textures in navigable areas because users will be directly on top of these surfaces. Therefore, the navigable terrain was segmented into eight pieces of 500m by 500m dimensions, as this allowed for terrain textures with much higher resolution. Impassible boundaries were created that encompass an 85-hectare space within the navigable segments, and this ensured that users could only walk on the smaller segments with higher resolution textures. Boundaries were invisible, and areas outside these boundaries served as viewshed components.

Segmenting the terrain presented two considerations around the preparation of heightmaps. Firstly, navigable terrain segments needed to fit within the larger non-navigable terrain. This was done by creating a ‘hole’ in the latter, meaning that the navigable terrain area was ‘blacked-out’ on the larger map in Photoshop (see Figure 15a) and this area became a depression when extruded in Unity (i.e., because extrusion is based on the greyscale). The navigable segments were then arranged within the depression (see Figure 15b). The second consideration that presented itself when segmenting terrain was that greyscale needed to be coherent across all segments because Unity units are arbitrary and heightmaps are extruded according to the scale. To maintain coherence, two cells in each segment were resampled to represent the maximum (14.5 m) and minimum elevation (−31 m) observed among all eight pieces before conducting segmentation. These resampled cells served as reference points for elevation extents, ensuring that the greyscale represented standardized elevation changes when segments were clipped from the larger map and subsequently used as heightmaps for the smaller terrain assets.

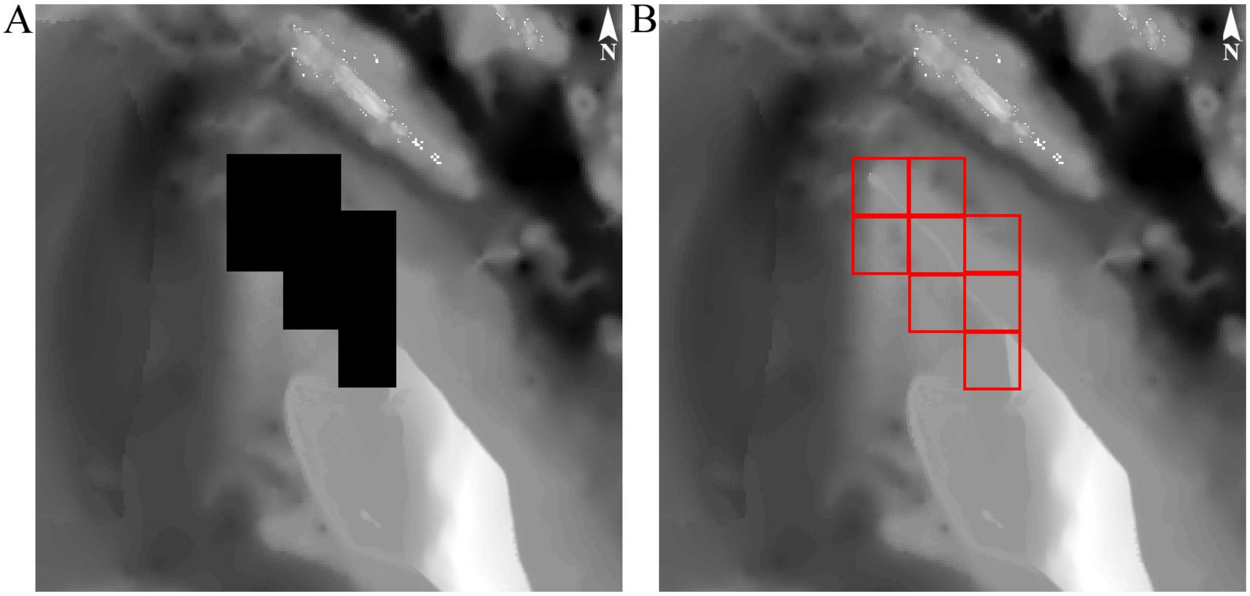

Figure 15. Segmenting of navigable terrain

Figure 15a displays the non-navigable terrain map with area blacked-out to create a depression for the navigable terrain segments. Figure 15b displays the eight navigable terrain segments fitted into the map.

5.3.2 Terrain textures

Terrain textures modelled elements that did not significantly protrude from the beach and seafloor, such as beach sediment, macrophytic wrack, pebbles, small pieces of woody debris, etc. In real coastal places, these elements have the potential to ‘speak’ to the sense of place of various coastal users in different ways; for example, wrack deposits on the beach could be seen as ‘clutter’ by some, whereas others might view it as part of a healthy local ecosystem (Thompson, 2007). Consequently, terrains textures have potential to play an important role in how geovisualizations connect with sense of place, and significant efforts were made to create high resolution surfaces that resembled the real-world environment.

One approach for mapping surface textures of real-world places onto terrain assets in Unity involves fitting orthophotographs on these assets; however, this approach can result in a model that is adequate only for aerial viewing as it suffers from poor resolution when experienced from the ground-level view (e.g., Bourke and Green, 2016). To avoid such issues, this research instead designed and employed a technique, which resulted in textures that are mapped like orthophotographic imagery but built with a much higher resolution. The technique, referred to here as ‘texture mapping’, involved taking pictures of the beach and collecting corresponding waypoints in a series of tracks that (for the most part) ran parallel to the shoreline. Collection occurred in 2–10m intervals, depending on the variation in sediment type; that is, more pictures were taken in areas of higher variation. Point data were projected overtop of the topo-bathymetric raster in ArcMap, maps were exported from ArcMap as image files, and then they were fitted into a large Photoshop canvases (20,000 px by 20,000 px) (see Figure 16a). Batch processing was used to scale down beach photographs in a manner that (roughly) matched the map dimensions, and the scaled images were placed on top of the appropriate points (see Figure 16b). Gaps were then filled in using Photoshop tools such as clone and pattern stamping (see Figure 16c). The result of this technique is a high resolution surface with different sediment textures that are mapped in a way that they appear (approximately) in the same areas as observed during field collection (see Figure 16d). It is worth noting that this technique involves significant data collection, and the texture maps that were built use approximately 2,300 photographs with corresponding waypoints.

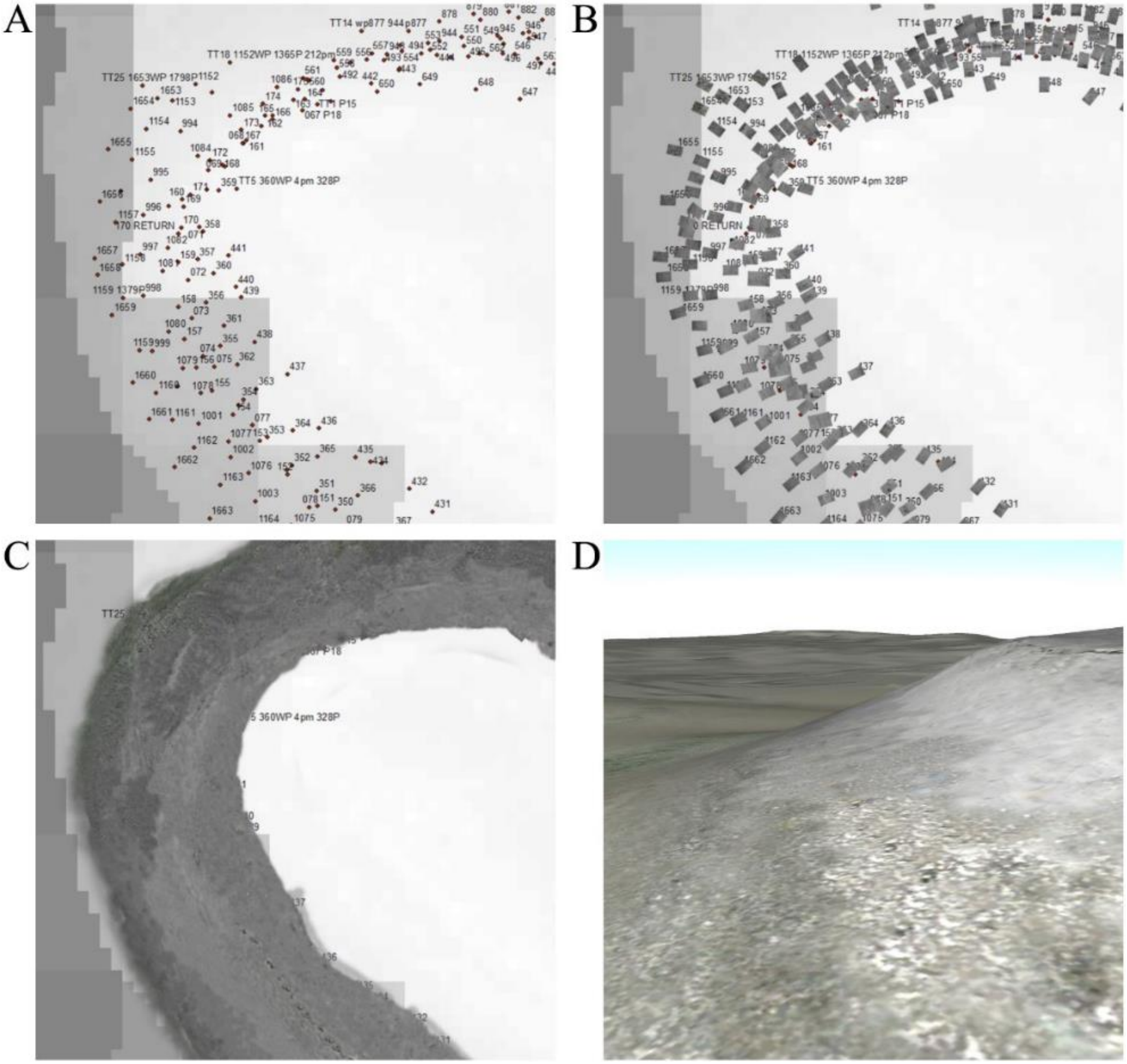

Figure 16. Mapping of surface textures

Figure 16a shows a map of locations where beach texture photographs were taken. Figure 16b shows scaled-down images of beach textures superimposed on mapped points in Photoshop. Figure 16c demonstrates results of building the remainder of the surface texture using clone and pattern stamping tools. Figure 16d depicts the texture map placed on a terrain asset in Unity.

Texture mapping was also done for the marine environment, and seafloor photographs were collected during snorkeling fieldwork using a GPS-enabled waterproof camera (Nikon AW130). However, due to visibility issues, underwater images were not directly applied to texture maps. Instead, terrestrial images that held similar compositions to the various underwater images (e.g., a similar proportion of algae to sand) were applied to the marine points on the texture maps, and seafloor texture was built using this imagery.

5.3.3 Water elements and tides

When modelling other aspects of the geovisualization, texture maps were temporarily removed and other maps were fitted onto terrain assets to serve as references for positioning the different elements. These types of maps, referred to here as ‘reference maps’, were used to model shoreline and water levels at different tidal heights. The shoreline was mapped at three different tides, capturing low tide (0.2 m), medium tide (1.9 m), and high tide (3.2 m). Maps were exported from ArcMap and arranged in Photoshop in order to fit the terrain assets in Unity properly (i.e., in terms of orientation and extent) (see Figure 17a). The reference maps were then applied to the terrain surfaces in Unity. A water surface element was obtained through Unity’s standard asset library, added to the model, and then raised until it roughly aligned with the mapped shoreline data (see Figure 17b). As three tidal levels were mapped, a separate scene was created for each level, and users can experience the geovisualization at low, medium, and high tide by clicking key commands that load respective scenes.

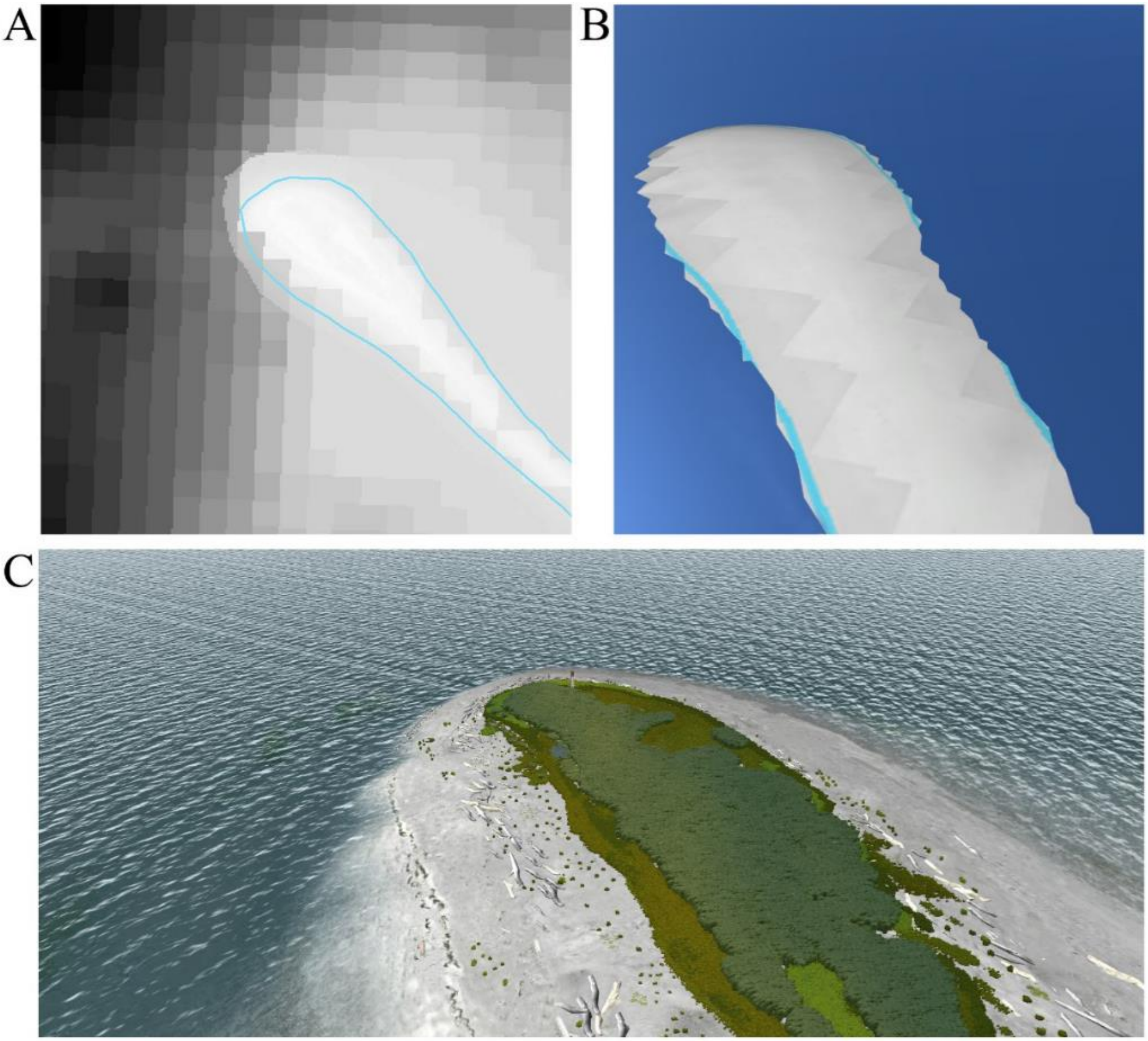

Figure 17. Adding water surface element

Figure 17a shows shoreline mapped at medium tide (1.9m). Figure 17b depicts the process of using the shoreline reference map to fit the water surface element to the appropriate tidal level. Figure 17c shows a water surface asset fitted to the appropriate tidal level and with surface effects applied.

Certain areas of Sidney Spit are flooded at high tide; thus, walking along the spit during high tide can constitute a different place experience than that of low tide (i.e., wading through water rather than walking on beach). However, such differences were not initially modelled in the geovisualization when extruding the topo-bathymetric heightmap, as the raster did not adequately capture the depressions where flooding occurs. To rectify this, 3D modelling tools (from Unity’s toolset) were used to depress terrain in flooding areas, using the high tide reference map to guide this modelling. Terrain was depressed only to the extent where areas were flooded at the appropriate tidal levels (e.g., some areas flooded at high tide but not at medium and low tides), ensuring the geovisualization properly depicted flooding patterns of the real-world environment.

Previous efforts on developing realistic geovisualizations of marine places have applied fog effects to represent the poorer visibility of the underwater environment (Canessa et al., 2015). In a geovisualization that captures solely the marine environment, a fog effect can be applied to an entire virtual environment; however, this is more complicated in a coastal visualization that transitions from land to sea, as visibility differs depending on whether the character is above or below the water surface. In order to capture visibility changes, a ‘collider’ was placed in the marine environment that triggers a fog effect once the user submerges underwater. When emerging above the surface and exiting the collider, it triggers once again and the fog effect is disabled.

5.3.4 Vegetation

Bushes, grasses and other small plants were built as ‘terrain detail’ items, which refers to two-dimensional elements placed orthogonally to terrain surfaces and always face the viewer regardless of the viewing angle. Some plant models could be retrieved from Unity’s standard asset library and customized for the geovisualization (particularly dune grasses); however, the library did not contain models for many of the local plants such as silky beach peach, yellow sand-verbena, sea asparagus and Scotch broom. Therefore, many of the plant models were built in Photoshop, using photographs taken in the field for developing realistic depictions. When placed in the model, a ‘bend factor’ was applied to plants, which caused them to sway as if blowing in the wind in order to convey the impression of windy coastal environment.

Plants were positioned within the model using multiple methods. Vegetation found in large dense patches, such as the Scotch broom located at the north end of the spit, were added to geovisualization using orthophotographs (retrieved from Parks Canada and Google Earth) as reference maps. Less conspicuous plants that were more difficult to see through orthophotography were added using reference maps created by walking around vegetation areas and taking photographs (with corresponding waypoints) at various points along the walked route.

When placed on terrain assets, these vegetation reference maps were used by looking at photographs corresponding to point data and examining them for the types, densities and compositions of plants adjacent to said points. Vegetation found in smaller patches, such as seen with sea asparagus or dune grasses located closer to shore, were added to the map using reference maps created from GPS tracks that followed patch borders and photographs of the patches to estimate vegetation density (see Figure 18).

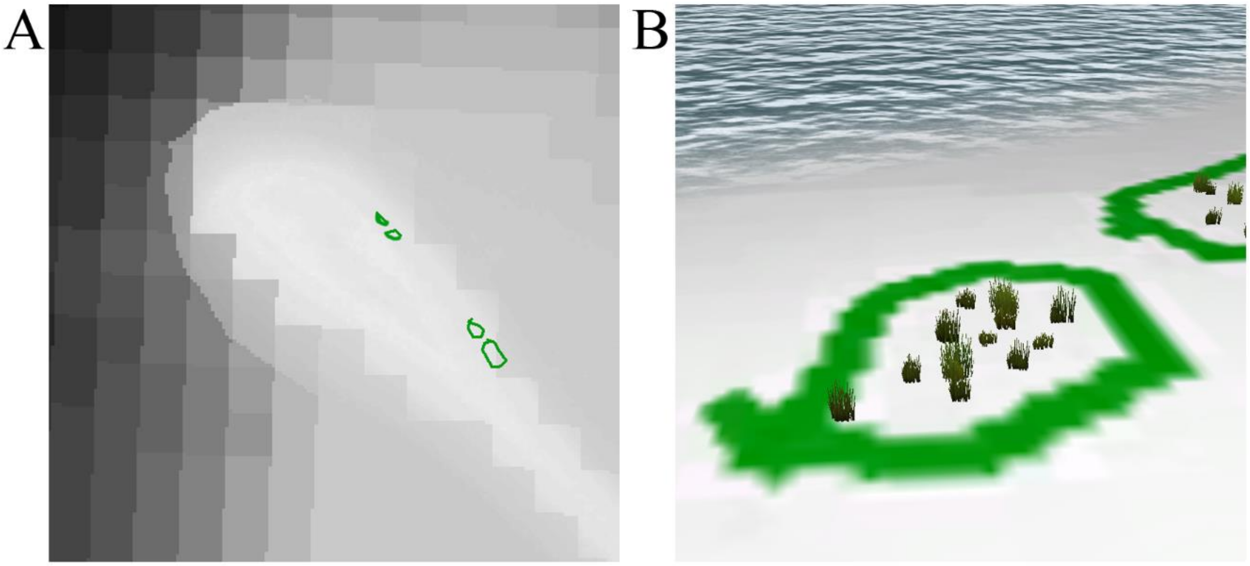

Figure 18. Mapping of small vegetation patches

Figure 18a shows a map of locations of small grass patches on the beach. Figure 18b depicts the map fitted to terrain assets in Unity for informing where grass elements are added to the geovisualization.

Marine vegetation also was featured in the geovisualization, with particular attention given to eelgrass meadows (see Figure 19). Eelgrass is an ecologically important species that provides habitat and shelter for wildlife (Dumbauld et al., 1993; McDonald et al., 2001), and thus modelling the position and distribution of eelgrass meadows around Sidney Spit was deemed important. These meadows have already been mapped through previous research efforts using remote sensing techniques (O’Neill et al., 2011), and maps from this work were used as reference maps for placing eelgrass within the geovisualization. Heights of eelgrass blades were adjusted according to depth; that is, eelgrass in deeper areas were modelled with taller blades.

Sea lettuce models were also added to the geovisualization; however, maps were not available for sea lettuce patches. Instead, sea lettuce elements were placed within the model using images obtained during the snorkeling fieldwork, as these allowed for a rough idea of sea lettuce densities in certain areas. It is important to note that sea lettuce is represented through the texture maps placed on the terrain surfaces; however, it was also added as a terrain detail item in marine areas because of how sea lettuce floats when underwater (i.e., it is less ‘flat’ than what is depicted through the texture maps).

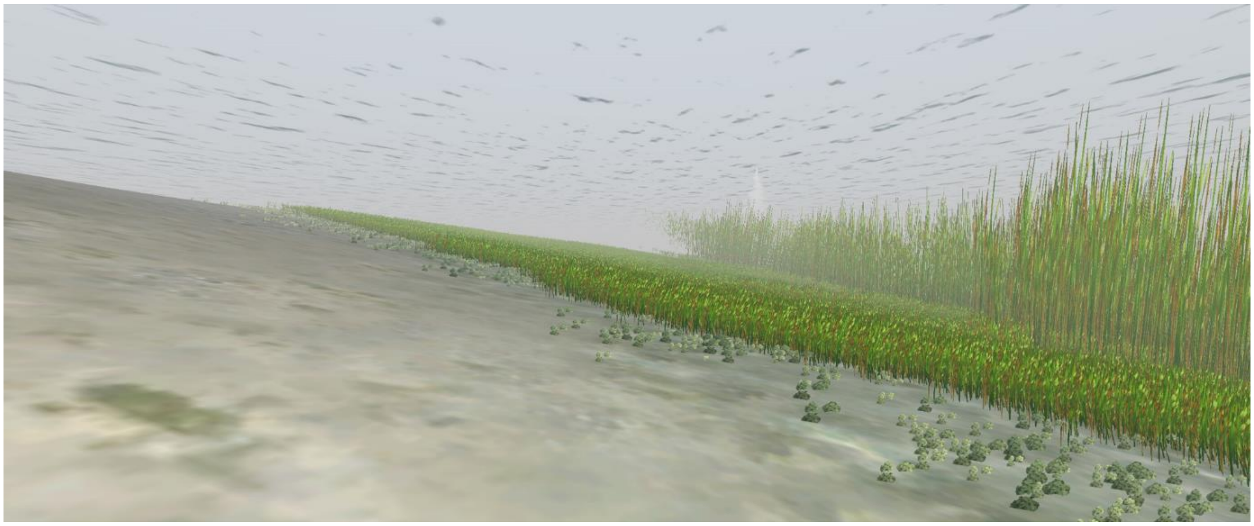

Figure 19. Marine environment within geovisualization
Image features a screenshot of the marine environment within the geovisualization, taken from a location where eelgrass and sea lettuce elements can be observed.

Trees were also added to the geovisualization; however, unlike other vegetation, tree elements consisted of three-dimensional models (obtained through Unity’s standard asset library), rather than terrain detail items. Most tree elements were positioned outside of the navigable area, such as in the southern portion of the park and the nearby Forrest Island; thus, they primarily served as viewshed components. Trees were added using orthophotographs to create reference maps, similar to how the large vegetation patches (e.g., Scotch broom) were modelled.

5.3.5 Objects

Objects were either created using SketchUp or (in the case of more complex designs) purchased through the Unity Asset Store and then modified/customized to suit the geovisualization. Objects consisted of both stationary (i.e., not animated) and dynamic (i.e., animated) elements. Modelling of stationary objects employed similar techniques from object-to-object, and these objects included signs, litter, picnic tables, beached dinghy, dock, fences, lighthouse and pilings. Similar to the processes for modelling tides and vegetation, stationary objects were added using reference maps created from either field data (see Figure 20) or orthophotography. Large woody debris also was added to model, and this was done in a process similar to that described above with the 'less conspicuous plants' (see *5.3.4 Vegetation*). Photographs of woody debris were taken with corresponding waypoints, and these points were subsequently used to create reference maps. The appropriate concentrations/sizes of debris objects were then added to the geovisualization, as informed by reference maps and corresponding photographs.

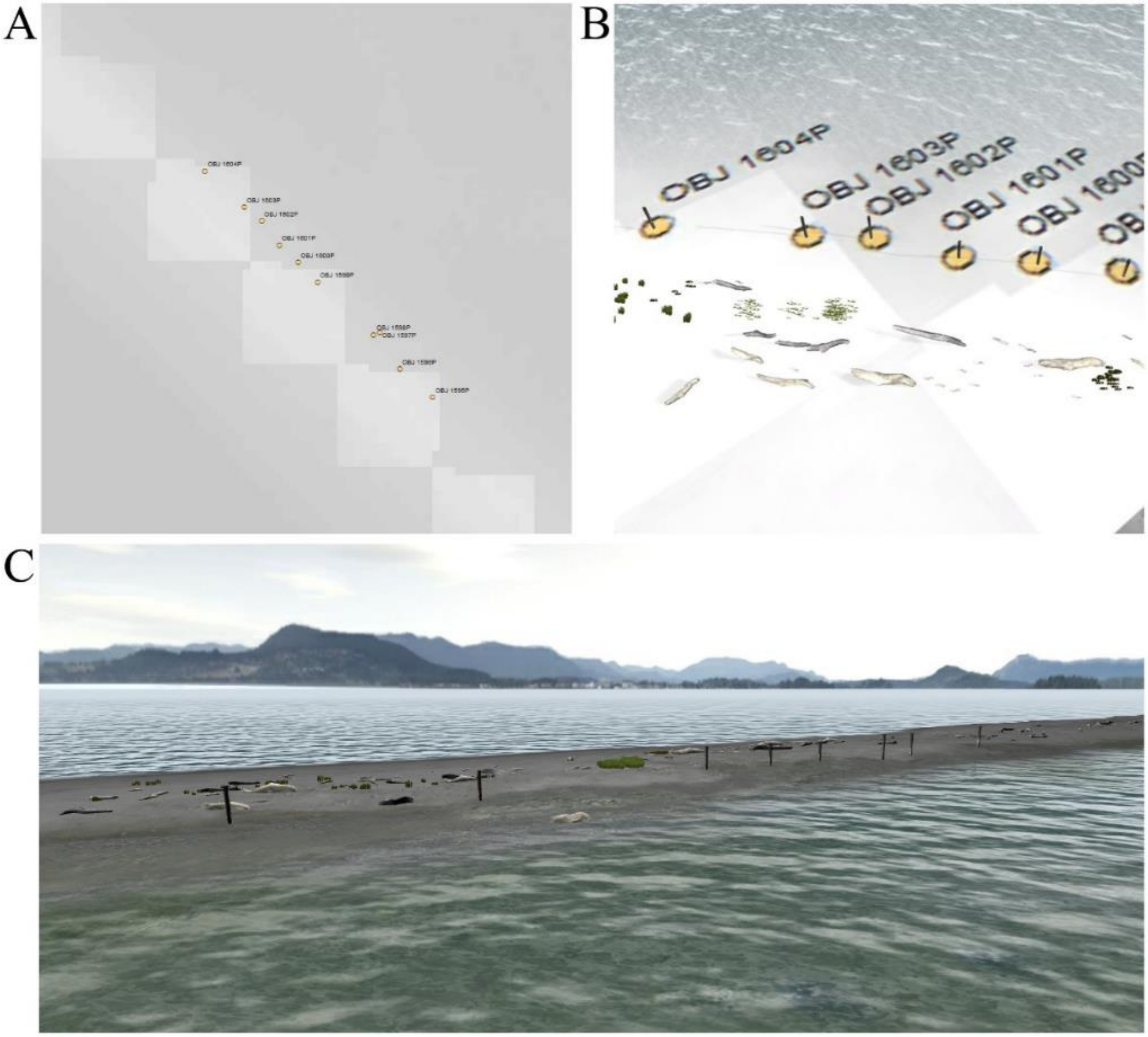

Figure 20. Object mapping of pilings

Figure 20a shows a map of waypoints representing locations of pilings on Sidney Spit. Figure 20b depicts a reference map fitted to a terrain asset in Unity and used to inform where piling elements are added. Figure 20c displays a screenshot of the geovisualization featuring the added piling objects.

The majority of stationary objects were built in SketchUp, using textures created from photographs collected in the field (the exception to this being the picnic table model, which was purchased through the Unity Asset Store). Smaller objects were scaled in Unity using the convention of 1 Unity unit is equivalent to 1 meter, and dimensions were calculated by photographing and comparing an object of known dimensions to the object-to-be-modelled (e.g., a water bottle was placed next to the pilings prior to taking their pictures). Pieces of larger objects, such as dock posts and fence railings, were scaled in similar manner; however, orthophotography was also used to capture the ground extent of the full objects (i.e., the entire dock, the complete fence).

Dynamic objects required a variety of techniques depending on the nature of the object, and included people, dogs, gulls, crabs and boats[28]. Base models of people and dog were purchased from the Unity Asset Store, and then models were modified (e.g., size, shape, colours, etc.) to represent visitor diversity. In addition, data were collected on observed proportions of children to adults, and accordingly, children models were created by scaling down adult models and changing details such as adding cartoon characters to model shirts. Models were animated within the geovisualization[29], and their actions were based on anecdotal observations of the types of activities people engage in when in the park. Such activities include walking along the beach, engaging in conversation, playing in the water (specifically children), walking a dog on a leash, throwing stones in the water and enjoying the ocean view. Distributions of people and dog models in the geovisualization were determined through counts conducted at various points on the spit. Data were collected at three points - the northern end of the spit, middle-to-southern portion of the spit, and the southern end. The latter point involved three counts, which captured people/dogs nearby the point, southwest of the point (near the visitors area) and southeast of the point. Altogether, 55 counts were collected over the 16 days of fieldwork, and averages of these counts were used to appropriately distribute people models (and a dog) throughout the geovisualization. In addition, a dinghy model was built and placed near the people models in the middle portion of the spit because such a boat was frequently seen in this area.

Base models for gulls were purchased through the Unity Asset Store. Animations were applied to gull models to depict these elements as living animals, and involved movements such as gulls turning heads, occasional foraging and wing flapping. Gull models were distributed throughout the geovisualization based on 30 field observations. Gull data collection involved taking photographs of colonies and corresponding waypoints. Numbers of gulls in photographs

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[28] The detailed descriptions for modelling dynamic objects are included in the main text in this dissertation; whereas, due to word count considerations, this content was included as supplementary material in the published article.

[29] Models were purchased with a set of animations, which were modified and/or combined with other animations to represent different activities.

were counted, and using waypoint data, average sizes and locations of colonies were estimated. Prior to averaging, data were separated by whether it pertained to high, medium or low tide because field observations suggested that gull distributions varied with the tides. This resulted in the development of three reference maps (i.e., one for each tidal level featured in the geovisualization), and gulls were distributed according to the respective tide within a scene.

Dungeness crabs were included in the geovisualization, and crab models were built from photographs of an exoskeleton using Autodesk 123D Catch, i.e., an application that builds three-dimensional models from pictures of objects taken from multiple angles. When placed in the geovisualization, crab elements were depicted as living animals through simple position-shifting and rotation animations that made it appear as if the animals were walking in and out of eelgrass meadows. Crabs were specifically placed on the edges of eelgrass meadows to convey the species reliance on these meadows (Dumbauld et al., 1993; McDonald et al., 2001) and also because the edges were where they were most frequently observed during fieldwork (i.e., they were seen as they exited the cover of the meadows). Estimating crab population densities was beyond the scope of this research. Instead, crabs were distributed throughout the model in accordance with how frequently they were observed, using a four-step calculation method. Firstly, underwater photographs taken during snorkeling fieldwork were examined to calculate the proportion of pictures with crab sightings to pictures without crabs; this was done for photographs collected east (0.042) and west (0.065) of the spit. Secondly, average water depths at observation points were calculated for both east and west datasets, accounting for the fact that tide was approximately 2m during collection. Thirdly, the angle of the user perspective in the geovisualization was obtained from the Unity settings (60°), and through trigonometry, averages were estimated of seafloor area seen if snorkeling at the water surface and submerging head in places where data were collected. Fourthly, the nearshore area was segmented into these averages of seafloor area, and crabs were placed in every n^{th} segment based on proportions obtained in the first step (i.e., every 24th segment on the east side and 15th segment on the west). This resulted in a total of 68 crabs placed in the geovisualization, spaced approximately 70m apart off the eastern side of the spit and 45m apart off the western side. Ultimately, this technique did not capture absolute crab populations; however, it provided an approximation of a park user’s experiences around encountering crabs when snorkeling, and this is sufficient for a tool that aims to capture place-based features.

Boats models were purchased from the Unity Asset Store, and they consisted of three types - yachts, sailboats with sails raised and sailboats with sails lowered. Boat models were scaled using Google Earth orthophotography of the Sidney Marina (Sidney, BC). Lengths of 20 sailboats and 20 yachts docked in the marina were measured using the Google Earth ruler, and then boat models were scaled in accordance with these collected values. Boat models were positioned off the western side of Sidney Spit in an area where mooring buoys have been placed by Parks Canada for the use of park visitors. The number of boat models included in the geovisualization was calculated by averaging 12 boat counts taken over eight field days, which resulted in 20 models. Boats were positioned with the hulls dipping below the water surface, and a slight vertical shifting animation was applied to create the impression of a floating object. Locations of 20 boat models were determined by using point data of mooring buoy locations, obtained from Parks Canada. A reference map was created from these points, and models of boats attached to mooring buoys were positioned accordingly (see Figure 21a). However, it is important to note that only 16 buoys are located in the mooring area, and the other boaters are (likely) using their anchors. This required distributing four boats in various other locations throughout the mooring area, and modelling them absent of a mooring buoy system (see Figure 21b).

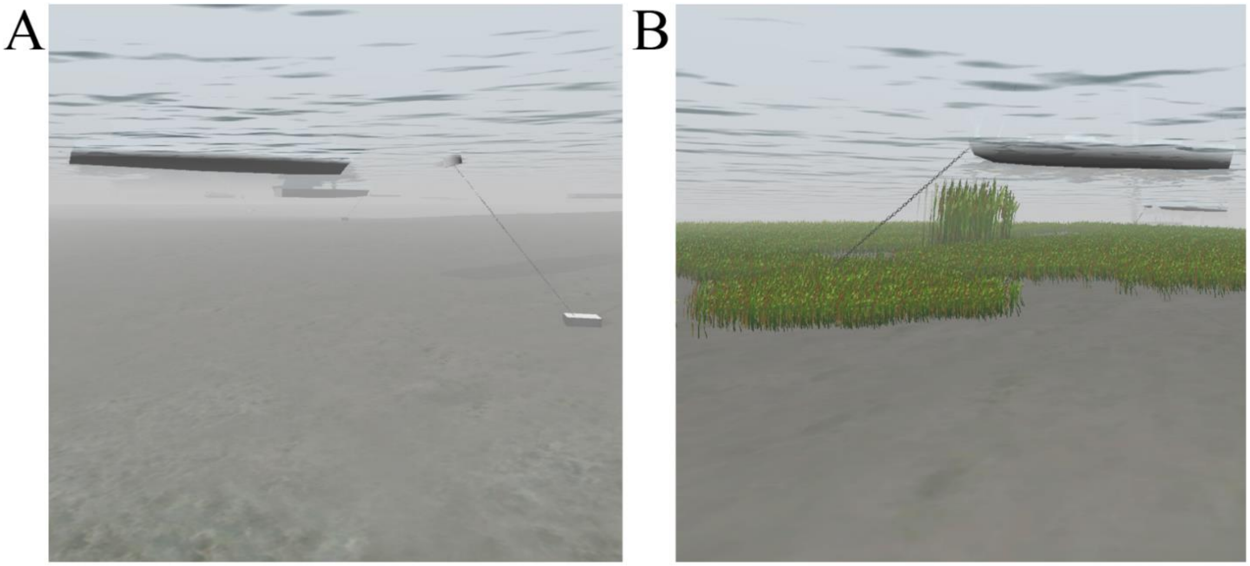

Figure 21. Modelling of mooring buoy systems and anchored boats

Figure 21a depicts a model of a boat tied to a mooring buoy. Figure 21b depicts a boat using an anchor instead of a mooring buoy.

Boats traveling near Sidney Spit also were included within the geovisualization; however, accurately modelling these boats presented challenges. Using actual paths of recreational boaters and running boats along these paths would require importing a large number models into the geovisualization, and this could impact rendering speed and the performance of the tool. Therefore, this research employed a different strategy, in which a collection of boats models were set on paths circumnavigating Sidney Island in both directions, creating the illusion of many different boats travelling past the park. The types and paths of boats were determined using field data, which involved taking 36 sets of photographs over seven field days from various points on the spit and in different directions. The sizes of the boats in the photographs were used to classify a boat as being on a proximal (~220m from shore), midway (~600m from shore) or distant (~1300m from shore) track[30]. In addition, the types of boat (i.e., sailboat or yacht) and directions of movement observed in the photographs informed the type of model moving on a particular track and whether the model travelled clockwise or counterclockwise around the park. Finally, numbers of boats observed in pictures were noted, and these values were used along with the other observations to calculate frequencies of how often certain boats were seen at particular distances moving in certain directions (e.g., how often a distant sailboat moving east is observed with a proximal yacht moving west off the north end of the spit). With these frequencies, the boat paths could be timed in a manner that represents the types, numbers, distances and directions people typically see with boats in the viewshed. This effect was achieved with seven boat models (i.e., five sailboats and two yachts) moving clockwise and four models (i.e., two sailboats and two yachts) moving counterclockwise.

5.3.6 Distant viewshed elements

Some viewshed elements were captured within the non-navigable terrain; however, this excluded distant elements that extended beyond this area. Instead, these distant elements were incorporated into the geovisualization using a skybox, which is a cube that encompasses a virtual environment and contains images on the inside panels to serve as background scenery (e.g.,

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[30] Distances from shore were estimated using camera magnification, approximate sizes of boats, and length measurements of boats in photographs. Track distances were based of averages of boats that measured (within photographs) less than 1.5cm, between 1.5cm and 3cm, and above 3cm.

Hong-ge, 2010; Hu et al., 2012). A panoramic image was stitched together using photographs taken from various points around Sidney Spit, and this image was fitted to the inside of the skybox. However, Unity does not contain a function for aligning the skybox in a geographically accurate manner; thus, a method for doing this was designed. For each panoramic picture, a corresponding waypoint was collected (111 points in total) and the direction the photograph was taken was recorded. When projected in ArcMap, an eight-point star symbol was selected to represent the point data (see Figure 22a), and a reference map was subsequently created. A skybox with a ruler spanning the panels was then created and imported in the geovisualization, and using the star symbols for orientation, the ruler points serve as reference points for aligning the panoramic imagery (see Figure 22b). For example, when standing at point 1,133 and facing northeast in the virtual environment, one would see a particular ruler mark in the center of his/her field of vision. By comparing this to the photograph taken facing northeast at point 1,133 in the real-world environment, the alignment of the panoramic could be determined. This process was done for 10 points, which provided enough reference for building and aligning the skybox in a geographically accurate manner.

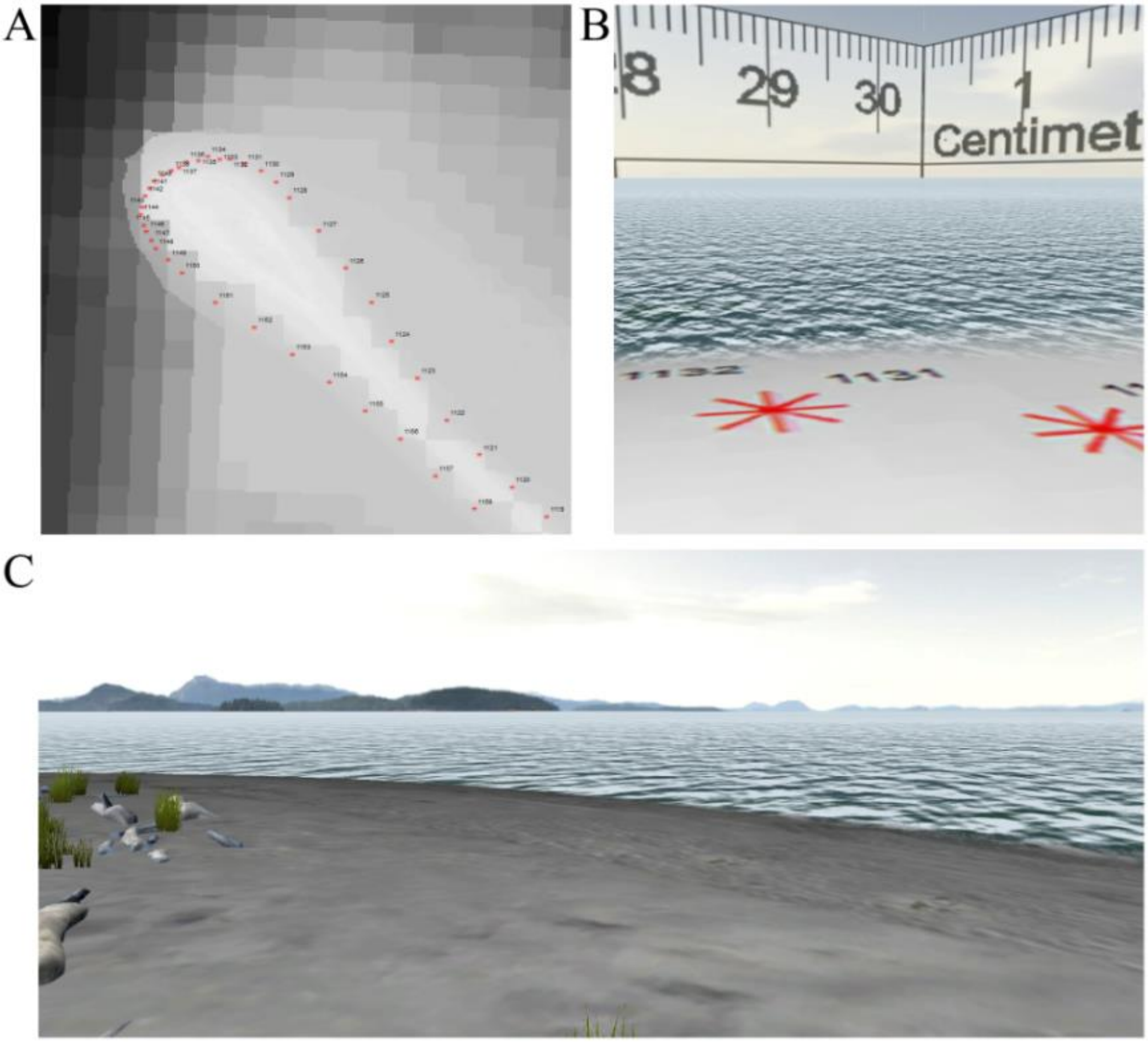

Figure 22. Aligning viewshed imagery

Figure 22a shows a map of waypoints where viewshed photographs were taken. Figure 22b shows the map fitted to terrain in Unity, and a ruler skybox used for guiding alignment of viewshed imagery. Figure 22c exhibits the final product with viewshed imagery properly aligned.

5.3.7 Sound

Sounds incorporated into the geovisualizations include ocean waves, boat motors, gulls cawing, dogs barking, people walking on the beach, greetings from other park visitors and sounds of conversation. Sounds with distinct sources (e.g., footsteps of people, boat motors, etc.) were directional (i.e., stereo sound) and increased in volume as the user approached the source.

Volume levels of different sound clips were adjusted in attempt to ensure that all sounds were audible and some did not unduly overpower others (based on the researcher's perception). Further volume adjustments occurred based on user feedback (see *5.4.1 Parks Canada*).

Many sounds were triggered by colliders; for example, greetings would sound as the user entered a collider attached to front of a person model, giving the user the sense of being greeted by another park visitor (see Figure 23). Colliders were also used to change ambient sound when above and below the ocean surface, resulting in ocean waves heard above the surface and a softer 'bubbling' sound heard below. It is worth noting that the soundscape was designed in manner that all above-surface sounds could not be heard when in the marine environment with the exception of boat noises, and this exception was made in recognition of growing research around underwater noise pollution from marine vessel traffic (Simmonds et al., 2014; Williams et al., 2014; Williams et al., 2015).

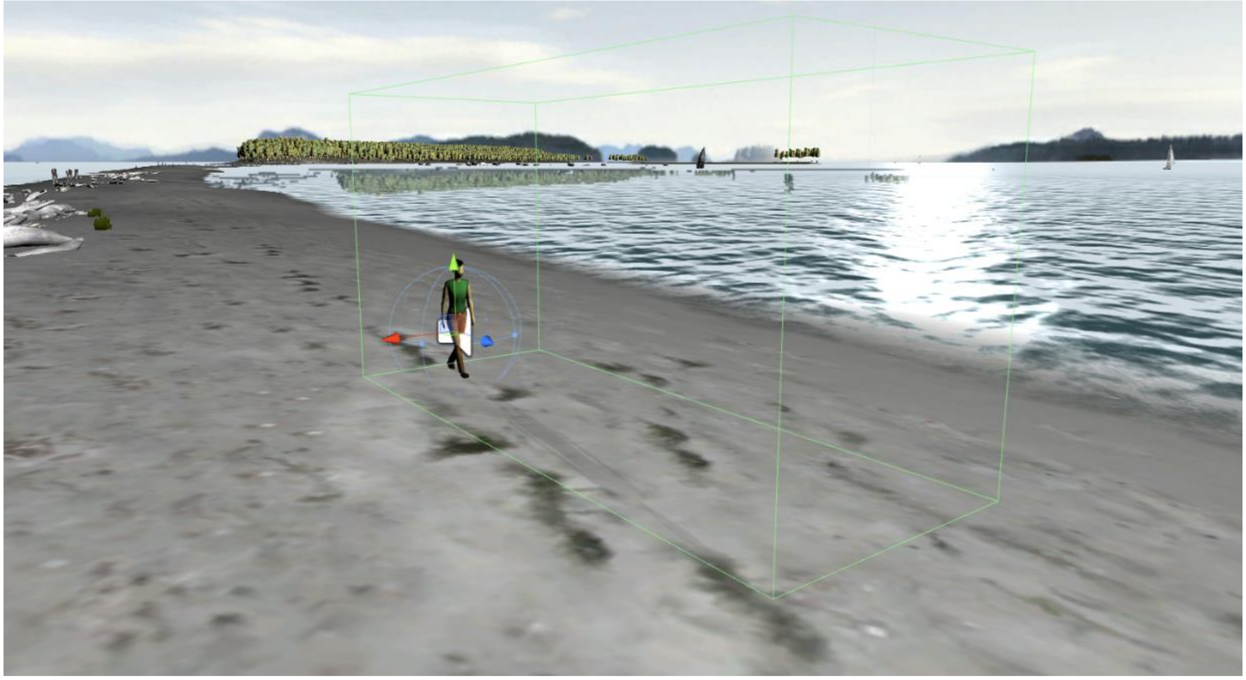

Figure 23. Person model equipped with sound collider

Green box around the person model represents a sound collider. When the user character enters the collider, a greeting sound is triggered, giving the user the sense of being greeted by another park visitor.

Audio clips were retrieved from a variety of sources. Some clips were obtained from public repositories such as soundbible.com, whereas as others came with models purchased from the Unity Asset Store (e.g., gull sounds). Sounds that involved intelligible human speech were recorded by the researcher, using his voice for male speech and a colleague’s voice for female speech (see *Acknowledgements*), and these audio clips were altered in pitch to give the impression that they originate from different people.

5.3.8 User character

The geovisualization is experienced from the first-person perspective, and the camera was vertically set to emulate an adult park visitor of a height of approximately 170 cm. When navigating the virtual environment, the camera moves at a speed of 10 km per hour, which is faster that one would normally move in the real-world. However, as found in previous research (Bishop and Rohrmann, 2003), people perceive their movements in virtual environments as slower than the actual speed the camera travels. A faster walking speed was selected to compensate for this perception and to allow users to navigate the environment at what appears as a reasonable pace. In addition, because the geovisualization covers a sizable area (i.e., 85 navigable hectares), ‘teleportation points’ were positioned in various places along the spit, allowing users to instantly travel to a particular point using a key command.

The users’ movements were linked with sounds associated with walking in a coastal places (audio clips were purchased from the Unity Asset Store). Such sounds varied depending on where the user was within the virtual environment. For example, sounds of footsteps on sand could be heard when walking on beach, sounds of footsteps on wood could be heard when on the dock, and ‘splashing’ sounds were heard when wading in water. In addition, footsteps sounds are replaced with water ‘swishing’ sounds when in the underwater environment.

5.4 Focus Group Results

5.4.1 Parks Canada

Parks Canada participants expressed that (for the most part) the geovisualization was realistic and resembled Sidney Spit well. Particular aspects of the geovisualization that contributed to its representation noted in the feedback forms included beach textures (n = 2) and driftwood (n = 2). For the former, specific mentions were made of the beach wrack elements in surface textures, which aligns with aforementioned notion that certain beach texture elements (such as algae deposits) can ‘speak’ to sense of place (see *5.3.2 Terrain textures*).

Viewshed elements were also mentioned as a positive aspect of the geovisualization, and some participants (n = 3) noted in their feedback forms that this contributed to the representation. However, one negative comment was made, where a participant mentioned that a nearby island within the viewshed (i.e., Forrest Island) detracted from realism. During the group discussion, the comment was expanded upon by explaining that the colours were much brighter than those of the other viewshed items, and thus it look too distinct and less realistic. The island was part of the three-dimensionally modelled terrain rather the surrounding skybox, and what the participant’s comments indicate is that these differences in how these elements were modelled affected the coherence of the viewshed.

> “The island to the north looks less realistic than the rest” (Participant 6).

Positive comments were made around the marine environment within the geovisualization. One participant commented on the change in visibility, and noted that this contributed to the underwater experience. Others positively commented on the inclusion of eelgrass, and these comments led to discussion around potential for using the geovisualization to raise awareness around impacts anchoring can have on eelgrass meadows. However, some suggestions for improving the marine environment were made, particularly with adding more animal species as currently Dungeness crabs are the only marine animal featured in the geovisualization.

Several participants noted the incorporation of sound to be a positive aspect of the geovisualization in the feedback forms (n = 4), particularly the sounds of footsteps and gulls. One negative comment was made around the sound, referring to the ambient wave noise as being too loud. However, for the most part, the soundscape was regarded as a contributor to realism and sense of place.

The major aspect of the geovisualization that detracted from the representation was noted to be the lack of bird diversity, which was mentioned in feedback forms (n = 2) and (more extensively) in group discussion. The park provides habitat for a variety of bird life (Maurer, 1989); however, only gulls were included in the geovisualization and thus bird diversity was not captured. The participants expressed that this was a major missing piece, noting the absence of sandpipers, plovers, eagles and herons. In addition, the participants discussed the absence of purple martins and the nesting boxes that were installed on the main dock by Parks Canada. They indicated the birds and nesting boxes to be salient aspects of place by expressing how they regularly notice the birds/boxes when first entering park from dock and (thus) their absence was conspicuous.

Vegetation also was noted to be a detractor from realism and sense of place. Similar to the birds, the lack of tree diversity was commented on, specifically noting the absence of Arbutus tree species. In addition, the grass on the dune was noted to be too dense and uniform in height, giving it a less natural and more ‘crop-like’ look.

> “Dune grass at very tip near light beacon – too uniform/crop-like” (Participant 3).

Other aspects that detracted from the representation related to how the geovisualization did not capture the perceived ‘busyness’ of the park. In the feedback forms, participants noted that more boats (n = 2), people (n = 2) and dogs (n = 2) are typically found within the park. Specific mentions were made of the absence of boats tied to the dock and of people/dogs in the visitors area. Comments on the scarcity of dogs in the geovisualization were followed by discussion on issues concerning off-leash dogs disturbing local wildlife, indicating that the noted scarcity was linked with concerns for place.

> “Day-use [i.e., visitors area] should be busier with people and dogs” (Participant 3).
>
> “Should be boats tied to the dock” (Participant 5).
>
> “In my experience, there are many more boats on the dock, many more people” (Participant 6).

Participants mentioned that the starting point within the geovisualization detracted from the feeling of being in the real-world place, referring to how it loaded with the user at the north end of the spit. This starting point was selected because the fieldwork began here and more data were collected for this portion of the park. However, as noted in the group discussion, the vast majority of visitors enter the park through the main dock, and thus this would be a more appropriate starting point in terms of capturing place experiences.

Some of the coded data could not be classified as predominately positive or negative in response; for example, human-constructed elements within the geovisualization received ‘mixed’ responses. Positive responses were given for textures on these objects, such as the creosote on pilings and the legible images on signs (see Figure 24). However, negative responses were also provided, particularly concerning the absence of certain objects such as dock signage and payment vaults.

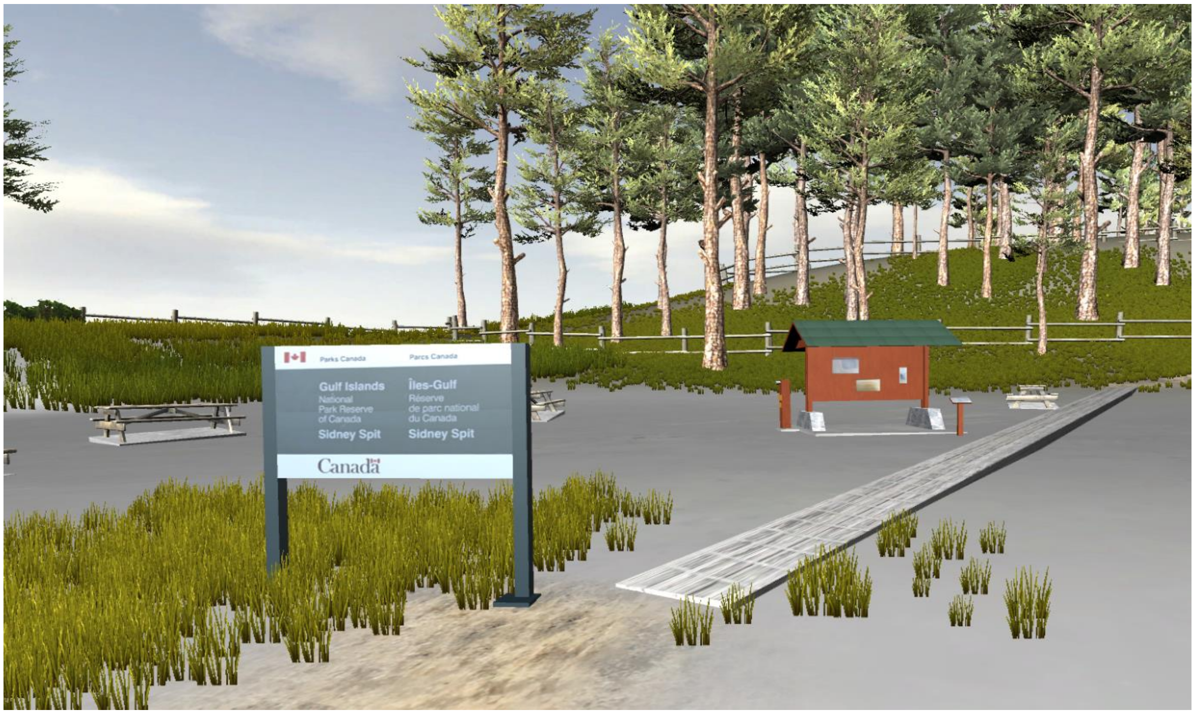

Figure 24. Visitors area within geovisualization
Signage within the visitors area was made using photographs of actual signs and is legible to geovisualization users.

Another aspect that received mixed responses was the dynamics within the geovisualization. Dynamic elements such as the movement and ripples on the water surface were regarded positively. However, other dynamics were regarded more critically; in particular, the swaying animation of vegetation in the wind was noted to be too dramatic. Such observations illustrate the importance of giving due attention to how dynamic elements should be animated, rather than simply thinking about what should be animated. This can be particularly important in the coastal context because as modelling techniques becoming more sophisticated, attention can be given to differences in physics found in terrestrial and underwater environments. For example, further research efforts can explore animating dune grasses and eelgrasses differently in accordance with how they (respectfully) react to wind and waves.

In recognition of the Parks Canada feedback, five more people models were placed in the geovisualization (within the visitors area), and these were equipped with animations and sounds to depict a group of visitors engaged in conversation. In addition, an off-leash dog running up and down the northern end of the spit was added[31], and gulls reacted to the dog by flying away when it approached. Five boats tied to the dock were also added, and the dock was set as the starting point. Furthermore, the bend factor in the grass was reduced to make the swaying animation less dramatic, and the range and randomization of grass blade heights were increased to reduce uniformity. Finally, ambient ocean wave sounds were reduced in volume. All these modifications were made prior to local resident focus groups, and thus local resident participants interacted with the modified version of the geovisualization.

5.4.2 Local residents

The overall response to the geovisualization in how it represented a real-world environment was positive, receiving a mean rating of 8.07 ($n = 21$, $SD = 1.83$). Interestingly, it was noted in multiple focus groups that imagery clearly looked like computer rendering; however, this did not detract from sense of place. Such comments align with Turner et al.’s (2013) observations, who found sense of place could be evoked through stylized (i.e., less photorealistic) virtual environments.

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[31] The position of the dog was based on a field observation of an off-leash dog disturbing gulls.

Table 9. Summary of local resident feedback on contributors and detractors from realism

Elements	Comments (n)	Positive (%)	Negative (%)
Viewshed	6	100	0
Driftwood	8	75	25
Human constructions	3	100	0
Vegetation	13	85	15
Birds	7	71	29
People	13	77	23
Dogs	7	100	0*
Boats	9	89	11
Beach textures	10	10	90
Dynamics	14	50	50
Marine environment and species	7	71	29
Sounds	15	93	7
Control	11	91	9

'Comments' column refers to total number of comments provided for a particular element. 'Positive' and 'negative' columns refer to the percentages of comments that (respectfully) refer to contributors and detractors from realism and sense of place.

* Negative comments were not specifically directed at the dogs; however, some comments regarding a lack of 'busyness' or visitor crowds could be interpreted to include dogs.

Several similarities were observed between Parks Canada and the local resident focus groups in terms of what contributed to realism and sense of place. For example, viewshed elements were mentioned as contributors (n = 6), in particular skybox elements such as islands, landscape, clouds and mountains. The presence of driftwood was also mentioned as a contributor by several participants (n = 6), although two participants did not did not like the design of the driftwood models. Human-constructed elements, such as signs, were regarded positively by three participants, and one of these participants made comments similar to those of Parks Canada regarding the legibility of signs, suggesting that being able to read signs is form of interaction that contributes to geovisualization's representation of place.

"Posters are readable on bulletin board!" (Participant 25).

In contrast to the Parks Canada session, vegetation for the most part was regarded positively with many noting in their feedback form that this contributed to realism (n = 11) and fewer providing negative comments (n = 2) around of the geovisualization. Participants made specific references to the grasses (n = 7) and trees (n = 5), and two participants spoke positively about the diversity of vegetation. Birds were also regarded less critically with only one comment in the feedback forms around the lack of diversity (and another critiquing the design of the bird models); whereas, five comments indicated that the bird elements contributed to the representation.

The presence of people and dogs were noted in the feedback forms as contributors to realism and sense of place (respectively, n = 10 and n = 7). One participant referred to a specific person model within the geovisualization as ‘holding our gaze’, indicating that the user’s interaction with this model is effectively being perceived as a social interaction. However, albeit comments were mostly positive, two participants[32] echoed Parks Canada sentiments concerning the lack of busyness in the geovisualization, despite the addition of more people models and another dog. One participant specifically referred to the ‘large crowds’ they experienced during their visit and expressed concerns around managing this level of visitor traffic. Similarly, the presence of boat elements also were noted to be a contributor to place (n = 8); however, at least one participant felt there were too few to adequately capture the busyness of the environment.

> “Guy in red t-shirt shifting feet and holding our gaze” (Participant 22).
>
> “Missing are the large crowds the day we were there - how will Parks [Canada] deal with these” (Participant 1).

As with the Parks Canada session, sounds were considered by many as a great contributor to realism and sense of place (n = 4) with some mentioning during group discussions that this was the best aspect of the geovisualization. Some participants specifically commented on sounds associated with particular aspects of the environment, such as dogs (n = 2), boats (n = 2) and people (n = 2), and with the latter, one of the participants noted that the people speaking ‘seemed natural’. The only negative comment associated with sound involved a participant noting that she would have liked to have understood some of the conversations[33], which could be interpreted as

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[32] Three negative comments were made regarding people elements in total; however, the comments differed in nature. Two regarded the lack of ‘busyness’; whereas, the remaining comment indicated that the presence of people models did not contribute to the representation.

[33] Some conversation sounds used ‘mumbling’ sound effects with no coherent content.

the people models being convincing enough that they spurred a desire for further interaction. Other positive comments around sound related to changes in footstep sounds when moving through different parts of the geovisualization (n = 2), particularly the splashing sounds when wading in water.

> “Liked the fact that people spoke–which seemed natural” (Participant 13).
>
> “When approach group of people, would have liked to hear what they are talking about” (Participant 27).

Local resident focus group sessions differed from the Parks Canada session in that participants were provided with laptops to explore the geovisualization on their own. In turn, many local resident participants provided comments through feedback forms around how user control contributed to the geovisualization experience (n = 10), and only one participant provided a negative comment around this aspect (specifically noting that the movement speed felt somewhat slow). Four participants noted the ability to look in different directions as a benefit, and during the discussion, one of these participants specifically noted having the ability to look up toward flying birds after seeing shadows coincided with the instinctual responses he would have in the real world. In addition, three participants commented on the ability to move across the land-sea interface as strong aspect of the geovisualization. These points were reinforced during the discussion as some expressed that the ability to enter the marine environment was one of the most important aspects of the geovisualization, discussing how it portrays coasts and interconnected terrestrial and marine environments. It is also worth noting that changing the starting position to the main dock did appear to contribute to the geovisualization’s effectiveness, as a participant noted that it contributed to a sense of ‘being there’ in the real-world environment.

> “Starting at the dock – totally felt like I was there” (Participant 20).

In contrast to the Parks Canada session, the beach textures were noted by many local resident participants as detractor from realism and sense of place (n = 9). In some cases, these comments referred to certain items that were not included in the textures such as footprints; however, many of the comments referred to items that were in the textures but more difficult to see in the lower resolution laptop versions (e.g., shells, small pieces of wood). In addition, the contrast between sand and water was poorer on the laptop screens, making it difficult to differentiate between the two bodies. Because Parks Canada participants did not use laptops, this was not described as a detractor in this session, and it was clear through the discussions and feedback forms, local resident participants recognized the issue as being with the laptop version.

> "The details on the [projected] screen are more realistic and easier to follow" (Participant 20).

As with Parks Canada, dynamic elements received mixed responses with some participants mentioning contributors (n = 7) and others noting detractors (n = 7). Comments on contributors generally referred to the presence of animations, such as people walking, dogs running and waves washing ashore (it is worth noting that grass swaying in the wind also was noted as a contributor, indicating that reducing the bend factor was effective). Detractors were more specific around behaviors, noting movements that did not appear 'right' such as some people moving too 'jerkily' and gulls not foraging in the correct manner. Such observations reinforce the notion that attention needs to be given to how dynamic elements are animated, and in certain cases such as with wildlife elements, architects of geovisualizations can collaborate with ecologists to develop better animations that model behaviors in a more convincing manner.

As noted above, the ability to enter the marine environment was regarded positively; however, the elements displayed in this environment received a more mixed response. Some participants made positive mention of the eelgrass (n = 3) and crabs (n = 2), but the lack of other species was commented on in feedback forms (n = 2) and also emerged as a topic in group discussions. In addition, some participants mentioned that they might not have even noticed the crabs if they were not pointed out during the demonstration. Such observations indicate that expectations around vibrancy of marine ecosystems were not met with the geovisualization.

5.4.3 Familiarity effects

Quantitative analysis on the ratings of how well the geovisualization represents a real-world place did not produce statistical evidence for supporting the notion that familiarity influenced these values. This was the case for both approaches for investigating familiarity effects, where categorization was done with people 'primed' with a visit to Sidney Spit prior to the focus group ($t(19) = 1.09$, $p = 0.28$) and with people that have visited the park multiple times in the past

($t(19) = -0.17$, $p = 0.87$). A potential explanation for this could relate to comments made during one of focus groups involving participants that were not taken to Sidney Spit. It was noted during group discussion that the geovisualization was very ‘typical’ of BC coastal places. If this sentiment was shared among participants in other groups, then it could be argued that the virtual environment held a certain degree of familiarity to all participants as it resembled other local coastal places, regardless of whether the participant had specific familiarity with Sidney Spit[34].

Table 10. Descriptive statistics of representation of place ratings

Group	Description	N	M	SD
Primed	Was taken to Sidney Spit by researcher prior to focus group	13	8.63	0.74
Not primed	Was not taken to Sidney Spit by researcher prior to focus group	8	7.73	2.22
Familiar	Visited Sidney Spit multiple times outside of session	11	8.14	1.31
Unfamiliar	Visited Sidney Spit once or no times outside of session	10	8.00	2.23

Data were either categorized as ‘primed’ and ‘not primed’ or ‘familiar’ and ‘not familiar’. Ratings were not provided by 6 of the 27 participants; thus, the table features data from 21 respondents.

Albeit familiarity effects were not observed with ratings data, an interesting trend was observed when examining coded feedback data. When categorizing groups into ‘familiar’ and ‘unfamiliar’, all positive comments around viewshed elements ($n = 6$) were associated with the ‘familiar’ group. Similarly, when categorizing into ‘primed’ and ‘not primed’, most viewshed comments ($n = 5$) were associated with the ‘primed’ group. No other geovisualization element exhibited such a noticeable coding difference, and it is possible that viewshed elements in particular can speak more strongly to sense of place of people that have experienced and/or are familiar with the specific real-world place. This notion is further supported by the fact that Parks Canada participants (i.e., a ‘familiar’ group) also brought forward viewshed elements as strong contributors to realism and sense of place.

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[34] It is important to recognize that the sample size of this study is quite small; whereas, the sample size of Bishop’s and Rohrmann’s (2003) research (i.e., the study that served as precedent for exploring familiarity through ‘priming’ participants) was much larger ($n = 84$). It is possible familiarity effects would have been observed with a larger sample size; however, this is uncertain and the current study only interprets and reports on observed effects (or lack thereof).

5.5 Discussion

Newell and Canessa (2015) posit that geovisualizations are effective collaborative planning tools due to their capacity for connecting with people's sense of place. Building on this thinking, the current study conducted applied research to examine the considerations around place-based approaches to coastal geovisualization. As discussed in *5.1 Introduction,* such considerations include how to model coastal 'place' (as well as coastal space), how place-based experiences of the geovisualization architect can influence modelling, what elements are significant in terms of connecting with sense of place, what aspects might detract from this sense, and how to incorporate multisensory experiences associated with places into a virtual representation. Each of these considerations are important in terms of how a geovisualization represents and connects with particular place meanings and values, and thus they hold implications for geovisualizations' capacity as place-based tools for engaging different groups and stakeholders. This work on developing a coastal geovisualization and assessing/examining how it connects with sense of place has provided insights on these considerations, and these insights are discussed through the sections below.

5.5.1 Modelling place

The current study is novel in how it focuses on modelling place rather than space; however, as demonstrated in the research, such place-based modelling is strongly linked with spatial considerations. Sheppard (2001) noted that a visualization can realistically portray a place without accurately representing a real-world location, and such a comment reflects consequences of capturing place features without due attention to space. Space and place are both fundamental properties of geography (Agnew, 1987); therefore, albeit this research focuses on place-based tools, the process of geographical visualization required attention to both properties. However, this being said, spatial considerations were handled differently with this place-based tool than if preparing a tool for spatial analysis. For example, creating the topo-bathymetric raster did not require reconciling vertical datums as the aim was simply to develop a surface with the correct land-to-sea 'shape', and in addition, raster cells were distorted with a Gaussian blur to better capture said shape. As another example, boats traveling past the park were not modelled using vessel tracks; rather, they were set on paths with particular distances from the shoreline to accurately emulate place-based experiences of observing boats when viewing the ocean. Similarly, distant viewshed elements were not modelled in terms of their actual location around Sidney Island; instead, they were prepared as a two-dimensional panoramic, fitted in a skybox, and then oriented to accurately represent the viewshed. Ultimately, developing place-based tools involves consideration around both space and place; however, with many of the modelled elements, spatial work was done in the context of place, meaning that place characteristics were aligned with spatial relationships.

Places are shaped by our lived experiences (Stedman, 2003; Gunderson and Watson, 2007), and thus the activities a person performs in a coastal place can influence their sense of place (Shackeroff et al., 2009). As seen in this study, such influences in turn can translate to how the architect of a coastal geovisualization models place. In some cases, this can contrast with the sense of place of the geovisualization users, e.g., initially setting the starting point at the north end of Sidney Spit was based on entirely the fieldwork experiences of the researcher/modeller, whereas the dock starting point better aligned with the place experiences of others. In other cases, there might be congruence in place experiences between the architect and users, e.g., the ability to read signs was incorporated into the geovisualization due to the modeller’s experiences reading the signs as soon as entering the park and this feature was regarded positively by others who (likely) had similar experiences. In addition, because the activities people perform influence sense of place, it follows that their professions and interests do as well (Yung et al., 2003). When such professions/interests involve specialized knowledge, this can lead to nuanced perceptions of places; for example, Wood and Lavery (2000) found that seagrass scientists and coastal resource managers include particular biological elements in their images of certain seagrass meadows based on their knowledge of how healthy they perceive the meadows to be and what makes for a healthy ecosystem. Similarly, in this study, the lack of bird and tree diversity was apparent to Parks Canada staff, who had expert knowledge on Sidney Spit’s ecosystem; whereas, this was not as conspicuous to those without the same level of knowledge (i.e., the researcher/modeller and local resident focus group participants). Such observations suggest that attention needs to be paid to the user group when developing realistic geovisualizations because the exclusion of particular elements can reduce the tool’s effectiveness for connecting with the sense of place of certain coastal stakeholders and (perhaps of more concern) for conveying possible effects/impacts to such elements when using the tool to display potential management options to these stakeholders.

5.5.2 Connecting with sense of place

The presence of people in the geovisualization was considered to be a contributor to realism and sense of place, with specific mentions made around how people models could speak and greet the user. This aligns with studies that describe social contexts as being part of sense of place (Lai and Kreuter, 2012; Campelo et al., 2014) and research that discusses how many coastal users value coastal places for their social opportunities (Thompson, 2007; Stocker and Kennedy, 2009). However, although the presence of people models was regarded positively, the abundance of people, or lack thereof, was regarded more critically (even after more models were added to geovisualization). The numbers and distribution of people were based on field data averages; therefore, fewer people in fact were observed in some field days than were present in the geovisualization. However, ultimately, focus group comments indicated that (at least for some) this did not adequately capture the busyness of the park. In light of these findings, perhaps using visitor traffic averages in modelling coastal place is not the best approach; rather, this would be better done through ranges and allowing users to experience ‘busy days’ or ‘quiet days’, in a similar manner to how users can experience the geovisualization at different tidal levels.

Viewshed elements were regarded as contributors to realism and sense of place. This was somewhat expected, as it coincides with other research that describes ocean views as particularly important to certain coastal users (Thompson, 2007). However, what was interesting about user interaction with viewshed elements was its potential sensitivity to familiarity effects, meaning that people who were familiar with the real-world coastal place appeared more likely to comment on the viewshed (and commented positively). Such a finding aligns with previous research that has found ocean views to be linked with place attachment (e.g., Devine-Wright and Howes, 2010) and that such attachment can form with time spent in coastal places (e.g., Kelly and Hosking, 2008). What this would suggest is that architects of coastal geovisualizations should pay particular attention to the development of viewshed components when building the tools for collaborative planning with stakeholders of high place familiarity, particularly when proposed plans could threaten ocean views such as with offshore wind turbine developments (e.g., Phadke, 2010).

In contrast to the viewshed elements, beach textures received highly critical responses. In turn, these responses led to important findings on the effects image resolution held on the geovisualization's ability to connect with sense of place. Lewis et al. (2012) noted that much of visualization research has been driven by a 'technical thrust' that focuses on qualities such as graphical capabilities and rendering speed; whereas, the 'human aspects' (i.e., user-side) of the research have not been given as much attention. However, the findings from this study suggest that technological and human aspects of geovisualizations are intimately linked, particularly with respect to quality of image. When constructing the geovisualization, beach textures were considered by the researchers as important components of modelling place and much time was spent mapping and developing the texture surfaces. However, these efforts were negated when running the geovisualization on lower performance computers (i.e., the laptops), as place-related elements such as shells and woody debris could not be seen with poorer resolutions. Such an observation indicates that place-based tools require a certain level of computer performance to adequately convey the complexity, texture and vibrancy of real-world environments.

5.5.3 Modelling marine places

A unique feature of the geovisualization in this study is that it allowed people to travel into the marine environment. Participants regarded this positively due to how it illustrated the interconnectivity of marine and terrestrial environments, which was an encouraging observation because effective coastal management requires cognizance that coasts comprise a land-to-sea continuum (Cicin-Sain, 1993; Sorensen, 1997; Garriga and Losada, 2010) and part of the intention of making the geovisualization navigable was to convey the interconnectivity (see *5.1 Introduction*). However, the marine component received some critical response, particularly in how it seemed lacking in marine species and (thus) did not capture the vitality of marine ecosystems. From the modeller's experiences with the snorkeling fieldwork, the geovisualization actually did align with his memories of the underwater environment; that is, the visibility was poor and he mostly could see eelgrass, sea lettuce and (occasionally) Dungeness crabs. However, despite this representativeness, the modelled marine environment did not meeting user expectations. A possible explanation for this incongruity can be drawn from Merchant (2012) phenomenological research on experiences of novice SCUBA divers. She observed that some divers' remembered coral reefs as 'disappointing' due to their lack of vibrancy; however, when shown underwater images with filters that enhanced vibrancy, these images aligned more with their perception and expectation of the marine world than did their memories. As a terrestrial species, humans do not spend much time in the marine environment; therefore, it is possible many people form mental images of marine places based more on pictures, videos and/or knowledge around marine ecosystems, rather than through first-hand experiences. If this is the case, it raises questions on how marine environments should be modelled in place-based geovisualizations. In particular, should this be according to field observations or collective understandings/impressions, and if it is a combination of both, how does the architect of a geovisualization optimally 'balance' these modelling approaches?

5.5.4 Multisensory tools

Unlike many other visualization tools, the geovisualization in this study incorporates sound and thus operates on senses beyond just sight. This feature was very well received, and it appeared to enhance the tool's ability to connect with sense of place. Sterne (2003, 15) noted that "hearing immerses its subject; [whereas,] vision offers a perspective", which suggests that soundscapes can complement visuals within a geovisualization by offering a degree of immersion that allows for stronger place-based sensations. This notion is supported by other research that has found that people feel more 'present' in virtual environments with soundscapes (Larsson et al., 2007). In light of such research and the findings of this study, future work on realistic geovisualizations should progress from studies on purely visual tools. Some efforts have been made in this area, such as Bishop and Stock (2010) incorporation of sound into their wind turbine visualization. However, much more research around developing and examining applications of multisensory tools is needed, and such research can even explore beyond what is studied here (i.e., sight and sound) to include other senses such as touch and smell (Lindquist and Lange, 2014).

5.6 Conclusion

Modelling place requires incorporating a large amount of detail and capturing a wide diversity of elements. Such efforts are time-intensive; however, future research similar to that done in this study can continually illuminate techniques for place-based modelling and streamlining the process. In addition, a geovisualization does not need to be built as a 'final product', meaning that it can involve an iterative and ongoing effort with improvements to the base model as more stakeholders interact with it. This approach does necessitate considerations around geovisualization ethics, particularly ensuring there is transparency in terms of what has been excluded due to time and/or data constraints (Sheppard, 2001). However, as Lewis et al. (2012) noted, this should not prevent continual development of such tools; instead, users should be made fully aware of the tools' shortcomings. In fact, the process of engaging in dialogue around these shortcomings and ways of improving a geovisualization's representation of a real-world place can be valuable on itself, as it can lead to discussion and insights on what different stakeholders consider to be important aspects of certain places and environments.

Chapter 6

Visualizing our options for coastal places: Exploring realistic immersive geovisualizations as tools for inclusive approaches to coastal planning and management[35]

Abstract

Effective coastal planning is inclusive and incorporates the variety of user needs, values and interests associated with coastal environments. Realistic, immersive geographic visualizations, i.e., geovisualizations, can serve as potentially powerful tools for facilitating such planning because they can provide diverse groups with vivid understandings of how they would feel about certain management outcomes or impacts if transpired in real places. However, the majority of studies in this area have focused on terrestrial environments, and research on applications of such tools in the coastal and marine contexts is in its infancy. The current study aims to advance such research by examining the potential a land-to-sea geovisualization has to serve as a tool for inclusive coastal planning efforts. The research uses Sidney Spit Park (BC, Canada) as a study site, and a realistic, dynamic geovisualization of the park was developed (using Unity3D) that allows users to interact with and navigate it through the first-person perspective. Management scenarios were developed based on discussions with Parks Canada, and these scenarios included fencing around vegetation areas, positioning of mooring buoys, and management of dog activity within the park. Scenarios were built into the geovisualization in a manner that allows users to toggle different options. Focus groups were then assembled, involving residents of the Capital Regional District (BC, Canada), and participants explored and provided feedback on the scenarios. Findings from the study demonstrate the geovisualization's usefulness for assessing certain qualities of scenarios, such as aesthetics and functionality of fencing options and potential viewshed impacts associated with different mooring boat locations. In addition, the study found that incorporating navigability into the geovisualization proved to be valuable for understanding scenarios that hold implications for the marine environment due to user ability to cross the land-sea interface and experience underwater places. Furthermore, this research demonstrated that building scenarios within a realistic geovisualization required modelling place-based characteristics (including soundscape) as well as spatial properties, and this approach can allow users the ability to more comprehensively assess scenarios and consider potential options.

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6.1 Introduction

Effective coastal planning is inclusive and incorporates the variety of user needs, values and interests associated with coastal environments (Bowen and Riley, 2003; Cicin-Sain and Belfiore, 2005). Accordingly, tools that can effectively facilitate collaborative approaches to planning and management can serve as integral components within the governance of coastal systems and their essential resources and services. Realistic, immersive geographic visualizations, referred to here as 'geovisualizations', hold potential as such tools due to their capacity to communicate management and/or development outcomes to diverse groups of stakeholders. Through realistic representation, geovisualizations can provide people of a variety of different backgrounds and expertise with salient understanding of how they would feel about certain management outcomes or impacts if they transpired in real places (Newell and Canessa, 2015; Sheppard, 2001). In turn, this can enable productive planning discussions among different parties that are potentially affected by proposals and plans. In support of this notion, previous research has found that geovisualizations show promise as tools for collaborative efforts such as climate adaptation planning (Sheppard et al., 2011), understanding and assessing natural resource management issues (Lewis and Sheppard, 2006), and stimulating discussion among stakeholders regarding future land-uses in the face of changing landscape conditions (Schroth et al., 2011).

Although research has made progress elucidating the potential geovisualizations have as tools for collaborative planning and management, this work has primarily been conducted in the terrestrial context, leaving the coastal context largely unexplored. Coastal systems have particular biophysical and human-related characteristics that present unique challenges and considerations for geovisualization work, and these are insufficiently understood through terrestrial-focused research. Coasts consist of a land-to-sea continuum; thus, they are geometrically complex and support a wide variety of activities, interests and values (Shackeroff et al., 2009; Stocker and Kennedy, 2009; Thompson, 2007). Engaging in effective coastal management and governance requires recognition that these places comprise interdependent marine and terrestrial environments (Cicin-Sain, 1993; Garriga and Losada, 2010), tasking coastal geovisualization with the challenge of capturing such complexity. In addition, coastal systems act as the nexus between terrestrial and marine processes and thusly form highly dynamic places (Sorensen, 1997); therefore, unlike terrestrial visualizations which can be constructed as static images (e.g., Lewis and Sheppard, 2006; Schroth et al., 2009; Tress and

Tress, 2003), coastal geovisualizations must incorporate dynamic, four-dimensional properties in order to accurately capture the ‘reality’ of coastal places (Beegle-Krause et al., 2009; Gold et al., 2004). In recognition of these considerations, Newell and Canessa (2017) recommend building coastal geovisualizations with navigability to allow for movement across the land-sea interface and also with four-dimensional properties in order to convey dynamism. Building geovisualizations (and virtual representations of scenarios) with such properties presents challenges; however, addressing these challenges is necessary for these tools to be effective for collaborative planning within the coastal context.

This work is part of a larger research project, which explores geovisualizations as tools for collaborative coastal management and planning, and this chapter details the second part of two-part study. The first part involved building the coastal geovisualization and examining how well it represents a real-world coastal place, and this work is detailed in Newell et al. (2017)[36]. The second part (i.e., this chapter) focuses on building coastal management scenarios into the geovisualization and then investigating how the tool performs in terms of allowing diverse groups the ability to effectively assess scenarios and provide thoughts, comments and ideas.

6.2 Methods

6.2.1 Study area

The geovisualization in this study models the Sidney Spit area in the Gulf Islands National Park Reserve (GINPR), which comprises the northern most portion of Sidney Island and is located approximately 4 km east of the municipality of Sidney, BC (see Figure 25). The park contains a spit that projects 1.8 km northward (known as Long Spit) and is contiguous with hook-shaped spit (known as Hook Spit) that forms the border of a lagoon. Sidney Island provides critical habitat for a variety of bird species and marine life, and the northern part of the island and adjacent waters were established as the Sidney Spit Provincial Marine Park in 1961 (Maurer, 1989). In 2003, this area became incorporated within GINPR, and current uses of the space consist primarily of recreational activities such as camping and walking (Parks Canada, 2012). The island is accessible by private boat or by a seasonal ferry, which typically runs from late-May to early-September (Parks Canada, 2012). Marine areas around the island are used by

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[36] The first part of the two-part study referred to here is included in this dissertation as Chapter 5.

boaters, and some fishing activities are permitted in these spaces (e.g., Fisheries and Oceans Canada, 2014).

Figure 25. Map of Sidney Spit
The map was retrieved from the Capital Regional District Webmap system. Both the City of Sidney and Sidney Spit are labelled, and the Sidney Spit park boundaries are displayed.

6.2.2 Sidney Spit geovisualization

The geovisualization was developed using data provided by Parks Canada and collected through fieldwork. The process involved a combination of ArcGIS (v10.3.1), Adobe Photoshop (CS5), Trimble SketchUp (pro 2015) and Unity3D (v5.3.4) game engine. These programs were selected respectively to build the model with spatial integrity (ArcGIS), develop realistic textures (Photoshop), build objects (SketchUp) and create a dynamic and navigable virtual environment (Unity). The result was a representation of Sidney Spit that allowed users to walk through it, experience it from the first-person perspective, and interact with a variety of static and animated elements, such as signs, litter, picnic tables, beached dinghy, dock, fences, lighthouse, pilings, boats, crabs (Dungeness), dogs, gulls, people, vegetation (marine and terrestrial) and driftwood. A complete description of the modelling process can be found in Newell et al. (2017).

The geovisualization contains approximately 85 hectares of navigable area, spanning from the main dock to north of the Long Spit and bounded by an impassible invisible barrier (see Figure 26). The geovisualization loads with the user at the dock, and the users can ‘walk’ through the virtual environment at a pace of 10km per hour. The travel pace is faster than typical walking speed; however, it was selected because people generally perceive their movements in virtual environments as slower than the actual speed the camera travels (Bishop and Rohrmann, 2003). As shown in Figure 26, a user can also travel through geovisualization using key commands that relocates him/her to various ‘teleportation points’. This feature was added to allow users to explore different parts of the spit and examine key areas affected by the scenarios without spending excessive time ‘walking’. Teleportation points initially were distributed evenly along the spit; however, points were added and repositioned to locations near areas where effects of scenarios could be observed (see sections on geovisualizations scenarios below).

Figure 26. Map representing the geovisualization’s navigable area
The yellow lines demarcate the boundaries of the navigable area of the Sidney Spit geovisualization. Red makers represent teleportation points, and marker labels display key commands for teleporting to the respective locations.

Modelled elements located outside the boundaries of the navigable area formed the viewshed. Nearby elements (i.e., within ~3km of navigable area) were modelled three-dimensionally and in a similar manner to those within the navigable space; however, more distant elements were represented through a ‘skybox’, which is a cube constructed around a virtual environment equipped with images on the inside panels to serve as background scenery (e.g., Hong-ge, 2010; Hu et al., 2012). Skybox panels were aligned in a manner that panel imagery displayed similar views to what park visitors would see when in various locations within the park (see Figure 27a). It is worth noting that these views were only visible above the water surface, as a fog effect was applied in the underwater areas of the geovisualization to represent the lower visibility experienced in marine environments (see Figure 27b), similar to that done in Canessa et al. (2015).

Figure 27. Geovisualization views from above and below water surface

Figure 27a displays a screenshot of the geovisualization with the user located above water and on the beach. Figure 27b displays a screenshot of the user located underwater.

The majority of geovisualization work has focused on the visual sense; however, there is recognition around the value of developing multisensory tools for planning (Lindquist and Lange, 2014) and accordingly, this geovisualization incorporates auditory stimuli. Sounds within the geovisualization include ocean waves, boat motors, gulls cawing, dogs barking, people walking on the beach, greetings from other park visitors and sounds of conversation. Most sounds were associated with particular objects and could be experienced three-dimensionally (i.e., stereophonic sounds that change in volume depending on distance to source); however, ambient sounds were also included, consisting of ocean waves when above the water surface and ‘bubbling’ when below the surface. Many sounds were triggered by ‘colliders’, meaning that the sounds were activated when entering a particular space; for example, greetings would sound when entering a collider positioned in front of a model of person. Colliders were designed in such a manner that above-surface sounds could not be heard when underwater with the exception of boat noises, and such an exception was made in recognition of growing research around noise pollution produced from marine vessel traffic (Simmonds et al., 2014; Williams et al., 2014; Williams et al., 2015).

6.2.3 Developing geovisualization scenarios

Scenarios were developed around management issues that are faced by the park. The issues were selected following a focus group comprised of six Parks Canada staff, including those working in resource management, promotion, protection, visitor experience and interpretation. The group was affiliated with the Parks Canada branch responsible for the management of Sidney Spit; thus, they were able to comment on critical issues and considerations specifically associated with the park.

The session was held at the Parks Canada office in Sidney, BC, and lasted two hours. The session began with a 15-minute presentation on how the geovisualization was built. The geovisualization was then presented on a 50-inch Panasonic TH-50PH12 screen, running the application from a Dell Precision T1700 computer with an NVidia Quadro K2200 graphics card and external speakers for sound. The group was given a demonstration on how to navigate the geovisualization and what terrestrial and marine elements can be seen within the virtual environment. Following the demonstration, a discussion was held on potential applications of the geovisualization and the types of issues it can be used for as a communication tool. The group also commented on what elements contributed to and detracted from the geovisualization's realism and representation of a real-world place; however, results from that discussion are reported elsewhere (Newell et al., 2017)[37].

Several suggestions were made around potential applications for the geovisualization; however, three particular management issues were selected for the purposes of this study. The selection was based on how prevalent the management issues were within the focus group discussion and the potential for clearly representing different management options around the issues using the geovisualization. The resulting scenarios presented options for (1) fencing of a vegetation restoration area, (2) positioning of mooring buoys for use of recreational boaters, and (3) managing of dog activity within the park.

Suggestions that were not used for scenario building included visitor preparation applications, such as allowing users to virtually experience campsites prior to making reservations and allowing users to virtually experience the park activities (e.g., virtual kayaking tour). The former was not selected as the campsite area was not modelled within this geovisualization, and the latter was not selected due to there not being clear management scenarios that could be built around this application. Another suggestion was to demonstrate effects of sea level rise through the visualization. This suggestion was not used in the study due to occurring on a different time horizon than those of the other management issues, and also management options for this particular issue, in which local resident input/feedback would be valuable (see *6.2.7 Focus groups*), were less clear than those of the selected issues.

6.2.4 Fencing

Fencing scenarios were based on potential plans for removing Scotch broom located in the northern portion of Sidney Spit and allowing native plants to spread throughout the area. Scenarios were developed with the intention of discouraging people from entering the vegetation area, while also minimizing the amount of fencing required to achieve said objective. Parks Canada identified two potential configurations for fences, each requiring approximately 215m of fencing (see Figure 28). One option involved fencing only part of the vegetation area with a full

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[37] Results from this discussion are documented in Chapter 5 of this dissertation.

enclosure loop encompassing the northern half. This configuration does not capture the entire area; however, it would protect certain critical species concentrated in the northern portion, particularly contorted-pod evening primrose. The second configuration spans more of the vegetation area using the same length of fence by only covering the southern and western sides of the area. The effectiveness of this configuration is based on the fence serving more as a signal for people not to enter the area, rather than being an actual physical barrier. The majority of visitors entering the park from the main dock, and (based on anecdotal field observations) most appear to approach the north end of the spit walking along the west beach; thus, these visitors would encounter the south and west fence in their walks. In addition, it was noted through the Parks Canada focus group that the eastern side of the vegetation area is steeper when approaching from the beach, which could serve to discourage people from entering the vegetation area when on the eastern beach.

Fencing scenarios also included options for potential locations for signs to be placed along the fence. Potential sign locations were selected by the researcher/modeller (i.e., rather than Parks Canada), and locations differed depending on configuration. Locations identified for the west side only option included a southern position, a northern position and a ‘mid-way’ position (see Figure 28a). Locations identified for the full enclosure option included a point on the west side, a point on the east and a point near the lighthouse at the northern end (see Figure 28b). The design of signs remained the same for all locations and both configurations, consisting of a square board bolted to a wood post with a simple message directing people to stay out of the restoration area (see Figure 29).

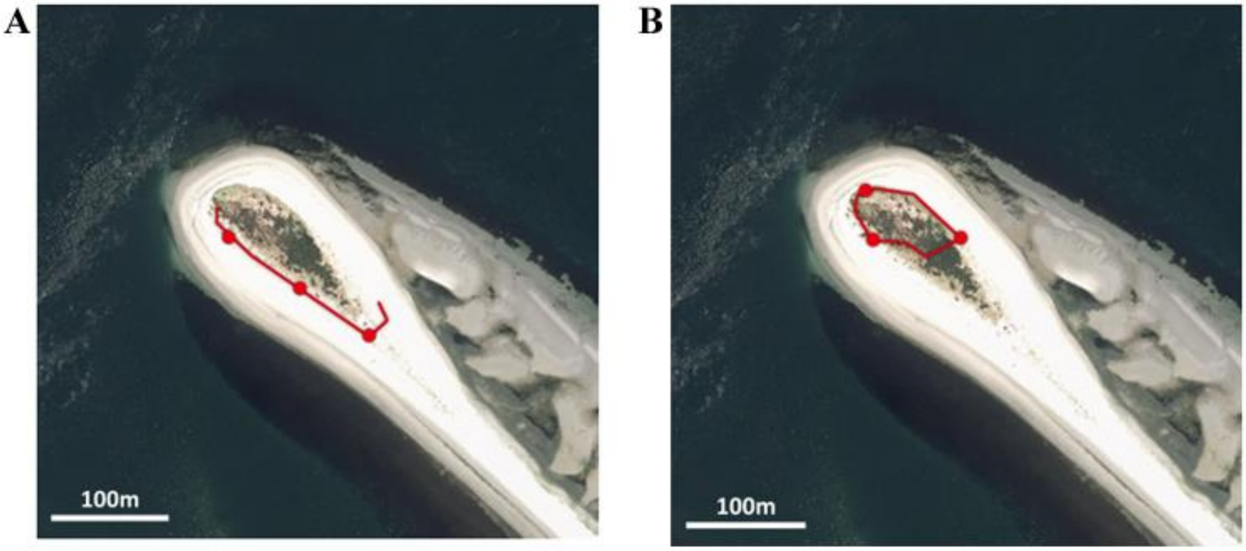

Figure 28. Maps of fencing configurations and potential sign locations
Figure 28a displays the west side only configuration. Figure 28a displays the full enclosure configuration. Red markers identify potential sign locations.

Fencing scenarios also involved options for materials and design (selected by the researcher), and these included split-rail wood fencing, rope fencing supported by wooden posts and wire mesh fencing (see Figure 29). The former two were selected because they aesthetically align with fencing already present within the park (i.e., split-rail) and the nearby town of Sidney (i.e., rope). The selection of the latter was based on other coastal dune fencing projects that have employed wire mesh (e.g., Devoy, 2016).

Previous visualization research has linked metrics such as financial costs with visualized scenarios to allow users to make more informed decisions (Grêt-Regamey et al., 2013), and drawing from this research, expenses associated with constructing fences (i.e., materials and labour) were estimated for each of the three fencing types. This was done by consulting a variety of websites that provide information on potential costs of construction projects, such as fencepriceguides.com, homewyse.com, promatcher.com, rnmfencing.com, angieslist.com, homedepot.ca and costhelper.com. Costs (in Canadian dollars) were estimated to be $20,000 for split-rail, $3,500 for wire and $17,500 for rope. It is important to note that these figures represent very rough estimations, and were not considered reliable for actually budgeting and executing fence construction. However, they capture differences in the magnitude of costs, and in the context of the current study, this was considered sufficient for assessing how well the geovisualization performs as a planning tool.

Figure 29. Fencing scenario materials and designs

Figure 29a exhibits the split-rail wood fencing option. Figure 29b shows the wire meshing fencing option. Figure 29c displays the rope fencing options. As seen in the images, wording and design for fencing signage is consistent among all three fencing types.

The building of fencing scenarios into geovisualization involved modelling fence pieces using SketchUp and then importing the pieces into Unity. Each piece consisted of two supporting posts and fencing that spanned the posts. When imported into Unity, pieces were scaled to assume a length of approximately 2.5m, and pieces were duplicated until enough were available to construct the entire 215m of fencing. Heights of fences varied depending on the material, with split-rail fence posts ranging 1.15m to 1.4m in height, rope fence posts ranging 1.15m to 1.3m and mesh fence posts ranging 1m to 1.25m.

Positioning of fences and signs was done using what this research refers to as ‘reference maps’, which are maps that are imported in Unity and fitted onto terrain assets in order to guide spatially accurate placement of objects (Newell et al., 2017). Reference maps for the fencing configurations were prepared from digitized images of orthophotographs with pen drawn lines on them (drawn by Parks Canada staff). Reference maps for sign locations were prepared by adding points to the maps in Photoshop after digitization.

Once fencing scenarios were built in Unity, key commands were assigned to toggle different configurations, materials, and sign locations. Key commands were assigned in such a manner that single key would toggle both a certain configuration and particular material, resulting in six keys allocated for toggling the three materials in both configurations. Once a particular configuration was selected, three other keys could be used to position the signs in one of the three proposed signage locations. Fencing scenarios could also be toggled off by a key command that disables fence and sign models.

As aforementioned, fencing scenarios were based on plans for removing Scotch broom and allowing native plants to spread throughout the area; therefore, toggling fencing scenarios changes the plant elements modelled within the geovisualization. Toggling replaces Scotch broom elements with native plant elements, which represent dune grasses, contorted-pod evening-primrose, yellow-sand verbena and silky beach pea. Following a suggestion made during the Parks Canada focus group, the composition and density of the native vegetation were modelled using images of a plant restoration site located on a nearby island (James Island) with similar native species (COSEWIC, 2009; NCC, n.d.). Modelling of contorted-pod evening-primrose patches was also guided by reference maps prepared from Parks Canada species at risk maps that display current distributions of the plant.

Two common nighthawk nesting sites are currently located in the Scotch broom patch, and thus when removing the broom, these sites are exposed. This was shown through geovisualization by adding models of nighthawks when fencing scenarios are toggled. Nighthawks were placed within the geovisualization using reference maps prepared from Parks

Canada data on nesting site locations. Toggling off fencing scenarios restores the geovisualization to its 'initial state' (i.e., with the Scotch broom present), and thus it also disables the nighthawk models.

6.2.5 Mooring buoys

Mooring buoy scenarios were developed based on concerns frequently expressed in the Parks Canada focus group regarding potential damages to eelgrass meadows from boat anchoring. Mooring buoys are currently available off the west side of Sidney Spit for the use of recreational boaters, and these buoys allow for moorage without need for boat anchors. However, currently only sixteen buoys are present, and a concern exists that boaters will drop their anchors in adjacent areas where eelgrass meadows are present when buoys are unavailable (or if they are unaware of the mooring buoy system). To mitigate against such issues, a potential relocation of mooring buoys was designed (by the researcher) in such a manner that would position the buoys outside of the eelgrass meadows, thereby reducing likelihood of anchoring within the meadows. This scenario also includes regulatory marker buoys that are positioned between mooring buoys and eelgrass meadows, which indicate that mooring is not permitted past the marker.

The 'proposed relocation' scenario was developed using data obtained from Parks Canada, which consisted of eelgrass meadow polygons (created from remote sensing data (O'Neill et al., 2011)), multi-beam bathymetry raster data (100m), and point data representing the current buoy locations. The first step in developing the scenarios was to determine a minimum distance between mooring buoys, which would ensure that the relocation was not significantly more 'crowded' than the current location. This was done by using ArcMap and involved calculating the minimum distance observed between buoys in the current distribution (43.3m). The next step involved minimizing increases in mooring system installment depths and chain lengths (increases were expected to occur due to the relocation being in a deeper area than the current mooring area). This was done by defining an area located outside of the eelgrass meadows, which encompassed raster cells of shallower depths. Once this area was defined, sixteen buoys with a minimum spacing of 43.3m were randomly distributed within the area using ArcMap (see Figure 30).

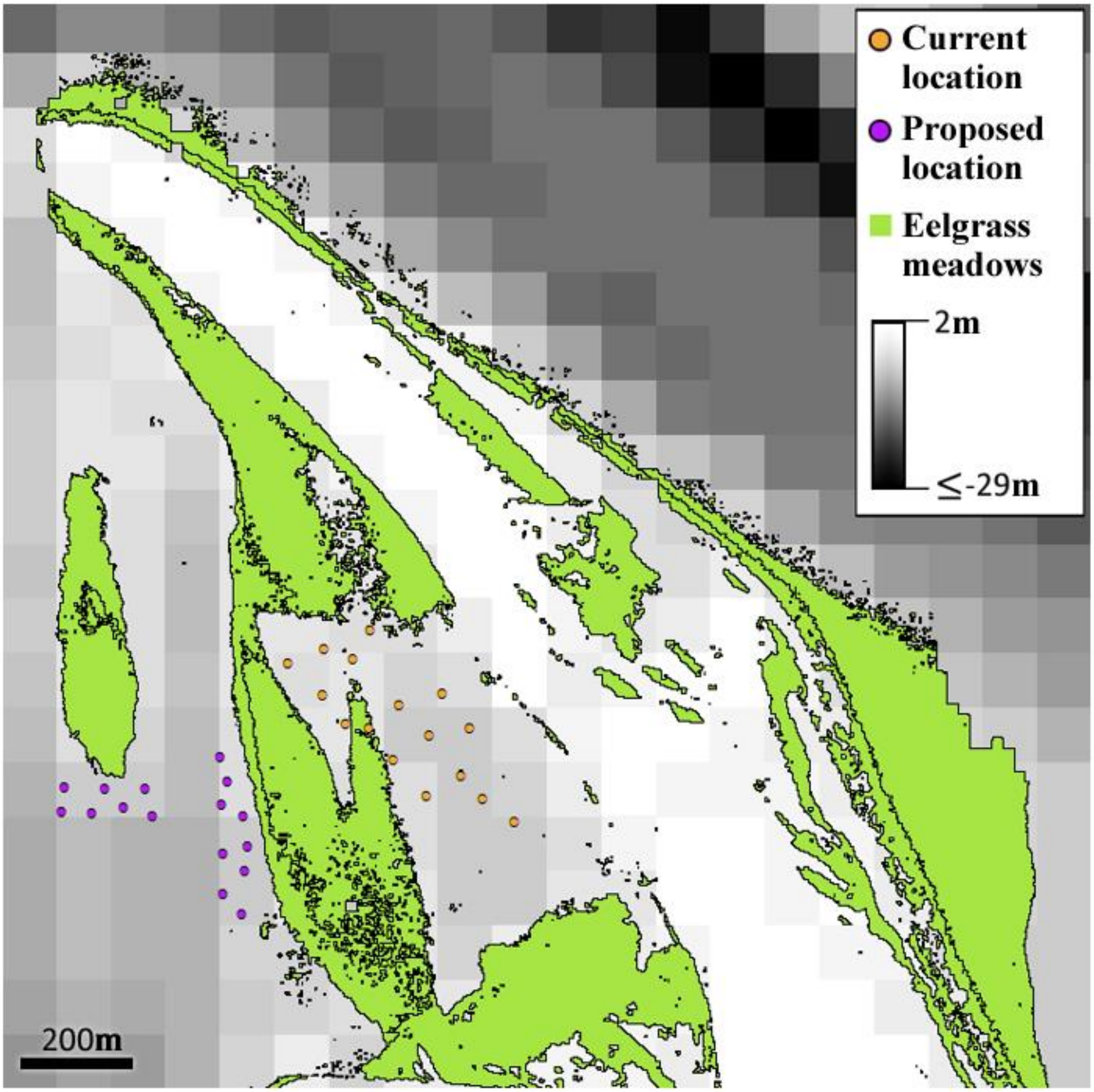

Figure 30. Map of eelgrass and mooring buoy scenarios
Current mooring buoy locations are represented through orange markers, and proposed locations for the relocation scenario are represented through purple markers. Eelgrass maps were created using data collected by O'Neill et al. (2011).

Despite efforts to minimize increases in crowding, boats in the proposed relocation scenario ultimately were on average nearer to one another than those in the current location, as evidenced by an independent sample t-test using values of distances between nearest points (t(30) = 5.88, p < 0.001). Boats in the current location assumed a mean distance of 65.1m (SD =

11.6), while the proposed relocation assumed a mean distance of 47.6m (SD = 2.79). In addition, mean depths at current buoy locations (M = 3.04, SD = 1.09) and proposed relocation points (M = 4.07, SD = 0.97) were also found to be different with the latter being significantly deeper (t(30) = 2.814, p = 0.009). The proposed relocation would require 34% more chain than what is currently used (i.e., sum total depth of current location is 48.7m, where sum total depth of relocation is 65.1m). Therefore, albeit efforts were made to maintain comparable spacing and depths between the current mooring buoy locations and the proposed relocation, ultimately the scenarios were found to differ in these ways.

The current locations of mooring buoys were built into the geovisualization by using a reference map prepared from point data of buoy locations and then placing boat models above all 16 points in vertical alignment with the water surface (Newell et al., 2017). Four additional boats were placed within the vicinity of the mooring buoys, which represented boats using anchors rather than buoys[38]. The proposed relocation scenario was built into the geovisualization using a reference map prepared from the relocation points that was developed using ArcMap (as described above), and in a similar manner to that of the current location scenario, four additional boats were added within the area. As noted above, relocation scenarios also involved regulatory markers, and eight of these markers were positioned between the buoys and eelgrass meadows.

Key commands were assigned to toggle different mooring buoy scenarios, and users could experience the scenarios from land or from aboard a moored boat. Experiencing scenarios on land involved using key commands to toggle the different boat positions, allowing users to assess how these positions might affect the views when standing within the park (see Figure 31a and 31b). Experiencing scenarios on water involved using key commands to transport users to the deck of moored boats, allowing users to interact with the scenarios from the boaters' perspective (see Figure 31c and 31d). The boats that users board when experiencing scenarios from this perspective are located approximately 200m (i.e., current location) and 500m (i.e., proposed relocation) away from the Sidney Spit shoreline.

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[38] Parks Canada has provided 16 mooring buoys; however, field data indicates that more than 16 boats are generally observed in the area, as field counts averaged to 20 boats (Newell et al., 2017). This indicates that some boaters are (likely) using their anchors within the area, which is represented in the geovisualization.

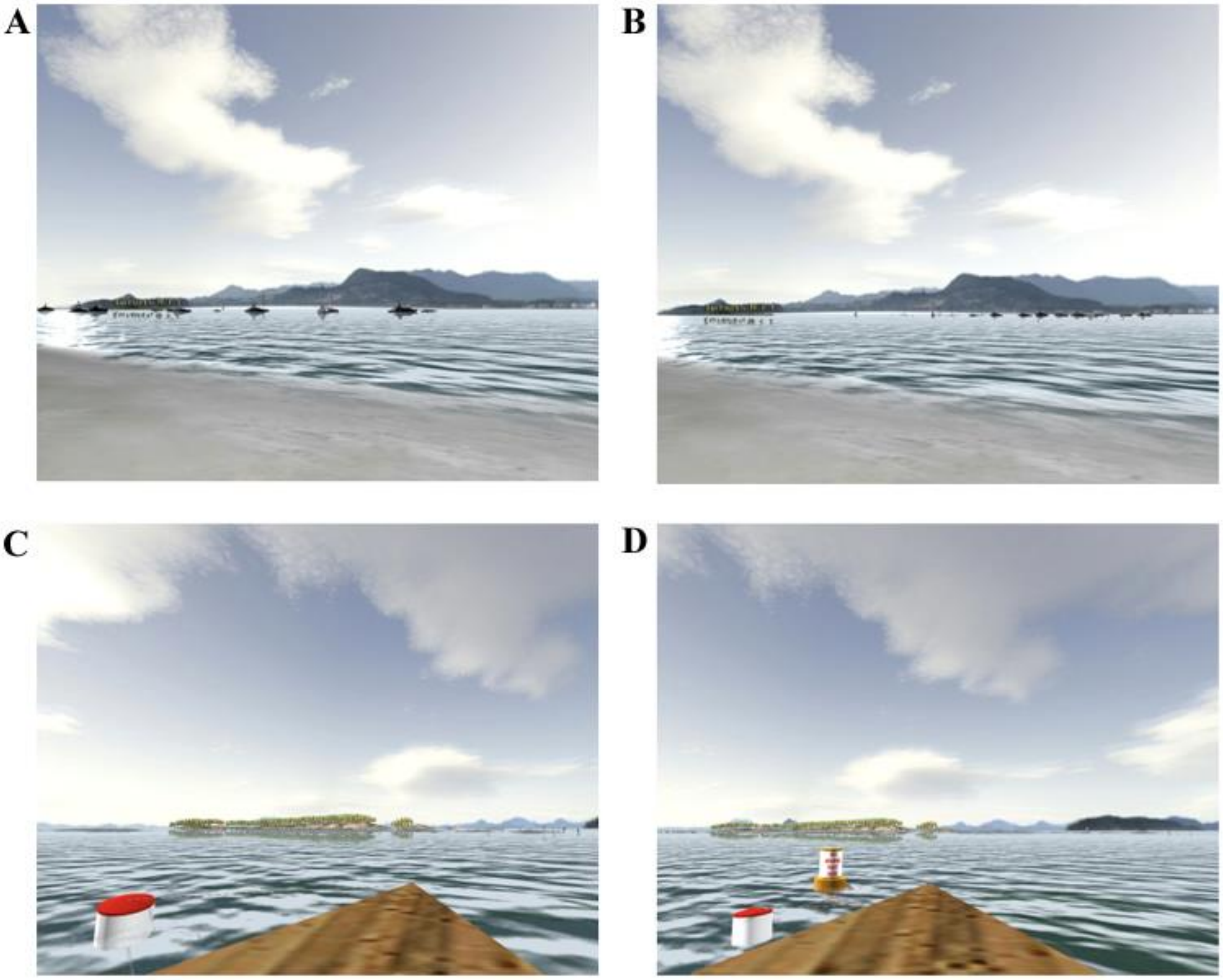

Figure 31. Mooring buoy scenarios experienced from land and from aboard boats
Figure 31a displays view of moored boats in the current location scenario as seen from land, and Figure 31b displays view of moored boats in the proposed relocation scenario (also as seen from land). Figure 31c displays a view from aboard a boat in the current location scenario, and Figure 31d displays a view from aboard a boat in the proposed relocation scenario. Mooring buoys can be seen in Figures 31c and 31d, and a regulatory marker buoy can be seen in Figure 31d.

Recreational boaters mooring near Sidney Spit can enter the park using their privately owned dinghy, and the geovisualization captures how the proposed relocation might affect this method of access. When aboard a boat in the geovisualization, users can step off the starboard side of the boat to land on a dinghy model and activate an animation where dinghy and user travel to shore. Dinghies travel at 7 knots in both current location and proposed relocation scenarios, giving users a sense of the differences in travel times between the two scenarios (i.e., 55 seconds in the current location and 140 seconds in the proposed relocation).

6.2.6 Dog management

Dog management scenarios were developed based on concerns expressed through the Parks Canada focus group regarding off-leash dogs. Sidney Spit provides important habitat for a variety of wildlife, particularly bird species (Maurer, 1989), and off-leash dogs can be a significant source of disturbance to such wildlife (Antos et al., 2007; Lafferty, 2001; Williams et al., 2009). Current park regulations dictate that dogs must be on-leash at all times when within the park; however, visitors do not always comply with these regulations, presenting risks to local wildlife. In recognition of these risks, three scenarios were prepared that (respectively) depict no change to the current situation, a regulation that prohibits bringing dogs to the park, and efforts to increase awareness among park visitors of the leash regulations.

The 'current situation' scenario was built with two dog models featured in the geovisualization. One of the models was placed at the southern end of the spit, and it was featured with another model representing a dog owner. These models were animated to depict an owner walking a dog while on-leash (see Figure 32a). The other dog model was placed toward the northern end of the spit and was also associated with an owner model; however, this model pair was depicted without a leash. The off-leash dog was animated to appear to run northward and toward a colony of gulls (see Figure 32b). The gull models were animated to appear to fly away when the dog reaches the colony. The two model pairs represent different dog and owner behaviours, and they were both incorporated into geovisualization to convey that some dog owners comply with the on-leash regulation, whereas others do not. It is worth noting that the placement of the off-leash dog was not (entirely) arbitrary, as it was based on an interaction between gulls and an off-leash dog observed during fieldwork. This is not to say (or mislead viewers in thinking) that this is the only location such an interaction occurs; rather, it simply served to inform where to place and model the interaction.

The 'no dog' scenario was constructed to simply consist of no dog models in the geovisualization. Similar to other scenarios, the no dog scenario was toggled using a key command. Toggling the scenario resulted in the on-leash owner depicted as walking in the park by herself (see Figure 32c) and the off-leash owner depicted as viewing the ocean rather than watching his dog (see Figure 32d).

The 'increased awareness' involved the addition of three models to the geovisualization - two representing Parks Canada employees (see Figure 32e) and another representing a sign (located by the dock) that communicates the dog leash regulation to visitors entering the park (see Figure 32f). One of the Parks Canada models was positioned near the dog and owner at the northern location, and the models were animated in a manner that depicted Parks Canada staff talking to the owner while the dog was now leashed. A sound clip was triggered when approaching the models, and this consisted of a male voice explaining the on-leash regulation and the importance of complying. The second Parks Canada model was positioned at the southern end of the spit and was depicted as a staff member, who was watching park visitors to ensure people are complying with on-leash regulations. Approaching this model triggered a sound clip, consisting of a female voice reminding people of the on-leash regulation. An additional sound clip was activated when the owner-dog pair at the southern end of the spit moved within proximity of the Parks Canada model, and this clip consisted of the female voice thanking the dog owner for complying with the regulation.

Similar to fencing scenarios, expenses associated with Parks Canada staff time were roughly estimated to be able to associate cost metrics with this scenario. It was deemed that the job could be assigned to summer students because the tasks requires a relatively low level of expertise and the park receives the majority of visitors in the summer; thus, Parks Canada student pay rates were used to estimate costs (Parks Canada, 2014). Based on a 7.5-hour workday, costs for two students were estimated to be around $190 to $200 per day.

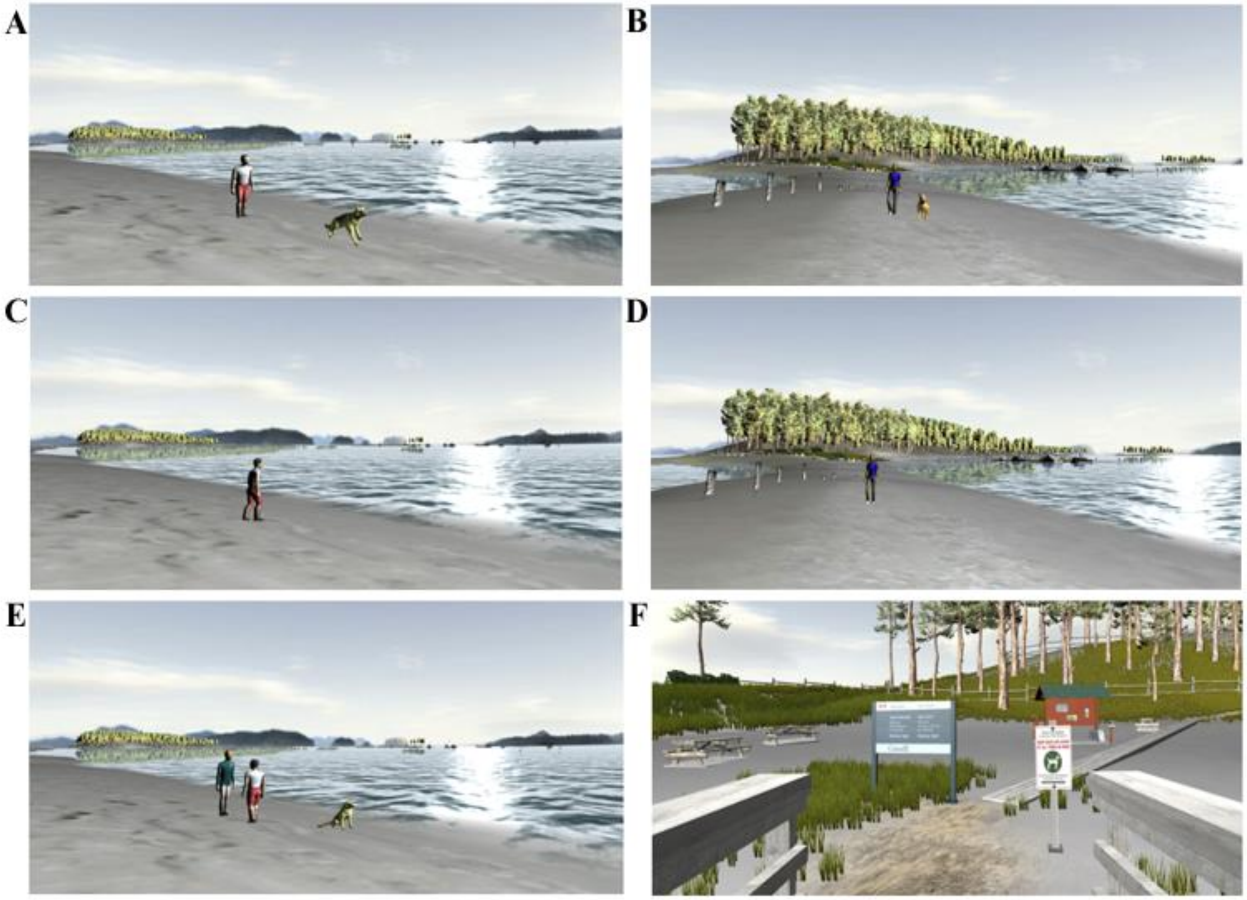

Figure 32. Dog management scenarios

Figures 32a and 32b depict the current situation scenario. Figure 32a displays owner and off-leash dog located toward the north of the spit, and Figure 32b displays owner and on-leash dog at the southern end of the spit. Figures 32c and 32d depict the no dog scenario, and display people without dogs at the northern and southern locations (respectively). Figures 32e and 32f depict the increased awareness scenario. Figure 32e displays a Parks Canada staff talking to the dog owner at the northern location with the dog now leashed. Figure 32f displays a sign placed near the dock reminding visitors of the dog leash regulations.

6.2.7 Focus groups

Focus group methodology was used to examine how well the geovisualization performs in terms of allowing people to assess and provide thoughts/opinions on scenarios. In total, 27 participants were recruited for the study. Age distribution of participants consisted of 63.0% over the age of 65, 29.6% aged 55 to 65 and 3.7% aged 45 to 54 (the remaining 3.7% was non-response), and gender distribution consisted of 70.4% female and 29.6% male[39]. All participants resided within the Capital Regional District (BC, Canada) and median length of residence was 24 years with the maximum being 70 years and the minimum being 2 years.

Recruitment was done through letter mail, and an invitation was sent to a random sample of 300 addresses. Recruitment initially targeted the municipalities of Sidney and North Saanich, as they are nearest to Sidney Spit, thus allowing the study to follow methodology of other visualization research that examines responses of local residents (e.g., Lewis and Sheppard, 2006; Salter et al., 2009; Schroth et al., 2009). However, further recruitment was needed for the study, and this was done through snowball sampling, which resulted in participants from other nearby municipalities. Ultimately, Sidney and North Saanich residents collectively comprised the majority of the participants (respectively 44.4% and 22.2%), but some of the participants resided in other municipalities, including Saanich (18.5%), Victoria (11.1%) and View Royal (3.7%).

Focus groups were conducted over seven sessions during July and August of 2016, and were held either in a conference room at the Mary Winspear Centre (Sidney, BC) or in the GIS Visualization Lab at the University of Victoria. Groups ranged in size, and listed chronologically, consisted of seven, eight, two, two, two, five and one[40] participant(s). Focus groups sessions were two hours in length; however, this chapter reports on only part of the session and the other parts are discussed in Newell et al. (2017)[41]. Similar to the Parks Canada session, the geovisualization was demonstrated using a Dell Precision T1700 (displayed by projecting onto a screen) with external speakers for sound. Each participant was also provided with a Lenovo ThinkPad T530 laptop (and headphones) equipped with the geovisualization and an information booklet detailing user controls, which allowed participants to explore the geovisualization on their own.

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[39] The distribution is skewed to older demographics and females in a manner that is not representative of the entire CRD population, according to the 2011 Census of Canada (Statistics Canada, 2012); therefore, this study does not claim to collect feedback on scenarios that are representative of all CRD residents. However, the number of participants is sufficient for conducting qualitative analysis on feedback collected from participants of a variety of different interests and views, and the work follows other visualization research that has involved small numbers of participants and qualitative work (Lewis and Sheppard, 2006; Salter et al., 2009).

[40] The session with the singular participant was the only session held in August, and it consisted of a person who was scheduled for an earlier session but had to cancel due unexpected circumstances.

[41] This aspect of the research is presented in Chapter 5 of this dissertation.

For each of the three scenario types, focus group participants were given a brief presentation on the rationale behind scenarios and a demonstration on navigating/toggling scenario options. Participants were also provided with supplementary information to enhance their understanding on the scenarios (see Appendix J), such as maps (i.e., Figure 28 and 30) and cost estimates (see 6*.2.4 Fencing* and *6.2.6 Dog management*). Participants were given time to explore scenarios on the laptops, as well as through the screen projection by asking the session facilitator (i.e., researcher) to display particular options. During this time, participants provided comments on preferences for scenario options and the geovisualization's usefulness for assisting with decisions around these preferences. Comments were provided through feedback forms (see Appendix K) and a brief discussion held at the end of the session, and data were analyzed using NVivo (v.10). Data were also collected through asking participants to rate the geovisualization's usefulness on a scale of 1 (i.e., 'not at all') to 10 (i.e., 'extremely well') in terms of how well it assisted with decisions, similar to those done in other visualization studies (e.g., Schroth et al., 2009; Smith et al., 2012). After all scenarios were explored, participants were asked to rate (on a scale from 1 to 10) and comment on the user-friendliness of the geovisualization, as well as provide feedback on how essential it was to have supplementary information (i.e., maps and cost estimates) to use the tool[42].

Geovisualization studies often involve the participation of people who reside and/or have personal familiarity with a visualized locality (e.g., Lewis and Sheppard, 2006; Salter et al., 2009; Schroth et al., 2009), and Newell and Canessa (2015) posited that such familiarity can enhance the geovisualization's ability to connect with people's values, beliefs and interests associated with the real-world places depicted through the visuals. In the current study, however, the visualized place was located a ferry ride away from the participants' homes, and it could not be assumed that all participants were familiar with the physical location. This provided an opportunity to investigate familiarity effects and their influence on user interactions with geovisualizations. Familiarity effects were investigated using two approaches. The first involved 'priming' some of the participants by taking certain groups out to Sidney Spit prior to exploring

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[42] The amount of time spent on each task was not recorded as done in other research such as Smith et al. (2012); however, focus groups were kept on a schedule and participants were given roughly the same amount of time for each scenario/task from group to group. Ultimately, the usefulness and user-friendliness of the tool was examined through feedback on tool's effectiveness given the time allotted for using it, rather than how long it took for users to complete a task.

the geovisualization (groups n = 7, n = 8 and n = 1), while other group served as a control by either visiting the park afterward (group n = 5) or not at all (groups n = 2, n = 2 and n = 2). The second approach involved asking participants how many times they have visited Sidney Spit prior to the session (i.e., excluding the trip taken on the day of the session), and responses from those who had visited only once or not at all were classified as 'unfamiliar' and those who have visited multiple times in the past were classified as 'familiar'. More detail on the approaches for characterizing familiarity can be seen in Newell et al. (2017)[43].

6.3 Results

6.3.1 Fencing materials

Table 11 displays participant preferences for fencing materials in terms of ranking them from most to least preferred. Top rankings consisted of 44.4% selecting mesh, 29.6% selecting wood and 18.5% selecting rope (7.5% did not respond). Mesh was ranked highest by more participants than other material; however, it was also commonly ranked as least preferred (37.0%). Similar low-ranking trends were observed with rope, as 37.0% selected it as least preferred; whereas, a minority (7.5%) selected wood as last preference (18.6% did not response). For second preferences, wood was most frequently noted (48.1%), followed by rope (25.9%) and lastly mesh (7.5%) (18.6% no response).

Table 11. Percentages of participants indicating preferences for different fencing materials

	Material			
Preference	Mesh	Wood	Rope	No response
First	44.4% (n=12)	29.6% (n=8)	18.5% (n=5)	7.5% (n=2)
Second	7.5% (n=2)	48.1% (n=13)	25.9% (n=7)	18.5% (n=5)
Third	37.0% (n=10)	7.5% (n=2)	37.0% (n=10)	18.5% (n=5)

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[43] Details how familiarity was characterized are also documented in Chapter 5 of this dissertation.

Preferences for mesh were strongly divided among the participants, and reasons for this division were elucidated through comments provided in feedback forms and group discussions. Participants indicated preferences to be based on either aesthetics or functionality, and in some cases, this was regarded as a trade-off. In terms of functionality, mesh was viewed as most likely to be effective for keeping people out of the vegetation, as it is most difficult to get through and extends to ground; however, mesh was also ranked lowest by many and this was primarily based on aesthetics. Even among those who ranked mesh highest, there were some who noted that aesthetics was a weakness of this option.

> “Mesh would be the most effective. Is also the least attractive.” (Participant 6)

In contrast to mesh, wood was considered to be quite aesthetically appealing. Comments around wood fencing typically referred to how this style aligns better with the surroundings and natural environment. However, functionality and ability to prevent people from entering the restoration areas was generally not considered a particular strength of the wood option, and in some cases, participants who ranked wood highest also noted that mesh might actually make for a better barrier.

> “Wood – natural, fits other ‘wood’ environment” (Participant 20)
>
> “Wood looks best and fits with environment; Mesh – makes actual barrier.” (Participant 12)

Similar to wood, positive comments around rope fencing primarily related aesthetics and shortcomings related to functionality (or lack thereof). However, feedback on rope aesthetics was more mixed than wood with some participants disliking its appearance. In addition, some participants were particularly critical of rope and its perceived lack of functionality, as comments were made during group discussions that rope might even attract people to sit on it or children to play with it. Other comments expressed how the look of rope does not present itself as a ‘real’ barrier, thus implying that it does not adequately signal to park visitors for them to keep out of the restoration area.

> “Rope – I don’t like the look…or the potential effectiveness.” (Participant 11)

> "Rope won't do the job – not looking like a 'real' barrier." (Participant 13)

> "Rope - Won't keep anyone out" (Participant 27)

As noted above, participants were provided with supplementary information regarding costs of different fencing options (see *6.2.7 Focus groups*), and some indicated that this information was taken into consideration when examining fencing scenarios. In these cases, cost information appeared to guide decisions toward mesh and away from wood or rope. However, cost benefits were ultimately expressed in conjunction with factors, particularly aesthetics and functionality, and none of the comments indicated that expenses were the sole (or even primary) driver of decisions around scenarios.

> "Mesh is most economical and offers the best protection – not very attractive, however... Wood looks best – fits in well with the natural setting – very expensive." (Participant 10)

> "The mesh is a better price, more of a barrier than wood or rope, but doesn't look natural - it is actually quite unnatural looking…I like the look of wood the best – more natural and fits in better, but don't like the expense of it." (Participant 11)

Most negative comments concerning mesh related to its aesthetics; however, it is worth noting there were some positive comments regarding mesh and visual appeal. The mesh itself was not considered by any to be particularly attractive; however, some participants noted that it was harder to see than the other fencing materials. Therefore, as indicated by the participants, mesh could be a less visually intrusive option, and it might not even be visible from certain distances.

> "Mesh fencing because from a distance (people in boats) will not see human development" (Participant 1)

> "The mesh seems less visually intrusive" (Participant 17)

6.3.2 Fencing configuration

The majority of participants selected the full enclosure scenario (70.3%); whereas, only 18.5% selected the west side only option (11.2% did not respond). Reasons indicated for selecting full enclosure were similar to reasons for mesh, that is, the perceived level of protection offered by this option. Many participants felt that having a fence that only covers one side of the restoration area (i.e., west side only) was inadequate for protecting the vegetation, regardless of whether it spanned more of the area. Therefore, the rationale behind selecting full enclosure appeared to be that providing effective protection for some of the area was better than inadequate protection for the entire vegetation area.

> "Full enclosure will ensure the plants will grow undisturbed" (Participant 1)
>
> "Without enclosure, people will cross protection area" (Participant 12)

Some participants commented on how the full enclosure option offers better protection through how it 'communicates' to park visitors. These comments referred to how a full enclosure configuration effectively signals to park visitors approaching the area from different angles that the area is sensitive and access is prohibited. This indicates that the perceived protective capacity was not simply based on how well the fence serves as a physical barrier; rather, it was also associated with its ability to communicate demarcation of restricted areas.

> "More logical or intuitive when happening across it with no explanation – lots of people may come in on the [east] side and trample everything, not aware that they shouldn't be there" (Participant 22)
>
> "Makes a statement – keep out/off…shows the seriousness of the project" (Participant 23)

Reasons for selecting the west side only fencing scenario varied. Some participants felt that west side only was adequate for discouraging people from entering the area, while holding the advantage of covering more area. Other participants mentioned that the west side only configuration was more visually pleasing. It is worth noting that these participants also selected wood as first preference for material, and this indicates that aesthetics played a strong role in their fencing scenario selections.

> “Prefer open concept. More in keeping with natural area and pleasing to the eye” (Participant 14)
>
> “Visually more satisfactory” (Participant 18)

6.3.3 Signage

Many participants selected preferences for sign locations based on perceived direction from where the majority of visitors approach the vegetation area (i.e., walking northward from the main dock). This resulted in 55.6% selecting the southern position in the west side only configuration, and 40.7% and 37.0% respectively selecting the western and eastern positions in the full enclosure configuration. However, it is important to note that participants appeared less certain of preferences for and/or partiality to a particular option for sign location than observed with any other aspect of the fencing scenario exercise. Several participants selected multiple sign locations for their preferences (22.2% with west side only and 14.8% with full enclosure), and many did not respond with a particular preference (33.3% with west side only and 29.6% with full enclosure).

In addition to assessing the proposed sign locations, other potential locations were explored using the geovisualization. An example of this involved the southwest corner of the full enclosure configuration. The western side of the full enclosure configuration extends into the vegetation area, and thus placing a sign right at the southwest corner could lead to visitors entering the area to read the sign (see Figure 28b). However, placing the sign on southern edge could potentially be advantageous in that visitors approaching from the main dock would encounter the signage earlier than if placed further north. These considerations were recognized and brought forward in one of the focus groups, and subsequently, the geovisualization was used to determine if a sign could be placed in this area, while still being visible from the beach (i.e., without walking upon vegetation).

Unexpectedly, participants also used the geovisualization to evaluate and comment on the appearance of the signs. Participants were not specifically asked to comment on design and wording of signs; however, this became a topic that frequently emerged within focus groups. Some found the wording to be too ‘authoritarian’ or ‘directive’, and (thusly) felt it would not encourage cooperation from park visitors. During a group discussion, one participant alluded to having a negative visceral reaction to the wording by describing it as ‘offensive’. These types of comments were followed by suggestions for ‘friendlier’ language and/or interpretative signage that would explain the ecological importance of keeping people from entering the area.

> “I would change wording on the sign – highlight restoration in progress and not such bold red letters of Do Not Enter. “Please” would soften the message and feel more respectful to visitors.” (Participant 11)

> “Have sign asking people to respect the area under ‘re-vegetation’. Signs should explain what is happening and why and request they don’t enter. Make the sign ‘friendly’” (Participant 20)

6.3.4 Mooring buoys

Participants were asked to indicate preferences for boating scenarios when experiencing scenarios from land and aboard the boats. As seen in Table 12, the majority of participants indicated preference for the proposed relocation scenario (59.2%), while only 14.8% preferred the current scenario (26.0% did not respond), when examining the scenarios from the land-based perspective. Preferences differed somewhat when examining the scenarios from the boater perspective, as 40.7% indicated preference for the proposed relocation and 33.3% preferred the current location (26.0% did not respond).

Table 12. Percentages of participants indicating preferences for mooring buoy scenarios

	Mooring buoy scenarios		
Perspective	From land	From on boat	No response
From land	14.8% (n=4)	59.2% (n=16)	26.0% (n=7)
From on boat	33.3% (n=9)	40.7% (n=11)	26.0% (n=7)

Many of the participants who preferred the proposed relocation scenario noted the potential for protecting eelgrass meadows to be a reason for this preference. This was the case even among participants that did not initially have strong knowledge around the ecological importance of eelgrass. They gained knowledge from the researcher and/or other participants who explained this importance, thereby allowing them to make informed decisions based on their ecological values. In addition, participants mentioned that exploring the marine environment in the geovisualization prior to examining mooring buoy scenarios also helped provide an impression of the ecological significance of the eelgrass around Sidney Spit, as they encountered species that used eelgrass for habitat (i.e., Dungeness crabs) and saw the extent of the meadows. It was noted during group discussions that such experiences provided a strong context for the mooring buoy scenarios and ultimately contributed to decisions toward strategies that might result in stronger eelgrass protection.

> "I believe the furthest away [boats are] from the eelgrass and destroying it, the better." (Participant 18)

Other reasons for selecting certain mooring buoy scenarios related to visitor experience. From the land perspective, it was noted that proposed relocation provides better views that are not 'dominated' by boats. In contrast, some participants favoured the current scenario when discussing visitor experience from the boater perspective, noting that this scenario provides a better view for boaters, gives easier access to shore and feels less crowded in terms of the presence of surrounding moored boats. Some focus group participants were experienced boaters and provided comments drawing from their own experiences; for example, it was noted that the current scenario would be more favourable to many boaters as they would feel more sheltered from winds[44].

> "From land – boats dominate seascape…From boat – better view of spit, quicker across to land." (Participant 12)
>
> "Personal [preference] is current location because of distance and land [adjacency] when moored for protection from gales." (Participant 21)
>
> "From land more sense of space and privacy. From boat closer to beach, more protected from [southeast] winds, less of a row to shore, not as close to other boats." (Participant 26)

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[44] It is worth noting that none of the three quotes used to support this point were from participants that self-identified as active boaters; however, Participant 21 was in a focus group where people that did identify as boaters shared a 'boater's perspective' on the mooring buoy scenarios.

It is interesting to note that sound was used in addition to the visuals for assessing mooring buoy scenarios. A sound clip of a boat motor played when participants travelled to the park's shore using the dinghy feature of the geovisualization, and the extended length of time this clip ran when in the proposed relocation scenario was disfavoured by one participant, who commented on the potential increase in noise pollution. The participant was in favour of protecting the eelgrass, but was conflicted with the trade-off involving increased acoustic disturbance in nearshore areas.

> "I want the boats to be farther from the shore and out of the…eelgrass, however I don't like the trade-off of more noise and longer noise of motor boats coming ashore." (Participant 11)

In addition to providing feedback on scenarios, suggestions for alternative approaches to the mooring issue were brought forward during discussion sessions. One suggestion involved building more dock infrastructure to increase space for boat moorage near the park, while potentially decreasing anchoring damage throughout the eelgrass meadows. When discussing this suggestion, it was noted that the geovisualization could be used for engaging boater stakeholders by displaying different dock locations and/or extensions and allowing boaters to comment on which options are most favourable (and why).

6.3.5 Dog management

Similar to the other scenario exercises, participants were asked to rank the dog management scenarios in order of most to least preferred. Of the three scenarios, high preferences were most commonly observed with the increased awareness scenario, with 44.4% selected it as first preference, 37.0% selected it as second and only 3.7% selected it as last (third) preference (see Table 13). Preferences for the other two scenarios, i.e., current situation and no dogs scenarios, were comparable to one another. Slightly more participants provided a top ranking to the current situation scenario (25.9%) than was observed with the no dogs scenario (22.2%); however, the current situation scenario was also ranked as last preference by more people (current situation – 37.0%; no dogs – 29.6%) and second preference by less people (current situation – 14.8%; no dogs – 25.9%).

Table 13. Percentages of participants indicating preferences for dog management scenarios

	Dog management approach			
Preference	Current situation	No dogs	Increased awareness	No response
First	25.9% (n=7)	22.2% (n=6)	44.4% (n=12)	7.5% (n=2)
Second	14.8% (n=2)	25.9% (n=7)	37.0% (n=10)	22.2% (n=6)
Third	37.0% (n=10)	29.6% (n=8)	3.7% (n=10)	29.6% (n=8)

Dog management was a controversial subject, and in some focus groups, exploring the scenarios sparked heated discussion around the problems associated with off-leash dogs in parks. Participants who selected the no dogs scenario as their first preference commented on potential dog-related issues, such as ecological disturbances (e.g., chasing birds), social nuisances (e.g., making noise) and safety concerns (e.g., potential for hurting people). Comments were also made about dog owners, alluding to how achieving complete compliance with on-leash regulations among this user group would be unlikely.

> “Dogs chase birds, are noisy and not always to be trusted not to hurt people. I understand the companionship factor but non-dog people have rights too. (Participant 22)
>
> “Onus is on the owners. Most dog owners are not responsible.” (Participant 5)

Participants who selected the increased awareness scenario generally recognized the potential problems associated with off-leash dogs, but held a more favourable view of dogs within parks and/or recognized their presence to be important to certain park users (and thus park visitors). Participants favoured the implementation of signage within the scenario, and (unlike the fencing scenario signage) positive comments were made about its aesthetics. The addition of Parks Canada staff was met with more hesitation than the signage, due to the costs associated with employing summer students. However, it was noted in one of the focus groups that these expenses could be reframed as a benefit because it involves giving students summer employment and work experience.

> "I think allowing dogs access to island is great but should be leashed so as not to destroy the grasses and chase wild life." (Participant 24)

> "Try gentle encouragement to enforce leash use. [This scenario] employs a student." (Participant 10)

> "I thought the sign (all dogs on a leash) looks attractive and firm enough." (Participant 19)

Participants who indicated preference for the current situation also recognized the potential issues associated with off-leash dogs, but like those who showed preference for increased awareness, they were amenable to dogs within the park. Some participants indicated they preferred the current situation with 'enhancements', for example, the implementation of signage but not necessarily increased Parks Canada presence. Another participant who selected the current situation preference suggested an alternative to increasing Parks Canada presence or banning dogs, which was to create a 'dog area' that restricted dog access to particular spaces. Following this suggestion, the geovisualization was used to explore potentially viable locations for such an area.

> "Signage to ask for leash use is most useful…A shame to ban dogs." (Participant 26)

> "Provide a separate area where dogs can be off leash" (Participant 12)

It is worth noting that dog scenarios were the last to be examined; therefore, participants encountered the dog running up the spit and disturbing the gulls prior to exploring these scenarios. In some cases, this previous 'exposure' to the off-leash dog behaviour might have factored into participant decisions around dog scenarios; for example, one participant alluded to being aware of the potential disturbance the off-leash dog was causing while exploring fencing scenarios as she noted to have frequently heard the dog barking. In addition, it is possible that the exposure to the dog also influenced decisions around fencing scenarios, as some participants made reference to effectiveness of certain fencing materials in keeping out dogs (as well as people). Such observations demonstrate how realistic, dynamic geovisualizations can be used for gaining a more holistic understanding of scenarios, rather than treating different scenarios as isolated actions or events.

6.3.6 Usefulness and user-friendliness

Participants rated the geovisualization's usefulness for assessing the scenarios on a scale of 1 (i.e., 'not at all') to 10 (i.e., 'extremely well'), and results indicate that geovisualization was considered useful for scenarios involving fencing (M = 7.96, SD = 2.37) and mooring buoys (M = 7.6, SD = 2.67). In both cases, single sample t-tests (one-tailed) provided strong evidence for supporting the claim that the average ratings exceeded a 'halfway' score (i.e., 5.5), meaning they tended toward higher ratings (fencing: t(24) = 5.19, $p < 0.001$; mooring buoys: t(22) = 3.41, $p < 0.001$). Ratings concerning the geovisualization's usefulness for dog scenarios were more mixed (M = 6.10, SD = 3.34), and in contrast to the other scenarios, statistical evidence was not found to support the notion that the average rating exceeded a halfway score (t(26) = 0.937, p = 0.179).

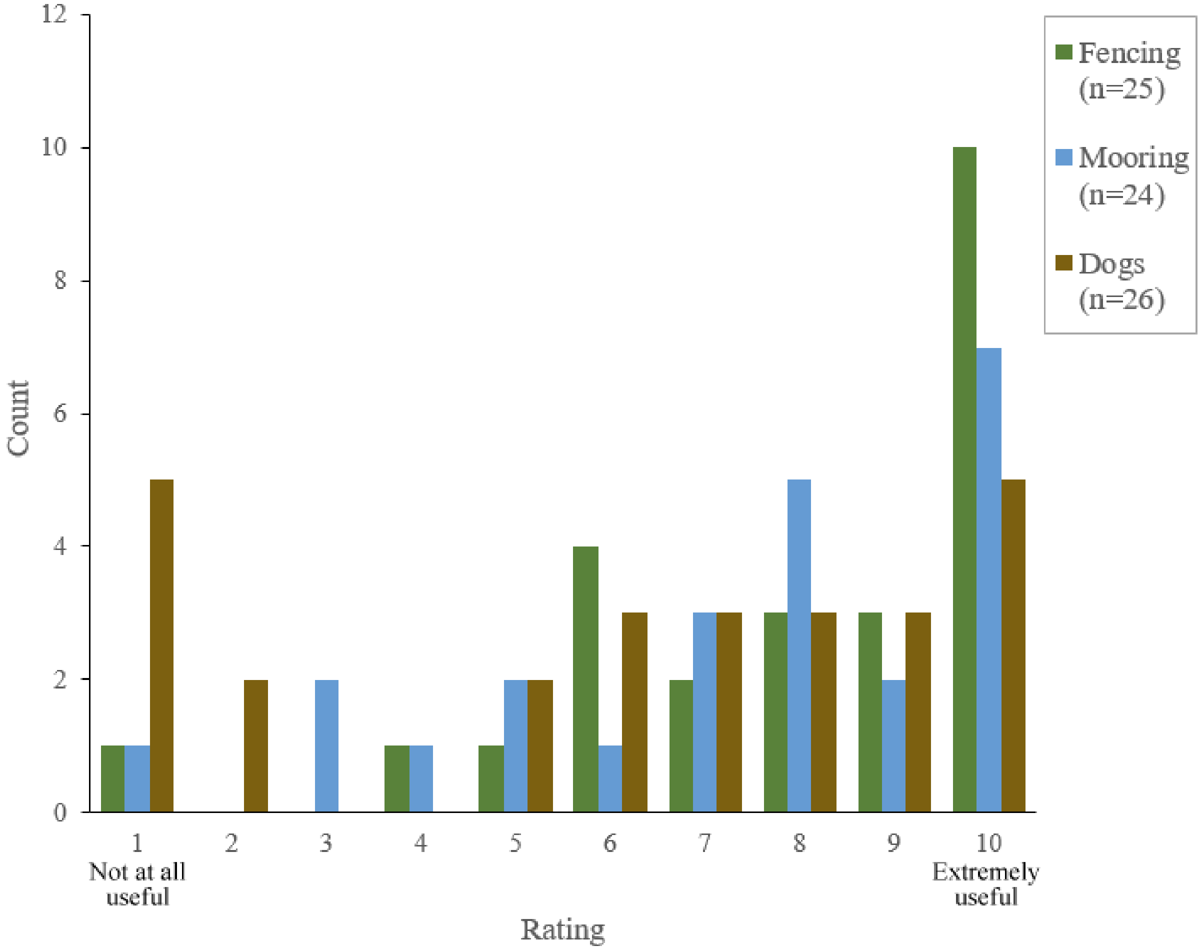

Figure 33. Distribution of usefulness ratings for using geovisualization to assess scenarios
The x-axis represents usefulness ratings indicated by participants using a scale from 1 to 10. The y-axis represents number of participants that selected a particular rating score.

As presented in *6.3.1 Fencing materials* and *6.3.2 Fencing configuration*, preferences for fencing options strongly related to perceptions around functionality and aesthetics, and participants indicated that the geovisualization helped them come to conclusions regarding these properties. Other feedback on the usefulness of geovisualization in assessing fencing scenarios included comments around how it helped in remembering what the environment looked like and (thus) allowed for strong contextualization of the scenarios. Some participants considered the geovisualization more useful for certain aspects of fencing scenarios then others (e.g., one participant noted that it was more useful for assessing signs than fences). In addition, some participants claimed that they could come to similar decisions around fencing scenarios using maps, alluding to the idea that the geovisualization would not be entirely necessary for this purpose. However, multiple focus group participants expressed that they were quite comfortable with map-based visuals, whereas others without the same level of comfort with such a visual medium might respond differently (Lewis & Sheppard, 2006).

> "Very clear to see the various options. What looks pleasing, most effective fence for habitat, etc." (Participant 26)

Participants noted that the geovisualization helped with certain aspects of the mooring buoy scenarios; in particular, comments were made around how it clearly showed potential effects to the viewshed. Other aspects of the geovisualization received mixed responses. For example, while one participant expressed appreciation for being able to experience travel times from ship-to-shore on the dinghy, another noted that boaters might already have a sense of this and this feature is not too valuable for forming opinions. In addition, as with the fencing scenarios, some participants mentioned that they could make similar decisions using just maps, and it was noted in one of the group discussions that maps might be a more appropriate tool for assessing mooring buoy scenarios.

> "Was helpful to see the visual of boats near and far and helpful to experience length of time needed to motorboat to shore." (Participant 11)

As aforementioned, impressions on the geovisualization's usefulness for assessing dog scenarios were more mixed than with the other scenarios. Some participants expressed that people could engage in discussion around dog management without the help of the geovisualization. It was actually noted that visual aids in general were not necessary for this discussion, and this differed from critiques of fencing and mooring buoy scenario applications in which maps were suggested to be potentially more useful tools. Other participants regarded the dog management application more positively, and found that the geovisualization conveyed the issue well. During group discussion, one participant noted that she did not want to 'see that', referring to the off-leash dog disturbing the birds, and this sentiment indicated that the geovisualization at least was successful in bringing beliefs and concerns to mind, if not providing new understanding around the dog management issues.

> "Not as necessary as other features of program. Visually realistic but verbal or text conjure enough of an image to form an opinion" (Participant 26)

> "Certainly gets the point across and prepares people for their visit." (Participant 17)

Participant feedback indicated that the perceived usefulness of the geovisualization was associated with user-friendliness. Mean rating for user-friendliness was 6.81 (SD = 2.40) and statistical evidence exists for claiming this exceeds a halfway score ($t(20) = 3.32$, $p = 0.002$); however, participants commented on how technical troubles interfered with the use of the tool. For example, some participants commented on difficulties navigating the virtual environment when exploring fencing scenarios, and this affected how useful the tool was for assessing these scenarios. As another example, participants frequently experienced difficulties boarding the dinghy and travelling to shore[45]. Many participants admitted that these difficulties were in part due to a lack of technical expertise and perhaps more technologically adept users would not experience the same issues; however, this is still problematic in the context of this research, as this work is premised on the idea that geovisualizations can be used to engage diverse groups and not just the technologically adept. Alternatively, it was noted that scenarios could be effectively examined with the researcher acting as facilitator and operating the controls, suggesting that user

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[45] This was a particularly prevalent issue with the first focus group due to a technical issue regarding the ship-to-shore mechanics that made users prone to falling into the water. This issue was rectified prior to future sessions.

control is not necessary for the geovisualization to be considered a useful tool. In fact, this was commonly noted to be preferable by many participants, as it allowed them to focus on the scenarios themselves rather than how to operate the tool.

> "I find all the tech computer for each person confusing. I preferred the presenter doing the tech stuff" (Participant 20)

Other comments around the usefulness of the geovisualization related to the supporting materials, specifically maps and cost estimates. Most agreed that the maps complemented the geovisualization well and provided better understanding of the scenarios. In some group discussions, maps were described as 'essential' supporting materials. In contrast, only some participants found cost information useful, whereas others noted that it did not contribute heavily to decisions around scenarios. Those who did not find cost information particularly helpful noted that their decisions were based more on functionality or attractiveness, and it was mentioned that financial expenses were more a concern for those controlling the budget (i.e., Parks Canada) rather than park users.

> "The maps were extremely useful – the cost estimates not so much – they would in any case have to be measured against the usefulness or attractiveness of a given design." (Participant 19)

6.3.7 Familiarity

A series of two-sample t-tests (two-tailed) were conducted to examine whether familiarity with Sidney Spit influenced how useful participants found the geovisualization to be for evaluating scenarios. However, no statistical evidence was found to support a difference in rating scores when comparing participants that were 'primed' by visiting the park prior to the focus group (n=16) with those who were not (n=11), and this was the case for all scenario types (fencing – t(23) = 0.577, p = 0.569; mooring buoys – t(22) = 2.05, p = 0.053[46]; dog management – t(24) = -0.065, p = 0.949). Similarly, no differences were found between participants classified as 'familiar' in terms of previous visits to the park (n = 14) and the other participants (n = 13) for

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[46] Differences for this result would be significant at $\alpha=0.1$; however, this study uses the common convention of $\alpha=0.05$.

any scenario types (fencing – t(23) = -1.89, p = 0.07; mooring buoys – t(22) = -0.928, p = 0.364; dog management – t(24) = -0.144, p = 0.887).

Although familiarity did not appear to affect perceived usefulness of the geovisualization, chi-squared analysis provided evidence of effects on participant preferences for scenarios. In particular, a significant effect was found with priming and preference toward fencing configuration, where west side only scenarios were more likely selected by primed participants ($\chi^2 = 4.11$, p = 0.043). Such an observation might relate to the fact that participants were asked to walk to the north end of the spit when taken to the park, and (based on researcher observations) the participants themselves approached the north end from the west side. Differences in fencing selection were observed only with priming and not with those classified as familiar due to previous visitation ($\chi^2 = 0.309$, p = 0.579), which supports the notion that scenario selection might be influenced by recent experiences.

> “Probably more [foot] traffic on the west side.” (Participant 6)

Significant effects were not observed with preferences around fencing materials in both primed ($\chi^2 = 0.003$, p = 0.957) and familiar-classified cases ($\chi^2 = 2.84$, p = 0.092). In addition, no effects were observed with mooring buoy scenarios[47] (primed: $\chi^2 = 3.64$, p = 0.056; familiar-classified: $\chi^2 = 0.484$, p = 0.489) and dog management scenarios (primed: $\chi^2 = 0.468$, p = 0.493; familiar-classified: $\chi^2 = 0.302$, p = 0.583).

6.4 Discussion

Building scenarios within realistic geovisualizations requires modelling both space and place (Newell et al., 2017). That is, it involves capturing geometrical relationships to ensure scenarios are spatially-accurate, while also working with realistic elements that can be recognized as real-world items and (thusly) hold potential to speak to people’s sense of place in different ways (Newell and Canessa, 2015). For example, the fencing configurations of the geovisualization in this research assumed primarily spatial properties; whereas, the fencing materials and designs built upon the configurations added meaningful objects that people could respond to with place-

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[47] Preferences for mooring buoy scenarios were considered in terms of participant selections for both on land and from aboard boats perspectives (e.g., current location and current location, proposed relocation and current location, etc.) because participant comments indicated that these selections were not independent from one another.

based preferences. Such a modelling process is reflective of Tuan’s (1977, 6) heavily cited comment on place, who noted that “undifferentiated space becomes place when we endow it with value”. In essence, scenario modelling within the geovisualization involved organizing abstract shapes and vectors (i.e., reference maps), and then layering them with objects and textures that transformed them into entities imbued with meaning and value (e.g., fences, boats, gulls, people, unique landforms, views, etc.).

A particular advantage of modelling place with space was that it allowed for a more comprehensive assessment of scenarios, as building elements with high degrees of realism allowed geovisualization users the opportunity to respond to aspects of the scenarios that were not initially intended for assessment. For example, many participants in the study reacted negatively toward the design and wording of the fencing signage, and they subsequently suggested improvements that could lead to better cooperation from visitors in terms of keeping people out of restoration areas. In addition, modelling place within this study also involved the development of a soundscape, following the reasoning that sense of place is influenced by sensory inputs beyond just sight (Tuan, 1975), and this too allowed for more comprehensive assessments. The initial intention of incorporating sound into the geovisualization was to create a better representation of coastal place (Newell et al., 2017). However, as noted by Lindquist and Lange (2014), people assess landscape changes through multiple senses, and in accordance with this notion, this study found that audio stimuli contributed to user assessment of scenarios. The soundscape was particularly useful for assessing temporal aspects of scenarios, as sound is inherently dynamic (Worboys and Duckham, 2004) and it can be assessed in terms of outcomes or level of impact occurring over a duration. For example, a participant identified a disadvantage of the proposed relocation mooring buoy scenario to be its potential for increasing sound pollution through longer ship-to-shore travel, indicating that the incorporation of sound into the geovisualization allowed her to come to this conclusion.

Modelling place with space does present opportunities; however, it is also associated with certain challenges. In particular, it requires constant consideration around how elements are modelled and what specific identities are bestowed upon them. Examples of such considerations are seen with the dog management scenarios. Previous research has found that perceptions of and feelings toward virtual human characters can differ depending on whether they are modelled as male or female (e.g., Yanghee and Baylor, 2006), and in this study, decisions had to be made as to what gender to portray the Parks Canada staff. Ultimately, the models were arbitrarily assigned genders, consisting of one male and one female; however, it is uncertain as to whether responses to scenarios would differ if instead both models were of the same gender, if genders of the current models were switched, or if models were created as androgynous beings without clear male or female identities. In addition, previous research has found that people hold perceptions around certain dog breeds in terms of personalities and temperaments (e.g., Gunter et al., 2016), and thus, it is possible that the appearances of the dog models (as well as their behaviours, e.g., aggressive or playful) could also play a role in how some people responded to dog management scenarios.

Navigability appeared to enhance the geovisualization's capacity as a tool for inclusive approaches to planning, particularly for scenarios specific to the coastal context. As noted in *6.1 Introduction*, the purpose of implementing navigability was to allow people to cross the land-sea interface, and this ability to enter the marine environment contributed to understandings and assessments of the mooring buoy scenarios. Certain niche user such as SCUBA divers can develop familiarity and place-relationships with marine environments (e.g., Moskwa, 2012); however, most coastal users experience these places from positions above the water surface and thus the marine realm consists of extra-perceptual places, i.e., places that have not been personally experienced (Goodey, 1974). This study found evidence that navigable land-to-sea geovisualizations can help overcome the extra-perceptual nature of the marine, as it was noted that the ability to explore the underwater environment and seeing eelgrass ecosystems helped convey the significance of efforts for protecting these ecosystems (i.e., relocating mooring buoys to reduce anchoring in eelgrass meadows). Such an observation is encouraging as it suggests that geovisualizations can contribute to decisions that are based on a more holistic understanding of coastal environments.

Another advantage of incorporating navigability into the geovisualization was that it allowed users to consider options beyond the pre-designed scenarios, as they could explore areas from the first-person perspective to get a sense as to whether said areas could provide alternatives to what was proposed. For example, the geovisualization was used to explore new areas for signage in the fencing scenario exercise and suitable locations for possible dog areas in the dog management exercise. Orland et al. (2001) described this approach to visualization as 'egocentric', and they commented on how it could be beneficial in that it allows planners to examine a situation from the ‘inside’ and make ground-level management decisions. The findings from this study confirm such a notion, as they indicate that realistic, navigable geovisualizations allow users the ability to consider multiple management options from different angles.

The geovisualization demonstrated to be valuable for examining aesthetics, and such a feature was particularly useful for assessing fencing scenarios. Feedback from focus groups indicated that the geovisualization was helpful for considering how certain fencing materials might align or conflict with the surrounding environment. Such aesthetic considerations are important when thinking about fostering positive visitor experience and sense of place (e.g., Collins and Kearns, 2010), and the findings from this study align with previous research that have found visualizations to be useful for showing how constructed elements can affect the ‘character’ of a place (Salter et al., 2009). In addition, the geovisualization demonstrated capacity for allowing users to think about aesthetics in the context of other factors, particularly by illuminating trade-offs between aesthetics and functionality. For example, mesh fencing was considered to be an effective barrier but was not aesthetically pleasing, whereas the wooden split-rail fencing was regarded in vice versa terms. The geovisualization also allowed users to identify circumstances where the appearance of a fence might actually be counteractive to functionality, namely with the rope which was described as ‘inviting’ for children to come over and play with it.

Related to aesthetics, the geovisualization also exhibited to be useful for examining viewsheds and assessing scenarios that hold implications for views. Such an application is important for geovisualizations employed in the coastal context due to the fact that many coastal users have strong value for the view out the ocean (Thompson, 2007) and (in some cases) these views can be important in terms of people’s attachment to place (e.g., Devine-Wright and Howes, 2010). Feedback on the mooring buoy scenarios suggested that the geovisualization can be used for viewshed analysis, as geovisualization users indicated that their preferences for certain scenarios were based on improving ocean views (i.e., moored buoys ‘dominate’ the seascape less when moving buoys further away from shore). Coastal geovisualizations therefore could be valuable in other cases where viewsheds might be impacted, and perhaps could play an important role in situations where viewshed impacts might be substantial and proposed plans are controversial, such as with offshore wind farms (Phadke, 2010).

Applications in which the geovisualization was regarded more critically included the dog management scenarios, as some participants indicated that discussion around dog management could be done without visual aids. Dog management scenarios differed from fencing and mooring buoy scenarios in that it primarily involved modelling of place and involved little spatially modelling. Places can have fuzzy boundaries that are not always easily defined spatially (Collins and Kearns, 2010; McLain et al., 2013), and such was true for the dog scenarios where even though models were assigned locations (i.e., dogs, owners and Parks Canada staff), it was generally understood that they would not be bound to these locations in the real-world. In contrast, fencing and mooring buoys were highly spatial in nature, and most agreed that some form of visual media would be useful for these scenarios (i.e., maps, if not the geovisualization). Such a finding suggests that people might value geovisualizations for representing data on place and space, but have more mixed opinions when solely (or at least primarily) place-based information is represented[48]. However, it is important to recognize that perceived value (or lack thereof) does not necessarily equate with actual usefulness, and it is possible that participants were responding to the conveyed dog scenarios on a more subconscious level, where the usefulness of the tool might not be immediately obvious. Sense of place encompasses visceral feelings and emotions (Tuan, 1975), and there was evidence in the study that people were responding to dog scenarios on such a level, such as with the comment around not wanting to ‘see that’ in reference to dogs disturbing birds and the mention of being aware of the dog barking when examining fencing scenarios. Therefore, it is possible that modelling scenarios that are much more related to place characteristics than spatial properties can be useful for examining scenarios and making decisions, even if the value is not immediately apparent to the users.

Perceptions around the geovisualization’s usefulness for scenario assessment was tightly linked with opinions on the tool’s user-friendliness, or in the case of many users within this study, the lack of user-friendliness. Newell et al. (2017) found that user control contributed to the sense of being in a real-world environment when freely exploring the geovisualization; however, this study observed that user control was regarded more critically when it came to targeted tasks, i.e., examining scenarios. It is possible that a different user interface and method of control

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[48] It might be the case that visual aids were considered unnecessary due to the controversial nature of the issue and people having preformed opinions on the issue; however, the suggestion that this is due to differences in the type of information conveyed (i.e., primarily place rather than space and place) is also possible and warrants further research.

would have resolved these issues. For example, Smith et al.'s (2012) interactive visualization of forestry management scenarios in southeastern Tasmania was noted by users to be relatively easy to use, and it was controlled through simple click and drag mouse operations, as well as being equipped a user interface with text that described the scenarios and identified the different features and functions of the tool. Alternatively, providing everyone with user control might not be necessary, as many of the study participants indicated they preferred having the geovisualization facilitated by the researcher because this allowed them to concentrate on aspects and implications of the scenarios rather than computer controls. Ultimately, many participants shifted away from operating the tool themselves and toward asking the researcher to display certain aspects of scenarios and the virtual environment, as this gave them a certain degree of control without having to familiarize with keyboard commands. This observation aligns with Salter et al.'s (2009) findings from a study on using visualization for participatory planning on Bowen Island (BC, Canada), as they found that study participants rated the usefulness of the tool highly even though participants interacted with it by giving navigational instructions to a computer operator and highlighting features on the screen with a laser pen. The findings of this research and Salter et al.'s (2009) study indicate that dynamic, navigable geovisualizations can be effective planning tools without stakeholders having direct control of the tools. However, as posited by Schroth et al. (2011), it is important to recognize that taking this approach requires operators of the geovisualizations to have strong facilitation skills and the ability to effectively incorporate the tool within planning discussions.

The geovisualization's usefulness also appeared to be related to the availability of certain supporting materials, namely, the fencing and mooring buoy scenario maps. In previous visualization research, Lewis and Sheppard (2006) noted that some stakeholders might respond better to realistic landscape visualizations than abstract maps when assessing scenarios; however, they did not discount the value of maps and suggested using a combination of visuals. The findings of this study support this suggestion, as many participants expressed the usefulness of complementary maps with some regarding these as 'essential' supporting materials. In contrast, cost estimates were not as widely regarded as useful supporting materials. These findings initially appear to contradict the assertions of Grêt-Regamey et al. (2013), who posited that linking cost metrics to visualization scenarios enhances capacity for scenario assessment due to making trade-offs explicit. However, it is important to consider the geovisualization users when thinking about what would be regarded as a ‘trade-off’. Although park management efforts use public funds, focus group participants were not among those who have direct control over the Parks Canada budget and thus were somewhat ‘removed’ from cost implications. Consequently, expenses such as the costs of different fencing materials did not factor as strongly into assessment as did other considerations related to more personal concerns and interests, such as those associated with ecological values (i.e., protection of vegetation) and visitor experience (i.e., park aesthetics).

Unlike user-friendliness and (some) supporting materials, perceptions around the geovisualization’s usefulness did not appeared linked or related to familiarity with Sidney Spit. This could be due to the participants having familiarity with similar coastal environments and other coastal parks located within the greater area (Newell et al., 2017), thus were able to make place-based decisions on that basis. However, this being said, familiarity was observed to influence the scenario assessment itself, particularly with the primed groups and fencing configuration. Primed participants appeared more amenable to the west side only fencing configuration, and this could be due to the participants’ personal experiences walking up the west beach when approaching the north end of the spit. If this supposition is correct, it demonstrates that recent experiences with real-world places influence how we regard and interact with virtual representations of these places, and accordingly, recent place experiences of geovisualization users should be considered when using these tools for planning purposes.

6.5 Conclusion

The purpose of this study was to explore the potential dynamic, interactive, realistic geovisualizations have for facilitating inclusive approaches to coastal planning, and the research found that coastal geovisualizations show promise as tools for engaging different people in assessment and discussion around planning scenarios. The geovisualization was considered more useful for examining certain management issues over others; however, by modelling both place and space, the tool demonstrated that it could be used for assessing aspects and considering options beyond simply the options and scenarios developed prior to planning sessions. The geovisualization also provided a platform for coastal users to share experiences and perspectives associated with their user group (e.g., boaters discussing closer mooring buoys as more appealing due to feeling more sheltered from wind), thereby allowing for planning discussions with diverse user interests in mind.

The findings from the study indicate that coastal geovisualizations can be useful for providing diverse stakeholders with comprehensive understanding of local issues and potential options, while also serving as platforms for gaining a better understanding of different stakeholder interests and perspectives. This indicates that coastal geovisualizations have potential as tools for facilitating inclusive, collaborative planning efforts. Nonetheless, it is important to recognize that the changes and consequences depicted through the scenarios in this research were relatively modest (e.g., erecting fences, changing positions of mooring buoys, adding Parks Canada staff, etc.). Future research can build on this work by developing interactive geovisualizations that depict more dramatic changes to coastal places (e.g., new marina, off-shore wind turbines, new commercial buildings, etc.). In addition, this study follows a research approach involving small numbers of participants for primarily collecting qualitative data (e.g., Lewis and Sheppard, 2006; Salter et al., 2009). Future research around this form of geovisualization can take a different approach. Namely, future studies can involve larger sample sizes and survey-based data collection to examine how a (theoretically) wider diversity of people regard the usefulness and user-friendliness of the tools (e.g., Smith et al., 2012) and show preferences for different scenarios (Groulx et al., 2017). Such research would be particularly valuable for examining questions around how different demographic aspects interact with and respond to the tools. For example, how do younger groups that (presumably) have had more early life exposure to computer technology regard usefulness and user-friendliness of these geovisualizations? Overall, this study has found that realistic immersive geovisualizations show promise as tools for inclusive approaches to coastal planning and management, and further research can continue to explore this potential.

Chapter 7

Synthesis and Conclusion

7.1 Research Questions and Objectives

This research effort was designed to address two major questions, the first focusing on how geovisualizations function as tools for inclusive coastal planning and management. This question explored the 'human component' of visualizations (i.e., how diverse stakeholders/users interact with these tools), and it was crafted with the recognition that incorporating people-place relationships into resource planning efforts is important for enabling inclusive approaches to planning and management (Cheng et al., 2003; Stocker et al., 2012; Thompson and Prokopy, 2016; Yung et al. 2003; Williams and Stewart, 1998). Accordingly, the question involved examining the relationship between sense of place and geovisualizations.

> How might geovisualizations function as tools for facilitating inclusive and collaborative coastal management, in terms of the way they operate within cultural and social dimensions and interact with coastal place-based values?

The second question focused on the environmental context of the research. The question concerned the development and application of geovisualizations that specifically represent coastal places. The majority of geovisualization research has been in the terrestrial context, and lessons and insights from terrestrial work are not directly applicable to coastal geovisualization due to the biophysical and socio-cultural uniqueness of these interconnected terrestrial and marine environments. Thus, the second research question was crafted to address this research gap and facilitate exploration of considerations associated the coastal context.

> What are the challenges and opportunities associated with developing and using realistic, immersive geovisualizations in collaborative management efforts employed in the coastal context?

The following sections demonstrate how this research effort has addressed these questions, and they integrate findings from the various studies in a manner that provides a coherent picture of the theoretical and practical insights gained through this dissertation. This chapter begins with a discussion on the relationship between sense of place and geovisualizations, particularly focusing on the coastal context. It then discusses considerations around building and using geovisualizations that represent coastal places. Following that, the chapter comments on the potential that the type of geovisualization studied in this research has in terms of serving as a tool for facilitating inclusive, collaborative approaches to coastal planning and management. The chapter concludes with discussion on future directions for coastal geovisualization research and final thoughts on this research effort.

7.2 Sense of Place and Coastal Geovisualizations

As noted, the first research question explored the human component of geovisualizations. This involved examining how users interact with these tools and why (or why not) they are effective in terms of stimulating thinking/discussion around planning. The foundation for this work is a theory that realistic geovisualizations are place-based tools, and the five studies of this research serve to develop this theory, explore it in the coastal context, support it with empirical data and analysis and investigate it through applied geovisualization research. The following sections describe these activities in further detail and illustrate how this research effort has shown that coastal geovisualizations are place-based tools that operate by connecting with the sense of place of users/stakeholders. The sections aims to provide coherence among the different studies within this research effort, and thus it will discuss how the studies align with and link to one another in this exploration of geovisualizations as place-based tools.

7.2.1 Place theory, sense of presence and geovisualization

The first research question alluded to a relationship between geovisualizations and sense of place; however, as noted in Chapter 1, such a relationship had not yet been explicitly established prior to this dissertation. Therefore, a theory that geovisualizations act as place-based tools was developed through the literature review-based work described in Chapter 2. This work drew upon sense of presence research, recognizing that this field of study has explored sense of place and virtual environments (e.g., Turner and Turner, 2004; Turner et al., 2013), and it used Biocca’s (2003) three-pole model of presence as a basis for understanding how geovisualizations can connect with a person’s sense of place. As seen in Chapter 2, adapting this model to the geovisualization context resulted in a theory that ‘virtual place’ (i.e., geovisualization) can align with ‘imagined place’ (i.e., mental imagery of the real-world place), and through this ‘coupling’, users can consistently engage in thoughts, feelings and meanings associated with the real-world location that is being imagined and visualized. Evidence that geovisualizations act in this manner was observed through reviewing visualization studies that have demonstrated the ability these tools have for communicating ‘meaningful information’ on places (Lewis and Sheppard, 2006), eliciting responses reflective of particular place-based values (Tress and Tress, 2003) and evoking emotional responses associated with places (Salter et al., 2009).

The theory that geovisualizations act as place-based tools provided a foundation for this research; however, the theory developed in Chapter 2 applies to geovisualizations of all types of environments, whereas this dissertation specifically examined the coastal context. As presented in Chapter 3, further review-based research was conducted to better understand coastal geovisualizations as place-based tools, and such work involved exploring what the aforementioned ‘imagined place’ might look like to different coastal users based on their varying relationships with place. Thompson’s (2007) seven cultural models of coastal property (i.e., landscape, community, ecological, moral order, sovereignty, productivity and commodity) served as a useful framework for this exploration, as they roughly defined different user groups and allowed for examination on how ranging interests and worldviews can lead to various ‘imaginings’ or ‘conceptualizations’ of coastal places. In turn, examining these conceptualizations illustrated how certain perceptual foci and key visual elements might exist for a particular user group and (in turn) might influence how they interact with a geovisualization. For example, Chapter 3 explains that ocean views are important to landscape culture, and this translates to imaginings of coastal places that emphasize viewshed elements. Consequently, these types of users would be sensitive to visual depictions of scenarios that would obscure these elements and disrupt the viewshed.

7.2.2 Coastal environments and imagined place

Chapter 2 provided a theoretical foundation for the research and Chapter 3 applied this theory to the coastal context; however, both chapters are based on purely literature review-based work.

Since this theory of geovisualization is novel, it required investigation through empirical study in order to examine its validity, and thus the survey study presented in Chapter 4 was conducted. This study employed survey-based methods frequently used in environmental psychology and human geography to quantitatively examine relationships to place (e.g., Devine-Wright and Howes, 2010; Kelly and Hosking, 2008; Lee, 2011; Lai and Kreuter, 2012), and it combined these methods with techniques derived from sense of presence research on how people visualize or imagine place (Turner et al., 2003). By taking such a methodological approach, this work integrated methods from sense of place research and virtual environment studies, effectively bridging the two fields of study.

7.2.2.1 Integrating studies

The empirical work supported the theoretical work by producing evidence that a relationship between sense of place and visualization of place (i.e., how place is imagined) exists. Probably the most salient pieces of this evidence consisted of statistically significant regression models that confirmed intuitive relationships, meaning relationships that one would expect to see. For example, the sense of place dimension associated with nature protection values led to higher likelihoods that wildlife elements were included within a person's imagining of coastal place. Such findings indicate that people's place-based values do translate to how they mentally visualize place, which in turn, supports underlying assumptions of Chapter 3, i.e., that sense of place influences and shapes conceptualization of place.

It is important to recognize the review-based work on conceptualization of place described in Chapter 3 employed a cultural model framework to identify different place-based interests and values, whereas survey study of Chapter 4 characterized sense of place by componentizing it into different psychological dimensions. The consequence of taking these different methodological approaches is that people-place relationships were not directly comparable between the two studies. However, further analysis of survey data, particularly the visualization of place data and additional comments provided through the 'More thoughts to share?' section[49], revealed that the cultural models (and their respective coastal

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[49] Additional comments were provided through the 'More thoughts to share?' by 29.3% of survey respondents.

conceptualizations) were represented in the survey responses. For example, over two fifths of respondents (43.0%) identified viewshed elements, including specific references to ‘ocean views’ (8.4%)[50] and islands in the distance (7.3%), and these elements form core components of the landscape conceptualization. In addition, evidence of landscape culture was observed through ‘More thoughts to share?’ comments that described ocean views as serving as an integral aspect of living near the coast.

> “My wife's family home was on Dallas Road with 180-degree view of the Olympics & straits! When we married we had to have a ‘sea view’ home and have lived at Cordova Bay for 50 years with a view of Mt. Baker & San Juan Island” (Survey ID 198)

The community cultural model and related conceptualization were reflected in survey responses that identified people as being part of visualizations of place (19.9%), including specific mentions of social interaction and children playing. In addition, developments such as marinas, retail buildings and houses, were also identified by participants as part of their visualization of place (19.5%), which was also described as part of the community conceptualization. However, as noted in Chapter 3, the community model can lead to desire for restricting development to maintain the ‘character’ of a place, and such a sentiment emerged through the ‘More thoughts to share?’ section of the survey.

> “Selling large tracts of coastal places to developers for exclusive use of a few privileged people deprives access [to those] who enjoy simple outdoor pleasures such as walking, running, hiking or merely dreaming” (Survey ID 197)

> “No matter what individuals think about development[,] most times it is ignored with preferential treatment given to the commercial developer…e.g. Loss of water usage for paddlers around this development.” (Survey ID 203)

Chapter 3 described the productivity model to include sub-surface elements in addition to above surface elements because reliance on marine resources naturally leads to mental imagery of underwater spaces (e.g., McKenna et al., 2008; Sáenz–Arroyo et al., 2005). Aligning with this

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[50] More participants identified ‘views’ (18.7%) without specifying ‘ocean’; however, it is likely that these views refer (or at least include) ocean views.

thinking, the survey study found commercial boats (11.9%) and marine environment (12.6%) as elements of visualization of place, and there were some responses that indicated that these were part of the same coastal imagining. For example, a respondent included ‘boats’ and ‘sea life’ in her visualization and made mention of improving fishing processes, indicating a possible enactment of the productivity model and conceptualization.

It is worth noting that only some of the commercial boats specifically referred to resource-harvesting, i.e., fishing boats, and this ultimately comprised a small portions of elements identified in survey responses (2.6%). Therefore, the productivity model (in terms of resource extraction) was not strongly reflected in the survey study. Instead, the economic value of the coast was discussed more in terms of recreational opportunities, relating an understanding that tourism is a significant industry for Vancouver Island’s economy (VIEA, 2016). To a certain degree, this indicates that thoughts and concerns for local economy are associated with a more locally prevalent community model, which is a notion that is further evidenced through the extraction of a sense of place factor (from the survey data) that encompasses both community and economic well-being. Granted, it was noted in Chapter 3 that productivity and community models can be linked due to communities forming around a particular coastal/marine resource industries; however, this discussion referred more to the history and cultural heritage associated with resource extraction activities (e.g., Jacob et al., 2005; Panelli et al., 2008; Urquhart and Acott, 2014). In this case, the ‘resource’ is not one that is harvested or extracted, rather it consists of the recreational opportunities that can be enjoyed by tourists and locals alike.

> “Tourism - I disagree with no short term rentals. This situation does bring in much needed revenue for property owners, provides a job for cleaning the house, the renters - almost always a young family spend [money] on island buying food, shopping & supporting the local economy…Let's have a balanced approach to being ‘environmentally friendly’ & supporting our local community” (Survey ID 228)

Survey responses also provided evidence of the ecological cultural model. On initial glance, it might appear as if the ecological model was found to be prevalent throughout the surveyed population, as ecological elements such as wildlife and vegetation were of the most frequently identified (66.1% and 47.7% respectively). In addition, high value for the environment was observed through high mean averages for nature protection values (M = 5.60, SD = 0.76) and ecological concerns (M = 5.04, SD = 1.24), as well as several of the ‘More thoughts to share?’ comments concerned local environmental issues such as oil tankers (12.0%) and untreated sewage (6.0%). However, as discussed in Chapter 3, the ecological model requires recognizing the coast as dynamic, interconnected terrestrial and marine systems, and marine elements were far less commonly noted as part of visualization of place (12.6%) than elements associated with terrestrial ecology. Therefore, although ecological elements, values and concerns were prevalent in the survey data, this did not necessarily translate to the complex conceptualization associated with the ecological model. This is consistent with the discussion in Thompson (2007) and Chapter 3 that states that the ecological model is not widely shared, and few responses accurately reflect enactment of this model by capturing terrestrial and marine elements and alluding to dynamic properties of coastal systems.

> “The shore is always changing; the tides busy bringing new treasures into shore & reorganizing or moving driftwood to the next bay. There is always a seal, otter, heron or chatty oyster catchers to add to the picture.” (Survey ID 219)

Evidence of the moral order conceptualization was found with people that described their visualization of place as ‘tranquil’ or ‘quiet’ (16.1%) and with little development (9.9%). As explained in Chapter 3, this conceptualization is based on a perspective that the immensity and beauty of land/seascapes are testaments to a higher power and thus human development would spoil such places. Those that hold such sentiments toward coastal development tend to use terms such as ‘pristine’ to describe the unspoiled nature of the land/seascapes (e.g., Collins and Kearns, 2013; Phadke, 2010), and such terminology was observed within the survey comments.

> “Some of my favourite places were unspoiled & unnamed (pristine)…Several abandoned industrial sites unfortunately serves as reminders of what we are capable of…destroying through lack of respect for ourselves and for the environment. We value our coast and its natural beauty and do not want to see it negatively impacted through ignorance or abuse.” (Survey ID 190)

The sovereignty model could not be identified through certain visual elements; however, there was evidence of possible sovereignty conceptualizations through how survey respondents placed themselves within the visualization. Approximately 5.3% of respondents noted that they imagined themselves on private property within their visualization of coastal place. In addition, private opportunities concerns (which includes property) was a factor extracted from the survey data, and certain comments from the survey participants expressed frustrations associated with the disregarding of private property rights.

> “[T]he general public disregards private landowners property lines to feel they can go anywhere they like. I've had hay fields trampled by people and their dogs who feel they can enjoy any large open area.” (Survey ID 262)
>
> “Concerned about high degree of "trespassing" by the public on private foreshore property where beach access exists.” (Survey ID 266)

No clear evidence was found to claim that the commodity model was present within the survey data. Almost a fifth (19.5%) noted development to be a part of their visualization; however, as mentioned above, this could relate more to the community model. It is possible that the commodity model was difficult to detect because as noted in Chapter 3, the model can be layered with the conceptualizations of other groups to incorporate imagery appealing to audiences targeted for selling coastal properties; however, it is also possible that this model was absent from the surveyed population. Although commodity culture was not detected, it is worth noting that an ‘anti-commodity’ sentiment was observed in several of the comments. Thus, the commodity model was recognized by survey participants as present within their communities, if absent from the surveyed population itself.

> “I feel very strongly against commercial/residential building along the coastal places. The longer this activity goes on means there is less for the rest of the people to enjoy.” (Survey ID 171)
>
> “Pressures from commercial exploitation including…real estate development appear to take away from free access to coastal places.” (Survey ID 173)
>
> “I do not like seeing the [impact] that real estate development has on our coastline. I would like to see a buffer zone of say 1000m of any shoreline.” (Survey ID 185)

7.2.2.2 Synthesis

Integrating the ideas and findings from Chapters 3 and 4 illustrates that (although methodological different) the theoretical and empirical works coincide and support one another in demonstrating how certain relationships with coastal places can lead to particular imaginings of these places. In light of this, the conceptual model presented in Figure 10 from Chapter 4 (i.e., the framework for examining relationships between sense of place, coastal concerns and visualization of place) can be revised to include placed-based values and interests framed through coastal cultural models. It is important to recognize that this revised model does not attempt to convey a specific configuration in the relationships between sense of place, concerns and cultural models exists, as this research has not adequately illuminated such nuances. Rather, the model more broadly expresses that each of these ways of understanding coastal place relationships can be observed within the same population and that they are viable routes for thinking about how different people and user groups imagine coastal places.

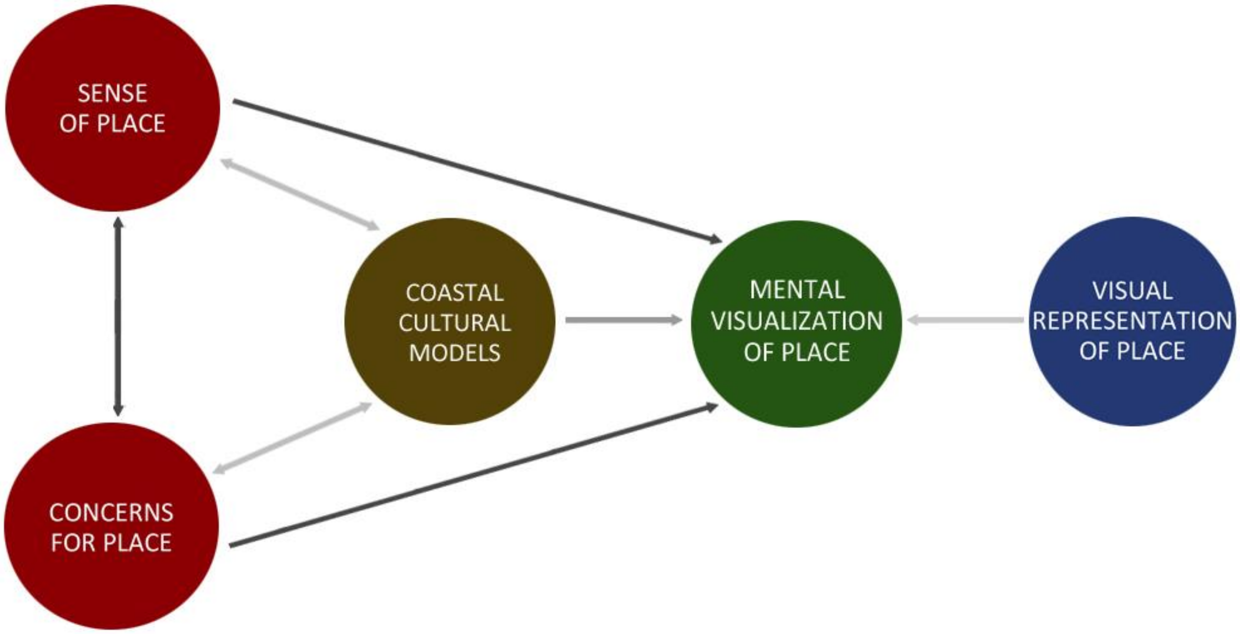

Figure 34. Revised framework for examining relationship between sense of place and visualization of place

The original framework is displayed in Figure 10 from Chapter 4. The revised framework differs from the original in that it incorporates coastal cultural models. The darker grey lines represent relationships examined through study in Chapter 4; whereas, the lighter grey lines represents relationships explored through integration of different studies within this dissertation.

7.2.3 Imagined place and virtual place

The frameworks featured in Figure 10 in Chapter 4 and Figure 34 in this chapter indicate that a relationship exists between visualization of place and visual representation of place. This relationship was derived from Chapter 2's adaptation of Biocca's (2003) three-pole model of presence, which proposed an interaction between virtual place (i.e., geovisualization) and imagined place (i.e., mental visualization of place); therefore, it was based on theoretical work. As the survey study did not involve participant interaction with coastal visualizations, it was not designed to test this relationship and thus did not provide empirical insight on all aspects of the framework. Instead, such insight was gained through the applied geovisualization research described in Chapter 5, which examined people's responses to a geovisualization in terms of how well it captured a real-world coastal place.

7.2.3.1 Integrating studies

Integrating the studies and applying findings from the applied research to the framework featured in Figure 34 poses challenges due to methodological incompatibilities between the applied research (Chapter 5) and the review-based and survey studies (respectively Chapters 3 and 4). In terms of the former, the applied research was not designed in a manner that allowed for classification of focus group participants into particular cultural models, and even if this was part of the research design, individuals can hold characteristics associated with multiple cultural models (Thompson, 2007). In addition, the geovisualization modelled a national park, and thus certain coastal cultural models would not apply to this context (e.g., the sovereignty and commodity models). In terms of the survey-based study, the geovisualization focus groups did not contain enough participants for conducting the binomial regression modelling described in Chapter 4, thus making it difficult to make specific claims around sense of place or coastal concerns dimensions being related to particular responses to the geovisualization.

Where the studies do appear to coincide and link to one another is through the key visual elements of coastal places. Key elements within mental visualizations of place that were identified through the survey study (and discussed above as related to the coastal conceptualizations) were observed in the applied research as significant contributors to the geovisualization's realism and ability to connect with sense of place. For example, viewshed elements were identified by 43.0% of survey respondents in their visualization of place, and in a similar vein, this was a thematic code used in the analysis of the focus group data as both Parks Canada and local resident focus groups commented on how such elements contributed to the geovisualization's representation of place (n = 4 and n = 6, respectively). Other examples include boats, driftwood and park structures (e.g., signs, picnic tables), which were both identified in survey responses (33.2%, 11.6% and 11.2%, respectively) and noted as contributors to the geovisualization's representation of place (local resident focus groups: n = 9, n = 6, and n = 3).

Other key visual elements common to both the survey and focus group data include flora and fauna elements. Land vegetation was frequently identified through survey responses as a key element (47.7%), and similarly, it was one of the more prevalent codes in local resident focus group data (positive comments: n = 11; negative comments: n = 2), as well as being a topic of discussion in the Parks Canada focus group session. Fauna that demonstrated similar trends between the two studies included birds. Many survey participants identified birds (29.2%) as part of their visualization of place and this element was also noted by focus group participants to be a contributor to the geovisualization's representation of place. However, perhaps more salient evidence of congruence between the two studies is through critiques of the geovisualization's bird aspect. Birds were regarded critically by local resident participants and (to a greater degree) Parks Canada participants, in terms of the lack of bird diversity, and aligning with this finding, a diversity of bird species was identified through survey responses. In some cases, specific species were noted in the survey to be a part of visualization of place, such as eagles and herons, and these same species were noted in focus groups as 'missing elements' of the geovisualization.

Focus groups and survey responses also appeared to exhibit similar trends in terms of human elements within visualizations of coastal place. Approximately a fifth of the survey responses (19.9%) included people within their mental visualization, and these elements were also frequently mentioned as contributors to the geovisualization's representation of place (local resident focus groups: n=10). In addition, specific mentions of social interaction emerged in both studies by participants who made reference to human elements, and these occurred in roughly the same proportions (i.e., 23.4% of survey responses that identified people as part of visualization of place, and 23.1% of focus group participants that discussed people models as contributors to the geovisualization's representation of place). Mentions of dog elements were somewhat more disproportionate, as only 4% of survey respondents identified these elements as part of their visualization of place, whereas they frequently emerged in the geovisualization feedback (n = 7).

However, the latter was likely influenced by the fact that dogs were deliberately made conspicuous in the geovisualization (i.e., barking and chasing birds), as some of the scenarios explored in the tool were associated with dog management.

Beach and beach textures (i.e., sediment) were frequently identified within survey responses (62.8%), and also were mentioned often through geovisualization feedback (local residents: n=10) and focus group discussions. However, although frequently mentioned, local resident focus group comments around this element were mostly critical with many participants describing it as detractor from realism and sense of place (n=9). As explained in Chapter 5, this appeared to be an issue with the participants using low resolution versions of the geovisualization that did not adequately display texture detail. Such observations demonstrate how elements that are key to visualization of place (i.e., as identified through the survey) can be affected when attempting to represent these elements using technology and tools that are not powerful enough effectively portray them.

The survey and focus group study also demonstrated similarities in how they extended beyond visual elements and included auditory stimuli. The geovisualization was built with a soundscape in recognition of previous literature, which asserts that sense of place is linked to more than solely visual sensory input (Tuan, 1975) and that people assess scenarios and changes to a place in a multisensory manner (Lindquist and Lange, 2014). In light of this literature, the finding that sound was a major contributor to the geovisualization's representation of place was not surprising; however, the complementary finding from the survey study was less expected. As explained in Chapter 4, the survey instructions employed sight-oriented terminology, requesting that participants 'visualize' coastal places and describe their 'mental pictures', yet 8.4% of responses described sound as part of their 'visualization' of coastal place. Such an observation is indicative of the significance of sounds for coastal sense of place, as survey respondents felt the need to identify auditory stimuli regardless of how the instructions were worded. In accordance with the survey study observation, focus group participants responded strongly (and positively) to sound characteristics when interacting with the coastal geovisualization.

Underwater elements appeared in both survey responses and focus group data; however, differences were observed between the two studies, particularly concerning prevalence of these elements within survey and feedback data. Approximately 12.6% of survey respondents identified underwater elements[51] and spaces as part of their visualization of coastal places. Albeit not a negligible share of the surveyed population, this is proportionately smaller than was observed with many of the terrestrial visual elements (e.g., people, vegetation, birds, viewshed), which is an observation that is consistent with the assertion from Chapter 3 that the majority user groups (i.e., cultural models) hold conceptualizations of coastal places that do not contain marine elements. However, in contrast, marine elements (e.g., underwater environment, marine life, and eelgrass) were frequently noted as contributors to the geovisualization's representation of place within focus group feedback (local residents: n=10), as well as serving as a prevalent topic in focus group discussions. Much of this discussion was prompted by the novel feature of being able to enter the underwater environment, but as discussed in Chapter 5, it was also noted that this ability did strongly convey the interconnectedness between land and sea and provided a more holistic impression of the coast. Such an observation is encouraging as it indicates that land-to-sea visualizations might be able to expand people's cognizance of place to include areas, which comprise critical habitats yet are (for most people) extra-perceptual and thus are not in the forefront of people's minds.

> "[The geovisualization is] perfect for…those who have no experience with underwater swimming or have never been to a salt-water beach." (Participant 22)
>
> "[Geovisualization is] very helpful. Displays interaction between ocean and land" (Participant 26)

In addition to identifying key elements of visualization of place, survey participants were asked to indicate whether they imagined themselves within their 'picture' of coastal place. The majority of respondents (83.5%)[52] noted that they were present in their visualization place, indicating that they were experiencing their mental imagery from the first-person perspective. Complementing this finding, many of the focus group participants noted that user control and

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[51] Some survey respondents identified wildlife that lives in the marine environment; however, their responses did not indicate that they were picturing these animals underwater. This indicates that they could be 'viewing' them as they surface, and thus they were not considered as underwater elements during the analysis.

[52] Not all survey participants responded to this question, and the 83.5% is based on 217 'yes' responses out of a 260 total responses.

first-person perspective contributed to the geovisualization's realism and representation of place (n = 10). Although not specific to the coastal context, such findings illustrate how developing a geovisualization from the first-person perspective can offer a degree of immersion (Isaacs et al., 2011), which subsequently could contribute to the alignment of virtual and imagined place involved in the process of a visualization connecting with sense of place (i.e., as discussed in Chapter 2).

7.2.3.2 Synthesis

Integrating the findings of the survey study of Chapter 4 with the applied research of Chapter 5 illustrates how mental visualizations of place contain similar elements to those that are noted as contributors to or detractors from a geovisualization's representation of place. As both survey and focus group participants were sampled from the same population, this demonstrates a certain coherence among the studies. Perhaps, it can be argued that some of the contributors to place are fairly 'general' in how they are characterized (e.g., wildlife, vegetation), and a wide variety of people would note that simply having these elements present makes a virtual representation more realistic and 'complete'. However, the focus group critiques of the visualizations suggested that more nuanced interactions occurred between imagined and virtual places, and that certain place elements are significant within these interactions. For example, the beach textures were not portrayed properly in low resolution versions of the geovisualization, thereby affecting the tool's ability to represent and (by extension) connect with sense of place. In addition, it was observed that elements of significance can vary from person to person depending one's understanding and relationship with place; for example, the lack of bird diversity was a more prevalent topic of conversation in the Parks Canada focus group session than in the local resident sessions.

The discussion above indicates that there is an interaction between how people understand/perceive places and how these places are virtually represented, and this interaction can involve both alignments and conflicts. However, it was also found through this research that virtual representations can interact with imagined place in a manner that illuminates less prominent areas, particularly with people that hold conceptualizations of places that are environmentally 'incomplete'. As discussed in Chapter 3 and 4, underwater spaces are not commonly featured in mental imaginings of coastal places; however, this was a significant topic in the focus group discussions, where it was expressed that the geovisualization effectively conveyed the interconnectedness between land and sea. These are important findings as they demonstrate that these tools can serve in a potentially powerful educational role and be used to enhance place understandings that otherwise might be limited due to lack of real-world experience or interaction with certain aspects of said places.

7.2.4 Geovisualizations as place-based tools

The final study of this research (Chapter 6) examined the geovisualization's capacity as a tool for allowing different users to effectively assess and contribute thoughts on potential management scenarios. As with the other studies, this work was premised on theory put forward in Chapter 2 (i.e., geovisualizations operate as place-based tools). The study employed the same focus groups that were used in Chapter 5; therefore, as discussed in *7.2.3 Imagined place and virtual place*, the research design did not allow for investigation around whether assessments of or reactions to scenarios were influenced by specific sense of place dimensions, coastal concerns and/or cultural models. However, the study did provide more general evidence for claiming that the geovisualization operated as a place-based tool, and this evidence consisted of focus group feedback data collected by asking participants to comment on the usefulness of the geovisualization for assessing scenarios. Participants noted that the geovisualization evoked memories of the real-world place and produced the sensation of actually 'being there'. Such comments imply that the geovisualization is operating in the manner suggested Chapter 2, meaning that the virtual place was producing place-based cues that shaped imagined place around thoughts and memories of the real-world location, thereby connecting with sense of place.

> "[The geovisualization] strengths [are] that you feel you're actually there; can't think of any weaknesses" (Participant 18)
>
> "[The geovisualization] brought back a few memories" (Participant 25)
>
> "[The geovisualization] helped me remember the area and envision in my head (see) what options would actually look like" (Participant 27)

Chapter 2 posited that familiarity with a real-world place influences a geovisualization's ability to connect with sense of place, as familiarity would allow one to draw from more salient place-based memories. However, in contrast to this notion, focus group feedback data from those who did not visit Sidney Spit prior to exploring the geovisualization suggested that the tool was capable of evoking memories and feelings of ‘being there’ for these participants, an example of this being a comment from Participant 8 (below). Potential reasons for this seemingly contradictory observations became clear through focus group discussion, particularly when the same participant (e.g., 8) noted that the geovisualization was very ‘typical’ of BC coastal places. This indicates that the virtual representation brought forward memories of experiences formed in other local coastal places that ‘felt’ environmentally similar to Sidney Spit. Such findings are important, as they suggest that geovisualizations do not need to be considered as a tool exclusively for coastal users that frequent the specific represented locations. Rather, those with understanding, experience and relationships with the greater geographical region also can effectively use the tool and provide input on coastal plans.

> “It gives you a real feeling of being there.” (Participant 8)

7.3 Building and Using Coastal Geovisualizations

Based on an analysis of coastal conceptualizations, Chapter 3 put forward recommendations on developing coastal geovisualizations with particular features in order for them to effectively facilitate inclusive planning efforts. These features include full navigability, dynamic elements and flexibility (i.e., capacity for continual modification and scenario building). The sections below discuss each of these features and the challenges and opportunities associated with implementing the features, as seen through the applied research of Chapter 5 and 6. The sections also draw from the discussion above and describe the place-based considerations surrounding each of the features.

7.3.1 Navigability

A recommendation from Chapter 3 is that coastal geovisualizations are designed as navigable virtual environments. Such a feature is particularly important in the coastal context for two reasons. Firstly, effective coastal management requires cognizance that coasts are comprised of interconnected marine and terrestrial environments (Cicin-Sain, 1993; Sorensen, 1997; Garriga and Losada, 2010), and the ability to travel within a geovisualization allows users to cross the land-sea interface and explore both realms. Such a feature is particularly important in light of the findings of Chapter 3, which exhibited that most conceptualizations of coastal place exclude subsurface elements. The second reason for implementing navigability is due to the significance the viewshed has for many coastal users (Devine-Wright and Howes, 2010; Thompson, 2007; Stocker and Kennedy, 2009). Views were found in Chapter 3 to be important components of conceptualizations formed through certain cultural models such as landscape and moral order, and similarly, viewshed elements were also identified by over two fifths (43.0%) of survey respondents as part of their visualizations of place. Therefore, coastal geovisualizations must provide users with the ability to assess potential impacts to viewshed in a ‘complete’ manner, meaning from different locations and angles.

Albeit an important feature, implementing navigability in the geovisualization presented certain challenges associated with modelling both terrestrial and marine environments, particularly in capturing the differences between the two domains as the user crosses the land-sea interface. For example, considerations existed around the visibility differences experienced in the two different environments. In a geovisualization that models solely marine places, a fog effect can be applied to the entire virtual environment to represent lower visibility (e.g., Canessa et al., 2015), and similarly, a visualization of a coastal place that does not allow for submergence (e.g., Shaw et al., 2009) can set visibility of the model to that of above water conditions. However, in the case of this research, a mechanism needed to be built to allow for changes in visibility as geovisualization users enter and exit the marine environment. In addition, this mechanism needed to be adjusted according to tide, as it involved colliders (i.e., spaces that trigger actions when entering) to activate visibility changes when the user character was fully submerged and thus the colliders had to be positioned properly to align with different water levels.

A conceptual challenge associated with implementing navigability was how to model movement within marine spaces. As an air-breathing species, humans can not spend extended periods in underwater environments without the assistance of equipment designed for facilitating a particular underwater activity, and the way people travel and experience marine places changes depending on the nature of the activity (e.g., SCUBA diving, traveling in an underwater vessel). In turn, these different modalities dictate the physics around user movement (as well as the window of vision), thus bringing forward questions around the activity-context that should serve as the basis for underwater movement. Ultimately, the geovisualization in this research employed the same movement physics underwater as experienced on land in effort to maintain a reasonable scope for this work; however, future coastal geovisualization research will be confronted with considerations around different modes of marine movement and the activity-contexts surrounding these modes.

Navigability also presented challenges in using the geovisualization, as well as building it. As aforementioned, user control contributed to the experience of being in a real-world place; however, such a feature was regarded more critically when attempting to use the tool for assessing scenarios. Many focus group participants indicated that they found the geovisualization controls to be confusing at times, and this detracted from the effectiveness of the tool because they were spending effort learning controls rather than thinking about the scenarios. It was frequently noted in focus group discussions that the tool could be more effective if operated by a session facilitator that navigates the virtual environment based on group discussion and requests, as this would allow for a certain degree of control without having to familiarize with keyboards commands. In collaborative planning sessions, such an approach could be effective given the geovisualization operator has strong facilitation skills (Schroth et al., 2011), particularly when working with stakeholders with lower technological comfort. However, questions do remain around how to leverage the place-based benefits from exploring the tool oneself (i.e., how user control contributes to feelings of being in a real-world place), while ensuring that stakeholders do not experience frustrations around attempting to familiarize with controls and key commands. Perhaps, the use of a different user control device, such as a joystick (Carassa et al., 2004), might be more intuitive to users navigating the geovisualization and could reduce frustrations; however, further research is needed to confirm whether this would be the case with this particular visualization.

> “I am feeling that manipulation of the technology is taking precedence over the content.” (Participant 22)

Although user challenges associated with navigation clearly existed, this feature still demonstrated value for the geovisualization’s ability to serve as an effective tool for coastal planning. As noted above, viewshed assessment was one of the main reasons navigability was recommended in Chapter 3, and supporting this reasoning, focus group participants did use the tool in such a manner when assessing mooring buoy scenarios from the land-based perspective (i.e., the effect moored/anchored boats had on the viewshed). However, navigability also provided unanticipated benefits, particularly in how it allowed users to explore management possibilities outside of pre-designed scenarios. For example, during the fencing scenario exercise, the geovisualization was used to examine other viable locations for signage beyond the options built into the tool. As another example, during the dog management scenario exercise, the geovisualization was used to explore areas in the park that could be suitable for designating as dog areas in order to restrict dog access and keep them away from sensitive habitat. Ultimately, the ability to navigate the geovisualization allowed for a broader range of ideas, comments and suggestions from users, which in collaborative planning sessions, can be valuable for harnessing local knowledge and a gaining more accurate reflections of local stakeholder values and interests.

Incorporating navigability produced the desired benefits associated with crossing the land-sea interface because as discussed in *7.2.3 Imagined place and virtual place*, this feature effectively conveyed the interconnectedness between terrestrial and marine environments. In turn, these enhanced understandings and perspectives of coastal places contributed to participants' scenario assessments. It was noted that the ability to explore underwater places increased awareness around and/or appreciation of eelgrass ecosystems, which subsequently increased appreciation for possible protective measures (i.e., mooring buoy relocation). Such observations are encouraging as they indicate that geovisualizations used in collaborative planning sessions can be effective for simulating thinking around both land and sea domains, while session participants formulate and share their thoughts/ideas/opinions on potential management options.

7.3.2 Dynamics

Chapter 3 recommended that coastal geovisualizations move past static media in order to accurately convey the dynamic nature of coastal places, particularly since certain user groups might inaccurately perceive coastal places as controllable and stabilizable (i.e., sovereignty cultural model). However, incorporating such properties comprised a substantial task, as it presented a new 'layer' of modelling considerations. Creating a dynamic geovisualization involved applying animations to elements that typically move within the real-world, which in turn, necessitated thinking about how these elements should move and what behaviours should be represented. For example, considerations emerged around what behaviours should be assigned to the different people models (e.g., enjoying the view, conversing with others, walking along the spit, etc.), and some of these behaviours presented further considerations, such as (for a walker) what route should a person take and how fast should he/she walk. In some cases, difficulties existed in reconciling the motions of objects and their spatial placement. For example, the paths of travelling boats were designed in such a manner that the user (roughly) sees the same variety and number of boats in the viewshed as they would when within the real-world park; however, achieving such a visual composition required animating some boats with unrealistically fast speeds to ensure that they appear in the right place at the right time. In other cases, objects were assigned behaviours simply to give the impression of an element being ‘alive’; however, insufficient attention was given to how the objects moved, resulting in unrealistic or uncharacteristic behaviours, such as evidenced through Participant 5’s comment below regarding the foraging gull models.

> “[S]eagulls seem to be pecking like wood peckers. [I] have not seen one in the model doing the ‘clam dropping’ which is what they do” (Participant 5)

Although modelling dynamics can be challenging, it presented great opportunities for the types of scenarios that can be conveyed within the geovisualization. Chapter 3 posited that dynamics can be particularly valuable for coastal geovisualizations, as such a feature can be used to illuminate relationships among and between species and habitats and the actions that impact these relationships. In this research, dog management scenarios featured an off-leash dog interacting with seabirds in a manner that negatively affected the birds, and this allowed for a more vivid portrayal of issues around dogs impacting wildlife in coastal habitats. However, it is important to recognize that the point on dynamics mentioned in Chapter 3 specifically expressed that such a feature would be particularly valuable for conveying interactions across the land-sea interface that are unintuitive and/or less understood by the general public, whereas the off-leash dog example primarily refers to a well-understood, terrestrial interaction. Regardless, the dog-bird interaction does illustrate the potential dynamic approaches to geovisualization have for communicating inter-species relationships, and such capacity can be further explored to include marine-terrestrial interactions.

Building geovisualizations as dynamic virtual environments also allowed incorporation of audio stimuli. Sound is inherently dynamic (Worboys and Duckham, 2004) and (as discussed in *7.2.3 Imagined place and virtual place*) it enhanced the geovisualization's ability for connecting with sense of place. However, as with modelling visual dynamics, developing a soundscape involves another layer of modelling and presents a new set of considerations, including the nature, quality and volume of different sounds. In addition, the challenges associated with crossing the land-sea interface discussed in *7.3.1 Navigability* are also present with sound modelling, specifically how terrestrial and marine spaces hold different sounds that need to be triggered as users enter/exit underwater areas. However, although challenges existed, incorporating sound also presented great opportunities, as soundscapes can be designed to illustrate or highlight particular coastal/marine issues or phenomena. For example, boat noises were the only above surface sounds that were not muted when submerging underwater and the soundscape was purposely designed this way in recognition of concerns around marine noise pollution from vessel traffic (e.g., Simmonds et al., 2014; Williams et al., 2014; Williams et al., 2015)[53]. Sounds also allowed for more complete understanding of different scenarios, as argued by Lindquist and Lange (2014) who asserted that visualizations should be developed as multisensory tools due to the fact that people assess landscape changes through multiple senses. An example of this is described in Chapter 5, where a participant recognized a potential trade-off of the proposed mooring boat relocation scenario to be an increase in noise pollution due to longer ship-to-shore travel.

7.3.3 Flexibility and interactivity

The final recommendation detailed in Chapter 3 was to develop as flexible and interactive geovisualizations that allow for continual scenario building and modification. Such a feature was recommended as could help disambiguate nuanced meanings surrounding coastal values and promote a clearer articulation of coastal interests/aspirations among different user groups. It can be argued that such a feature is important for place-based geovisualizations that represent non-coastal environments as well because relationships people form with places are influenced by a

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[53] The research did not investigate whether this sound design actually did draw attention or raise awareness of underwater noise pollution issues among focus group participants; however, such potential could be examined through future studies.

variety of social, economic, cultural and environmental factors (Vorkinn and Riese, 2001; Gosling and Williams, 2010; Scannell and Gifford, 2010); therefore, sense of place constitutes a complex phenomenon, regardless of the environment context. However, as coasts consist of terrestrial and marine environments, they have the ability to support a particularly wide variety of activities, interests and values (Shackeroff et al., 2009; Stocker and Kennedy, 2009), and thus it can also be argued that flexibility and interactivity are especially important features for coastal geovisualizations.

When exporting the geovisualization from the Unity editor as a standalone application, the final product was limited in terms of the user’s ability to manipulate and add/remove elements, which limited opportunities for exploring the flexibility and interactivity of the product. However, the workflow employed in scenario development (i.e., scenarios designed and built based on Parks Canada discussion) produced some insights around considerations involved with incorporating user input into geovisualization development and evolution. What was apparent was that the placement and repositioning of objects involved a relatively straightforward process that could be informed by people with low technical experience, thereby increasing the potential inclusivity of geovisualization development. For example, fencing scenarios were developed using maps on which fencing configurations were drawn by hand (i.e., pen drawings that did not require any software or technical tools). The larger challenge of incorporating user input into geovisualization development concerns the range of elements associated with coastal places. As observed in Chapter 4 (i.e., survey study), the types of elements associated with coastal places are plentiful and diverse, and thus building an asset library that captures the complete set of elements associated with all relevant stakeholder coastal conceptualizations would be a substantial task.

Perhaps, the challenges surrounding inclusive and collaborative approaches to geovisualization development can be reframed as opportunities when considering what constitutes a ‘geovisualization development process’. Rather than attempting to build geovisualizations to an ‘end state’, the construction of these place-based tools should consist of iterative and ongoing processes that continually incorporate stakeholder input. Such an approach could involve methods such as the focus group work employed in Chapter 5, where participants commented on the geovisualization’s representation of a real-world place. The outcomes of such processes would inform how to build a comprehensive asset library and a depiction of a real-world place that captures multiple perspectives and understandings, while also promoting valuable stakeholder discussions around commonalities and differences in perspectives/understandings surrounding coastal places. Ultimately, taking this sort of continual-build approach would lead to geovisualizations that represent ‘collective images’ of coastal place, in a similar manner to how compilation of mental maps (i.e., layered series of memory-produced maps) can display collective images of coastal space (e.g., Gueben-Venière, 2011; McKenna et al., 2008). As this collective image becomes more representative of the diversity of place relationships held by different stakeholders, (ideally) the tools will become more effective for stimulating discussion and thinking around the conflicts and common ground pertinent to coastal management plans.

7.4 Geovisualizations and Collaboration

Both research questions refer to the potential geovisualizations have for inclusive and collaborative approaches to planning and management, and much of this potential has previously been explored through visualization research conducted in the terrestrial context (e.g., Lewis and Sheppard, 2006; Schroth et al., 2011; Tress and Tress, 2003). This doctoral work follows these research efforts, and in a similar vein, it has found geovisualizations can be used as tools for engaging diverse groups of coastal users in assessing and sharing thoughts around potential planning scenarios. However, it is worth discussing how focus groups were of different sizes, and in many ways, the results produced from larger groups produced clearer impressions on how geovisualizations might operate in collaborative planning sessions. Although focus group participants provided feedback through forms, the sessions did involve group discussions and participants were free to talk throughout the sessions. In some sessions, participants who were affiliated with a particular user group shared insights and/or knowledge from their respective group, which subsequently allowed other participants to consider scenarios from broader perspectives. For example, two avid recreational boaters attended one of the focus groups, and these participants shared thoughts on the mooring buoy scenarios related to the boaters’ experiences and perspectives. As another example, a focus group contained a participant who identified as a marine biologist, and this participant shared knowledge with other focus group participants around the ecological importance of eelgrass, which appeared to contribute to the others’ understanding of importance of protecting eelgrass meadows. In both cases, the geovisualization served as a platform for stimulating these discussions and enabling examinations of the scenarios with new perspectives and knowledge in mind.

Although the geovisualization did demonstrate potential for facilitating collaborative planning, questions remain as to whether this tool could be described as ‘integral’ for all types of stakeholders and scenarios. While the geovisualization was (for the most part) regarded positively, some participants suggested that maps might work just as well for certain scenario assessments. Even among participants who viewed the geovisualization as useful for examining all types of scenarios, many noted that the maps served as essential complements. However, it is important to note that many of the focus group participants expressed that they were quite comfortable with map-based visuals; whereas, other people might not have the same level of comfort with such a visual medium (e.g., Lewis and Sheppard, 2006). Thus, employing a combination of visual tools is recommended when engaging diverse groups of people.

Questions also still remain concerning the types of inclusive planning approaches for which geovisualizations are best suited. The geovisualization could be used simply to gather opinions/feedback on proposals or plans in a similar manner to Schroth et al.’s (2009) open house event in Kimberley (BC, Canada), where community members were invited to see and comment on visualizations depicting local climate change impacts and adaptation options. Alternatively, the geovisualization could also be employed manner that more actively involves stakeholders, such as done in Al-Kodmany’s (2000) co-planning session in Pilsen (IL, USA), where a collaborative community planning session was held and supported through the use of visual media. In some ways, the methodology mirrored the former type of engagement, as it invited to residents of the CRD to interact with geovisualization scenarios and then provide comments. However, the potential for the latter form of engagement was made apparent through this research effort, as the tool also demonstrated to be an effective platform for stimulating discussion around management scenarios, exploring alternative options and (ultimately) involving coastal users in planning conversations.

In whatever way it is employed, the geovisualization demonstrated value for engaging diverse groups, which is useful for participatory approaches to planning. In particular, it exhibited unique value for collaborative planning in how it provided opportunities for users to more comprehensively assess and comment on different aspects of scenarios, including aspects that were not originally intended for assessment. For example, focus group participants discussed issues with signage wording and design, and subsequently suggested alternatives that would better solicit cooperation from the public. Other visual tools such as maps do not allow for this degree of assessment and thus might lead to oversights around certain aspects of management strategies. Therefore, perhaps further exploration on this observed capacity that geovisualizations have for ‘opening up’ scenarios for more comprehensive assessment will reveal these tools as invaluable for collaborative planning. As indicated above, such research likely will not position geovisualizations as a replacement for maps; however, it might demonstrate that they could indeed be an essential complement and an integral piece in the suite of tools employed in collaborative planning.

7.5 Limitations and Future Research

7.5.1 Engaging specific groups

Recruitment of focus group participants was done in a similar manner to that of the survey study (i.e., mail-out invitation to random sample of CRD residents) in order to add a degree of consistency and coherence among the research activities; however, such an approach limited the researcher’s ability to explore particular collaborative planning settings. To elaborate, the research did not recruit specific stakeholders, local governments or communities that would (or should) be included in collaborative efforts; instead, it assessed the geovisualization’s potential for inclusive coastal planning and management by engaging members of the public with different views and interests surrounding coastal places. Although interesting insights emerged from this work, future studies should consider organizing focus groups comprised of members of certain organizations or communities.

In particular, future geovisualization research should consider engaging First Nations communities, such as done in Lewis and Sheppard (2006). The initial research proposal for this project involved plans to contact members of Tsawout First Nations to discuss the possibility of organizing a local focus group; however, for the reasons stated above, the focus group studies ultimately did not involve such targeted recruitment. Still, this is considered a major limitation of the research, and it is worth noting that this limitation was recognized and discussed within a focus group session (see quote below). Engaging First Nations communities in the development of tools for collaborative coastal management is essential, particularly if taking approaches to geovisualization that involve continual development through incorporation of place perspectives, understandings and ideas of different coastal users (as discussed in *7.3.3 Flexibility and Interactivity*).

> "[I]nclude First Nations history of the area, traditional uses of resources. Work with them." (Participant 5)

7.5.2 Moving beyond the parks context

The geovisualization modelled an area within the Gulf Islands National Park Reserve (GINPR), and public uses of the island are restricted, consisting primarily of recreational activities such as camping and walking (Parks Canada, 2012). This context limits the types of scenarios that can realistically be incorporated into the geovisualization, and as a consequence, place changes depicted through the scenarios in this research were relatively modest (e.g., erecting a fence rather than constructing a building). In some ways, these limitations were useful for maintaining the scope of the research, as the research had many novel avenues to explore already, such as the relationship between place theory and geovisualizations and considerations around developing a land-to-sea virtual environment. However, now that these avenues have been explored, future research can move toward visualizations that depict more dramatic changes to coastal places, such as those that might occur in residential (e.g., Salter et al., 2009), urban (e.g., Grêt-Regamey et al., 2013) and/or industrial/commercial (e.g., Tress and Tress, 2003) contexts. In addition, as this research found geovisualizations to be useful for assessing how certain scenarios might affect viewshed experiences, future studies could investigate applications for planning scenarios that involve more dramatic impacts to ocean views, such as with offshore wind farms (e.g., Phadke, 2010).

7.5.4 Regional scales

The extent of the navigable space within the geovisualization was (for most part) dictated by the geography of Sidney Spit; that is, the 85-hectare space was selected to encompass the Long Spit and adjacent marine space. In many ways, this reduced complications associated with considerations around scale and deciding what sort of area the geovisualization should cover. However, as geovisualization research progresses and more places are modelled, questions will emerge around how the approach to geovisualization taken in this research can be applied to regional levels (or even if it should be).

The geovisualization is experienced from the first-person perspective, and Orland et al. (2001) posit that such a perspective is best suited for ground-level assessments concerning decisions that affect smaller areas. In fact, even with the limited area featured within the Sidney Spit geovisualization, a teleportation function was incorporated, and study participants indicated that this was a useful feature for moving around the virtual environment. This suggests that this form of geovisualization is best experienced as smaller, localized areas; however, questions still emerge around how to approach geovisualization when many modelled areas are located within a region. For example, GINPR consists of several different parks located in the Southern Gulf Island region. If more geovisualizations are developed that model these other parks, several different approaches could be taken for a regional geovisualization, including facilitating inter-park travel via boat in a similar manner to the ship-to-shore function describe in Chapter 6, only allowing people to travel between parks via teleportation, or even developing the park models separately and allowing users to access a particular park through a map interface. Future research on regional-scale geovisualization could explore these options, and investigate their respective challenges and opportunities.

7.5.5 Marine environment

This research effort produced valuable insights around the place relationships (or lack thereof) people form with underwater environments and the challenges/opportunities around developing a land-to-sea visualization. This being said, future studies could go further in exploring marine components of geovisualizations, particularly in terms of using the tool to examine scenarios with implications for marine areas. Scenario selection was based on discussion with Parks Canada and the scenarios selected were deemed appropriate for this particular research effort; however, only one of the three scenario types held strong implications for underwater spaces (i.e., the mooring buoy scenarios). Chapter 6 did present interesting findings concerning how ‘experiencing’ the marine environment contributed to mooring buoy scenario assessment by stimulating thinking around eelgrass protection measures, but future work could explore this capacity further by examining scenarios that result in more dramatic changes to marine places. Similar to that discussed in *7.5.2 Moving beyond the parks context*, this could involve researching contexts such as residential, urban and/or industrial places, and scenarios could involve building large coastal structures such a new marina or commercial dock.

In addition to examining different scenarios, future research should be conducted on the relationships between sense of place, marine places and virtual environments. This doctoral project has raised interesting question around how to represent marine places, that is, whether these should be modelled according to field data or whether they should represent collective impressions of how such areas ‘should appear’. In addition, as noted in *7.3.1 Navigability*, underwater travel within this geovisualization did not contain an activity-based context, and future work could investigate how users interact with and respond to a geovisualization (and the scenarios it depicts) if movements were modelled based on particular activities, such as snorkeling or SCUBA diving. Such questions offer interesting lines of inquiry that can be explored through the lens of human geography, integrating geovisualization research with methods such as those used in Merchant’s (2012) humanistic approach for studying the experiences of novice SCUBA divers.

7.5.6 Multisensory tools

Previous research has argued for the development of multisensory visualization tools (Bishop and Stock, 2010; Lindquist and Lange, 2014), and recent studies have made advancements in this area such as research on the incorporation of sound into visualizations of a public walkway (Echevarria Sanchez et al., 2017), a park within an urban area (Lindquist and Lange, 2016), and wind farms (Manyoky et al., 2016; Yu et al., 2017). The current research effort contributes to this evolving research field by also incorporating sound into the geovisualization, which ultimately led to insights around how audio stimuli can positively influence perceptions of realism and sense of place and can provide another means for using the tool for scenario assessment. However, the visualizations of this research and the aforementioned studies still only operated on two senses (i.e., sight and sound); whereas, sense of place is influenced by a range of sensory inputs, including smell and temperature (Tuan, 1975). In fact, the survey study of Chapter 4 demonstrated that 10.9% and 4.3% of respondents respectively identified smell and temperature as part of their ‘visualization of place’. Therefore, considering this research argues that geovisualizations are place-based tools, future coastal geovisualization research should employ methods from other studies on virtual environments that has incorporated sound, smell and temperature (Ramic-Brkic et al., 2013). However, albeit a valuable line of research, it is important to recognize that pursuing this research agenda will require confronting challenging (but interesting) questions around how to structure and deliver such sensory information in both terrestrial and marine areas of the virtual environment.

7.6 Other Geovisualization Applications

The collaborative planning application investigated in this research was premised on previous visualization studies that were also conducted within this context (e.g., Lewis and Sheppard, 2006; Salter et al., 2009; Schroth et al., 2011; Tress and Tress, 2003); however, this is a novel tool with other possible applications that also warrant research. To stimulate thinking around such applications, focus group participants were asked (through the feedback forms and discussion sessions) to suggest other potential uses for geovisualization. This section reports on these suggestions.

A commonly suggested application was to use the tool for educational purposes. Specific suggestions were made around using the geovisualization to convey certain environmental impacts (such as anchor damage to eelgrass) and teach people about local natural and cultural history. It was noted if used in such a fashion, the tool would be suitable for an aquarium setting, such as the Shaw Centre for the Salish Sea located near the departure point for the ferry to Sidney Island.

> “[S]how what damages are caused by bad behaviours…show how restoration can occur and how areas can recover and the significance from an ecological point…where this or that can be found – relevant ecosystems, key species, First Nations traditional use, etc.” (Participant 5)

> “I would like to see this adapted to different age ranges and used in an educational setting – also at the Ocean Discovery Centre in Sidney [i.e., Shaw Centre for the Salish Sea].” (Participant 10)

In addition to the environmental education context, it was also suggested that the tool could be employed in post-secondary settings. More specifically, students training to be community or environmental planners could use the tool to build and assess different management and/or development scenarios. In many ways, the results of this research indicate that this could be a suitable application for the geovisualization because it relates to how the tool was employed here, meaning that is was used for planning exercises and evaluating potential management scenarios.

> "University students – doing planning scenarios for courses." (Participant 20)

Another suggested application for the geovisualization was to use the tool to provide people with mobility issues the opportunity to experience places virtually. Such a suggestion speaks to geovisualization's ability to connect with sense of place, as it indicates that the geovisualization represented a real-world place well enough to be considered as a viable proxy for a coastal place experience. However, if this application were to be pursued, it would require further exploration around multisensory approaches to visualization in order to more comprehensively evoke place experiences, such as discussed in *7.5.4 Multisensory tools*.

> "Could be used for people unable to make the trip to enjoy the area, for example disabled adults." (Participant 14)

Other suggested applications included using the tool for visitor preparation. This was discussed within the Parks Canada focus group, and it was suggested that the geovisualization could be used by people intending to visit the park for the purposes of planning their trips and activities. It was also noted that the geovisualization could deliver educational messages within this application; for example, virtual tours could be developed for activities such as kayaking and they could be designed in such a manner that they communicate locations of restricted areas and sensitive ecosystems. In addition, it was suggested that the geovisualization could serve as platform for visitors to select campsites, as the tool would provide them with a better impression of the features and aesthetics of a site than would (for example) a simple map.

Another suggestion was that the geovisualization could as serve as a tool for communicating effects of climate change and impacts of sea level rise. Such an application can still fall within the planning context; however, it is worth discussing here as it is a clear application for coastal geovisualizations that was not explored in this research effort. Such an application has been explored in other research efforts, such as Shaw et al.'s (2009) study in

Delta (BC, Canada) that investigated the use of visualizations for conveying sea-level rise and potential adaptation measures. However, their visualization assumed an above-water perspective, and it did not allow for navigation below the water surface. Future work that employs this research's approach to geovisualization could investigate how tools that can be experienced from both on-land and underwater can be used to examine impacts of sea-level rise, and whether this degree of navigability contributes to their ability as tools for adaptation planning.

> "Higher tides shown to visualize the effects of global warming on a beach"
> (Participant 22)

7.7 Conclusion

In Chapter 2, the term 'humanistic geomatics' was employed to describe the incorporation of place theory into geovisualization research. Albeit a powerful way of approaching this research, it was also noted that this could be regarded by many as 'academic oxymoron' due to the merging of the traditionally separated disciplines of humanistic geography and spatial sciences (Agnew, 2011; Gold and Goodey, 1983; Kaltenborn and Williams, 2002). In many ways, this research has brought to light the tensions between the two epistemologies. The development of the geovisualization was data-driven to 'objectively' create a credible and accurate representation (i.e., as per Sheppard, 2001), but ultimately, the tool attempted to model and capture place, which is inherently subjective geography (Botts et al., 2003). Such contractions elucidate the challenges of building place-based tools for inclusive planning that aim to connect with multiple people's sense of place, particularly in light of the fact that the geovisualization architects themselves also have a specific relationship to and understanding of place. However, such challenges are not insurmountable. Relph (1970) posits that a 'consensual view' of the world that captures multiple perceptions of a shared reality exists, and related to this notion, a continual iterative geoviualization building process could potentially lead to a collective image of coastal places. In addition (and equally as important), the process of building this collective image can illuminate both commonalities and incongruences in perceptions of coastal place, similar to how compiled mind maps can do this for perceptions of coastal space (e.g., Gueben-Venière, 2011). Through these means, a better of understanding of how different coastal users perceive and value the coast can be ascertained, thereby leading to better understanding of conflicts and ways of working toward common goals.

The humanistic geomatics approach employed in this research has led to interesting insights around the considerations involved in modelling place as well as space. Modelling place presents considerable challenges in terms of capturing enough detail to sufficiently ‘represent reality’, an issue succinctly stated through the Appleton et al.’s (2002, 147) quote, “reality will always exceed our ability to simulate it”. Such a challenge holds implications for ‘scaling-up’ geovisualizations to represent larger areas, as it can limit the geographical extent that can feasibly be modelled with such a level of detail. However, as these are place-based tools, modelling larger areas might not be necessary or even appropriate for this type of visualization. The geovisualization is experienced from the first-person perspective, and such a perspective is best suited for ground-level assessments concerning decisions that affect smaller areas (Orland et al., 2001). Such a notion was supported by this research, as the geovisualization was equipped with a teleportation function in order to reach different locations without having to spend excessive time walking through the 85-hectare space, and as noted earlier, study participants mentioned that this was a useful feature. In addition, although challenges exist in modelling large areas with great detail, this does not interfere with the geovisualization’s capacity for allowing users to interact and assess spatially expansive areas. To elaborate, participants in this research experienced the geovisualization viewshed from within the boundaries of the navigable area, and these viewshed elements represented geography that extends far beyond Sidney Spit in the real-world setting. Ultimately, it is important to recognize that this type of geovisualization does not function in the same manner as spatial tools such as maps, and although methods of capturing larger areas might constitute an important consideration for the spatial tools, this is not necessarily the case for these place-based tools. As observed through this research, geovisualizations and maps are not substitutes for one another and do not hold the exact same functions; similarly, how they are built should also be considered in different terms.

In addition to exploring the modelling of the place, the research was novel in how it investigated the coastal context and visualized coastal place as interconnected marine and terrestrial environments. Such work has produce valuable insights on the challenges of modelling two dramatically different environments and featuring them in the same virtual space/place, as well as the benefits of allowing users the ability to enter the marine environment. In addition, the coastal context called for certain features to be incorporated into the geovisualization such as navigability and dynamics, and such features uncovered challenges/opportunities that are applicable to visualizations representing all types of environments. For example, the degree of navigability within the geovisualization contributed to its ability to connect to sense of place and enabled exploration of alternatives to built-in scenarios, but it also resulted in difficulties using the technology and frustrations with the tool. In terms of dynamics, this allowed for better conveyance of interactions between different elements (e.g., dog and gulls) and was conducive to developing a soundscape; however, it also presented a new series of modelling considerations around how to accurately represent behaviours and sounds. Ultimately, these features proved to be important for the geovisualization, and albeit they presented challenges, future research should continue to build on this work to increase the sophistication, usability and potential of these tools.

This research set out to explore the potential geovisualizations have for facilitating inclusive, collaborative approaches to coastal planning and management; however, the tool developed was novel and it is not yet certain what its ‘ideal’ application is. As illustrated through *7.6 Other geovisualization applications,* the tool holds potential for multiple purposes (e.g., education, visitor preparation, experiences for the mobility impaired, etc.), and each of these applications present interesting and valuable routes for further studies. In addition, even within the collaborative planning context, questions still remain around what is the optimal way for using the tool is; for example, would it be best employed in an open house event, a co-planning session, or perhaps in both settings but in different ways? This doctoral project has provided a strong basis and point of departure for further inquiry around building and using interactive, realistic coastal geovisualizations. Through continual development and research, we will be able to better harness the potential these tools can have for helping us manage and live sustainability within the valuable and vulnerable places of the world.

References

Agnew, J. (1987). *Place and politics: The geographical mediation of state and society*. Allen & Unwin: Boston, MA.

Agnew, J. (2011). Space and place. In J. Agnew and D. Livingstone (Eds.) *Handbook of Geographical Knowledge*, 316-330. Sage: London, UK.

Al-Kodmany, K. (2000). Public participation: Technology and democracy. *Journal of Architectural Education 53*(4), 220-228.

Antos, M. J., Ehmke, G. C., Tzaros, C. L., & Weston, M. A. (2007). Unauthorised human use of an urban coastal wetland sanctuary: Current and future patterns. *Landscape and Urban Planning 80*(1), 173-183.

Appleton, K., Lovett, A., Sünnenberg, G., & Dockerty, T. (2002). Rural landscape visualisation from GIS databases: a comparison of approaches, options and problems. *Computers, Environment and Urban Systems 26*(2), 141-162.

Armitage, A., & Keeble-Allen, D. (2008). Undertaking a structured literature review or structuring a literature review: tales from the field, *Electron. J. Bus. Res. Methods 6*(2), 103–114.

Arnspang, J., Benyon, D., Fahle, M. W., Granum, E., Madsen, C. B., Pajdla, T., Peleg, S., Smyth, M., Turner, P., Turner, S., & Weinshall, D. (2002). An investigation into virtual representations of real places, In *Fifth Annual International Workshop on Presence*, 66–78. Porto, Portugal.

Augustin, J. P. (1998). Emergence of surfing resorts on the Aquitaine littoral. *Geogr. Rev. 88*(4), 587–595.

Baños, R. M., Botella, C., Guerrero, B., Liaño, V., Raya, M. A., & Rey, B. (2005). The third pole of the sense of presence: comparing virtual and imagery spaces. *PsychNology Journal 3*(1), 90–100.

Bartier, P., & Sloan, N. (2007). Reconciling maps with charts towards harmonizing coastal zone base mapping: A case study from British Columbia. *Journal of Coastal Research 23*(1), 75-86. doi: 10.2112/05-0526.1

BC Stats. (2014). British Columbia regional district and municipal population estimates [*webpage*]. Province of British Columbia. Retreived from http://www.bcstats.gov.bc.ca/StatisticsBySubject/Demography/PopulationEstimates.aspx

Beegle-Krause, C. J., Vance, T., Reusser, D., Stuebe, D., & Howlett, E. (2009). Pelagic habitat visualization: the need for a third (and fourth) dimension: HabitatSpace. In Spaulding, M.L., (Ed), *11th International Conference on Estuarine and Coastal Modelling*, American Society of Civil Engineers, 187–200. Seattle, WA. doi: 10.1061/41121(388)12

Benson, E. D., Hansen, J. L., Schwartz, A. L. Jr., & Smersh G.T. (1998). Pricing residential amenities: The value of a view. *J. Real Estate Finance Econ. 16*(1), 55–73.

Biocca, F. (2003). Can we resolve the book, the physical reality, and the dream state problems? From the two-pole to a three-pole model of shifts in presence. In *EU Future and Emerging Technologies, Presence Initiative Meeting*. Venice, Italy.

Bishop, I. D., & Rohrmann, B. (2003). Subjective responses to simulated and real environments: a comparison. *Lands. Urban Plann. 65*, 261–277. doi: 10.1016/S0169-2046(03)00070-7

Bishop, I. D., & Stock, C. (2010). Using collaborative virtual environments to plan wind energy installations. *Renewable Energy 35*, 2348–2355. doi: 10.1016/j.renene.2010.04.003

Bott, S., Cantrill, J. G., & Myers, O. E. (2003). Place and the promise of conservation psychology. *Research in Human Ecology 10*(2), 100–112.

Bourassa, S. C., Hoesli, M., & Sun, J. (2005). The price of aesthetic externalities. *J. Real Estate Lit. 13*(2), 165-188.

Bourke, P., & Green, J. (2016). Keeping it real: creating and acquiring assets for serious games. *Comp. Games J. 5*, 7–22. doi: 10.1007/s40869-016-0018-z

Bowen, R. E., & Riley, C. (2003). Socio-economic indicators and integrated coastal management. *Ocean & Coastal Management 46*, 299–312. doi: 10.1016/S0964-5691(03)00008-5

Brown, G., & Raymond, C. (2007). The relationship between place attachment and landscape values: Toward mapping place attachment. *Applied Geography 27*(2), 89–111.

Burch, S., Sheppard, S. R., Shaw, A., & Flanders, D. (2010). Planning for climate change in a flood-prone community: municipal barriers to policy action and the use of visualizations as decision-support tools. *Journal of Flood Risk Management 3*(2), 126-139.

Butz, D., & Eyles, J. (1997) Reconceptualizing senses of place: Social relations, ideology and ecology. *Geografiska Annaler 79 B* (1): 1-25.

Campelo, A., Aitken, R., Thyne, M., & Gnoth, J. (2014). Sense of place: The importance for destination branding. *Journal of Travel Research 53*(2): 154-166. doi: 10.1177/0047287513496474

Canessa, R., Newell, R., & Brandon, C. (2015). Uncovering the Oceans through MarineScape geovisualizations. In D. Wright (Ed.). *Ocean Solutions, Earth Solutions*, 243-246. Redlands, CA: Esri.

Canessa, R. (2008). Seascape geovisualization for marine planning. *Geomatica 62*(4): 375–92.

Carassa, A., Morganti, F., & Tirassa, M. (2004). Movement, action, and situation: Presence in virtual environments. In *Seventh Annual International Workshop on Presence*, 7–12. Valencia, Spain.

Carter, J., Dyer, P., & Sharma, B. (2007). Dis-placed voices: Sense of place and place-identity on the Sunshine Coast. *Social and Cultural Geography 8*(5), 755-773.

Cheng, A. S., Kruger, L. E., & Daniels, S. E. (2003). "Place" as an integrating concept in natural resource politics: propositions for a social science research agenda. *Society and Natural Resources 16*(2), 87–104.

Christie, P. (2005). Is integrated coastal management sustainable? *Ocean & Coastal Management 48*(3-6), 208-232.

Chuenpagdee, R., & Jentoft, S. (2009) Governability assessment for fisheries and coastal systems: a reality check. *Hum. Ecol.* 37(1), 109–120.

Chuenpagdee, R. (2011). Interactive governance for marine conservation: An illustration. *Bulletin of Marine Science 87*(2), 197-211.

Cicin-Sain, B. (1993). Sustainable development and integrated coastal management. *Ocean & Coastal Management. 21*, 11–43. doi: 10.1016/0964-5691(93)90019-U

Cicin-Sain, B., & Knecht, R.W. (1998). *Integrated Coastal and Ocean Management: Concepts and Practices*. Island Press: Washington, D.C.

Cicin-Sain, B., & Belfiore, S. (2005) Linking marine protected areas to integrated coastal and ocean management: A review of theory and practice. *Ocean & Coastal Management 48*(11–12), 847–868. doi: 10.1016/j.ocecoaman.2006.01.001

Collins, D. (2009). Contesting property development in coastal New Zealand: A case study of Ocean Beach, Hawke's Bay. *Int. J. Urban Reg. Res. 33*(1), 147–164.

Collins, D., & Kearns, R. (2010). "It's a gestalt experience": Landscape values and development pressure in Hawke's Bay, New Zealand. *Geoforum 41*(3), 435–446.

Collins, D., & Kearns, R. (2013). Place attachment and community activism at the coast: The case of Ngunguru, Northland. *N. Z. Geogr. 69*(1), 39–51.

Collins K., Suonpää A. & Mallinson J. (2010). The impacts of anchoring and mooring in seagrass, Studland Bay, Dorset, UK, *Underw. Technol. 29*(3) 117–123.

Cooper, J. A. G., & McKenna, J. (2008). Working with natural processes: The challenge for coastal protection strategies. *The Geographic Journal 174*(4), 315–331.

Cooper, C., Larson, L., Dayer, A., Stedman, R., & Decker, D. (2015). Are wildlife recreationists conservationists? Linking hunting, birdwatching, and pro-environmental behavior. *The Journal of Wildlife Management*, *79*(3), 446-457.

Cooper, J. A. G., & Mckenna, J. (2008). Working with natural processes : the challenge for coastal protection strategies. *The Geographic Journal 174*(4), 315–331.

COSEWIC (2009). Assessment and Status Report on the Edwards' Beach Moth Anarta edwardsii in Canada. Species at Risk Public Registry. Government of Canada. Retrieved from https://www.registrelep-sararegistry.gc.ca/default.asp?lang=En&n=0BB2C96B-1

Costanza, R. (1999). The ecological, economic, and social importance of the oceans. *Ecological Economics 31*(2), 199–213.

CRD (2010) Juan de Fuca Electoral Area: Community parks strategic plan [*PDF document*]. Capital Regional District, British Columbia. Retrieved from https://www.crd.bc.ca/docs/default-source/jdf-pdf/juan-de-fuca-electoral-area-community-parks-strategic-plan.pdf?sfvrsn=2

CRD. (n.d.). About the region [*webpage*]. Capital Regional District, British Columbia. Retrieved from https://www.crd.bc.ca/about/about-the-region

Cresswell, T. (2004). *Place: A Short Introduction*. Blackwell Publishers: Malden, MA.

Cresswell, T. (2009). Place. In Thrift, N., & Kitchen, R. (Eds.) *International Encyclopedia of Human Geography, Vol. 8*, 169-177. Oxford: Elsevier.

Cross, J. E., Keskeb, C. M., Michael, G. L., Hoag, D. L. K., & Bastian, C. T. (2011). Adoption of conservation easements among agricultural landowners in Colorado and Wyoming: The role of economic dependence and sense of place. *Landscape and Urban Planning 101*(1), 75-83.

Dale, A., & Newman, L. (2005). Sustainable development, education and literacy. *International Journal of Sustainability in Higher Education 6*(4), 351–62.

Defeo, O., McLachlan, A., Schoeman, D. S., Schlacher, T. A., Dugan, J., Jones, A., Lastra, M. and Scapini, F. (2009). Threats to sandy beach ecosystems: A review. *Estuarine, Coastal and Shelf Science 81*(1), 1–12.

Devine-Wright, P., & Howes, Y. (2010). Disruption to place attachment and the protection of restorative environments: a wind energy case study. *Journal of Environmental Psychology. 30*, 271–280. doi: 10.1016/j.jenvp.2010.01.008

Devoy, R. J. N. (2016). Fanore Beach and dune management report: Current problems and planning for the future. Report Commissioned by Burren & Cliffs of Moher Geopark Tourism for Conservation LIFE Project, LIFE 11/IE/922, Clare County Council. Clare, Ireland.

DiStefano, C., Zhu, M., & Mindrila, D. (2009). Understanding and using factor scores: Considerations for the applied researcher. *Practical Assessment, Research and Evaluation 14*(20), 1-11.

Downs, R. M., & Stea, D. (1977). *Maps in Minds: Reflections on Cognitive Mapping*. Harper and Row: New York.

Downes, M., & Lange, E. (2015). What you see is not always what you get: A qualitative, comparative analysis of ex ante visualizations with ex post photography of landscape and architectural projects. *Landscape and Urban Planning 142*, 136-146.

Dugan, J. E., Hubbard, D. M., McCrary, M. D., and Pierson, M. O. (2003). The response of macrofauna communities and shorebirds to macrophyte wrack subsidies on exposed sandy beaches of southern California. *Estuar. Coast. Shelf Sci. 58*, 25–40.

Dumbauld, B. R., Armstrong, D. A., & McDonald, T. L. (1993). Use of oyster shell to enhance intertidal habitat and mitigate loss of Dungeness crab (Cancer magister) caused by dredging. *Can. J. Fish. Aquat. Sci. 50* 381–390. doi: 10.1139/f93-043

Echevarria Sanchez, G. M., Van Renterghem, T., Sun, K., De Coensel, B., & Botteldooren, D. (2017). Using Virtual Reality for assessing the role of noise in the audio-visual design of an urban public space. *Landscape and Urban Planning*, *167*, 98-107.

Ehler, C. N. (2003). Indicators to measure governance performance in integrated coastal management. *Ocean & Coastal Management 46*(3-4), 335-345.

Fernandez, P. R., Matsuda, Y., & Subade, R. F. (2000). Coastal Area Governance System in the Philippines. *The Journal of Environment and Development 9*(4), 341-369.

Fisheries and Oceans Canada (2014). Shellfish - Species and limits table [*webpage*]. Government of Canada. Retrieved from http://www.pac.dfo-mpo.gc.ca/fm-gp/rec/species-especes/shelltable-tableaucoquille-eng.htm

Fletcher, S., & Potts, J. (2008). Coastal and marine governance in the United Kingdom. *The Geographical Journal 74*(4), 295–298.

Fletcher, S., & Smith, H. D. (2007).Geography and coastal management. *Coastal Management 35*(4), 419–427.

Fletcher, S., Kawabe, M., & Rewhorn, S. (2011). Wetland conservation and sustainable coastal governance in Japan and England. *Marine Pollution Bulletin 62*(5), 956–62.

Frandsen, S., Barthelmie, R. J., Pryor, S. C., Rathmann, O., Larsen, S. E., Højstrup, J., Nielsen, P., & Thøgersen, M. L. (2004). The necessary distance between large wind farms offshore – study. (2005). Forskningscenter Risoe, Risoe-R; No. 1518(EN). Denmark.

Fraser, R., & Spencer, G. (1998). The value of an ocean view: an example of hedonic property amenity valuation. *Aust. Geogr. Stud. 36*(1), 94–98.

Garriga, M., & Losada, I. J. (2010). Education and training for integrated coastal zone management in Europe. *Ocean & Coastal Management 53*(3), 89–98. doi: 10.1016/j.ocecoaman.2010.01.004

Gold, C. M., Chau, M., Dzieszko, M., & Goralski, R. (2004). The marine GIS - Dynamic GIS in action. *International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences 35*, 688-693.

Gold, J. R., & Goodey, B. (1983). Behavioural and perceptual geography. *Progress in Human Geography, 7*(4), 578-586.

Goodey, B. (1974). *Images of Place: Essays on Environmental Perception, Communications and Education* vol. 30. Centre for Urban and Regional Studies. University of Birmingham: Birmingham.

Gosling, E., & Williams, K. J. H. (2010). Connectedness to nature, place attachment and conservation behaviour: testing connectedness theory among farmers. *Journal of Environmental Psychology 30*(3), 298–304.

Gould, P. & White, R. (1974). *Mental Maps*. Penguin Books: Harmondsworth, UK.

Grêt-Regamey, A., Celio, E., Klein, T. M., & Hayek, U. W. (2013). Understanding ecosystem services trade-offs with interactive procedural modelling for sustainable urban planning. *Landscape and Urban Planning 109*(1), 107-116.

Groulx, M., Lemieux, C. J., Lewis, J. L., & Brown, S. (2017). Understanding consumer behaviour and adaptation planning responses to climate-driven environmental change in Canada's parks and protected areas: S climate futurescapes approach. *Journal of Environmental Planning and Management 60*(6), 1016-1035.

Gueben-Venière, S. (2011). How can mental maps, applied to the coast environment, help in collecting and analyzing spatial representations? *EchoGéo* 17.

Gunderson, K., & Watson, A. (2007). Understanding place meanings on the Bitterroot National Forest, Montana. *Soc. Natl. Res. 20*, 705–721. doi: 10.1080/08941920701420154

Gunter, L. M., Barber, R. T., & Wynne, C. D. (2016). What's in a name? Effect of breed perceptions and labeling on attractiveness, adoptions and length of stay for pit-bull-type dogs. *PloS one 11*(3), e0146857.

Hay, R. (1998). Sense of place in developmental context. *Journal of Environmental Psychology 18*, 5–29.

Helmreich, S. (2009). *Alien ocean: Anthropological voyages in microbial seas*. University of California Press: Berkeley, CA.

Hill, M., Briggs, J., Minto, P., Bagnall, D., Foley, K. & Williams, A. (2001). Guide to best practice in seascape assessment. Maritime Ireland (No. 5), (Wales INTERREG).

Hofmeester, C., Bishop, B., Stocker, L., & Syme, G. (2012). Social cultural influences on current and future coastal governance. *Futures 44*(8), 719–729. doi:10.1016/j.futures.2012.04.002

Hong-ge, Y. (2010). The realization of flight simulation system based on openGL. In *2010 Second International Conference on Information Technology and Computer Science (ITCS), IEEE*, 198-201. Washington, D.C.

Hu, J., Wan, W., Wang, R., & Yu, X. (2012). Virtual reality platform for smart city based on sensor network and OSG engine. In *2012 International Conference on Audio, Language and Image Processing (ICALIP), IEEE,* 1167-1171. Shanghai, China.

Isaacs, J. P., Gilmour, D. J., Blackwood, D. J., & Falconer, R. E. (2011). Immersive and non immersive 3D virtual city: Decision support tool for urban sustainability. *Journal of Information Technology in Construction (ITcon) 16*, 151–162.

Jacob, S., Farmer, F. L., Jepson, M., & Adams C. (2001). Landing a definition of fishing dependent communities: Potential social science contributions to meeting National Standard 8. *Fisheries 26*(10), 16–22.

Jacob, S., Jepson, M., & Farmer, F.L. (2005). What you see is not always what you get: Aspect dominance as a confounding factor in the determination of fishing dependent communities. *Hum. Organ. 64*(4) 374 385.

Jentoft, S. (2007). Limits of governability: Institutional implications for fisheries and coastal governance. *Marine Policy, 31*(4), 360–370. doi:10.1016/j.marpol.2006.11.003

Jentoft, S., & Chuenpagdee, R. (2009). Fisheries and coastal governance as a wicked problem. *Marine Policy 33*, 553–560. doi: 10.1016/j.marpol.2008.12.002

Jonkman, J., Butterfield, S., Musial, W., & Scott G. (2009). Definition of a 5-MW reference wind turbine for offshore system development. National Renewable Energy Laboratory, Technical Report: NREL/TP 500–38060.

Jorgensen, B. S., & Stedman, R. C. (2001). Sense of place as an attitude: Lakeshore owners attitudes toward their properties. *Journal of Environmental Psychology 21*(3), 233–248.

Jude, S. R., Jones, P., Brown, I., Watkinson, R., & Gill, J. (2007). The development of a visualization methodology for integrated coastal management. *Coastal Management 35*(5), 525–544.

Kaltenborn, B.P., Haaland, H., & Sandell, K. (2001). The public right of access – some challenges to sustainable tourism development in Scandinavia. *J. Sustain. Tour. 9*(5), 417–433.

Kaltenborn, B. P., & Williams, D. R. (2002). The meaning of place: Attachments to Femundsmarka National Park, Norway, among tourists and locals. *Norsk Geografisk Tidsskrift - Norwegian Journal of Geography 56*(3), 189-198.

Kearney, J., Berkes, F., Charles, A., Pinkerton, E., & Wiber, M. (2007). The role of participatory governance and community-based management in integrated coastal and ocean management in Canada. *Coastal Management 35*(1), 79–104.

Kelly, G., & Hosking, K. (2008). Nonpermanent residents, place attachment, and “sea change” communities. *Environment and Behavior 40*(4), 575–594. doi: 10.1177/0013916507302246

Kojima, H., Kubo, T., & Kinoshita, A. (2013). Integrated coastal management as a tool for local governance of coastal resources: A case study of Munakata coastal zone. *Ocean & Coastal Management 81*, 66–76.

Kovačić, M., & Luković, T. (2007). Spatial characteristics of planning and construction of nautical tourism ports. *Geodria 12*(2), 131-147.

Kyle, G., Graefe, A., Manning, R., & Bacon, J. (2004). Effects of place attachment on users' perceptions of social and environmental conditions in a natural setting. *Journal of Environmental Psychology, 24*(2), 213–225.

Lafferty, K. D. (2001). Disturbance to wintering western snowy plovers. *Biological Conservation 101*(3), 315-325.

Lai, P.-H., & Kreuter, U. P. (2012). Examining the direct and indirect effects of environmental change and place attachment on land management decisions in the Hill Country of Texas, USA. *Landscape and Urban Planning 104,* 320–328. doi: 10.1016/j.landurbplan.2011.11.007

Larsson, P., Västfjäll, D., Olsson, P., & Kleiner, M. (2007). When what you hear is what you see: presence and auditory-visual integration in virtual environments. In *Proceedings of the 10th Annual International Workshop on Presence*, 11–18. Barcelona, Spain.

Lee, T. H. (2011). How recreation involvement, place attachment and conservation commitment affect environmentally responsible behavior. *Journal of Sustainable Tourism 19*(7), 895–915.

Lewicka, M. (2011). Place attachment: How far have we come in the last 40 years? *Journal of Environmental Psychology* 31(3), 207–230.

Lewis, J., & Sheppard, S. R. J. (2006). Culture and communication: Can landscape visualization improve forest management consultation with indigenous communities? *Landscape and Urban Planning 77*(3), 291-313. doi: 10.1016/j.landurbplan.2005.04.004

Lewis, J. L., Casello, J. M., & Groulx, M. (2012). Effective environmental visualization for urban planning and design: Interdisciplinary reflections on a rapidly evolving technology. *J. Urban Technol. 19,* 85–106. doi: 10.1080/10630732.2012.673057

Lindquist, M., & Lange, E. (2014). Sensory aspects of simulation and representation in landscape and environmental planning: a soundscape perspective. In A. Contin, P. Paolini, & R. Salerno (Eds.). *Innovative Technologies in Urban Mapping (Vol. 10)*, 93–106. Springer International Publishing.

Lindquist, M., Lange, E., & Kang, J. (2016). From 3D landscape visualization to environmental simulation: The contribution of sound to the perception of virtual environments. *Landscape and Urban Planning 148*, 216-231.

Lovett, A., Appleton, K., Warren-Kretzschmar, B., & Von Haaren, C. (2015). Using 3D visualization methods in landscape planning: An evaluation of options and practical issues. *Landscape and Urban Planning 142*, 85-94.

Lynch, K. (1960). *The image of the city*. M.I.T. Press: New York

McLain, R., Poe, M., Biedenweg, K., Cerveny, L., Besser, D., & Blahna, D. (2013). Making sense of human ecology mapping: An overview of approaches to integrating socio-spatial data into environmental planning. *Human Ecology, 41*(5), 651–665.

MacFarlane, R., Stagg, H., Turner, K., & Lievesley, M. (2005). Peering through the smoke? Tensions in landscape visualisation. *Computers, Environment and Urban Systems*, *29*(3), 341-359.

Mahon R. (2008). Assessing governability of fisheries using the interactive governance approach: preliminary examples from the Caribbean. *J. Transdiscipl. Environ. Stud. 7*(1), 2008, 1–12.

Mahon, R., McConney, P., & Roy, R. N. (2008). Governing fisheries as complex adaptive systems. *Marine Policy 32*(1), 104–112.

Manyoky, M., Hayek, U. W., Pieren, R., Heutschi, K., & Grêt-Regamey, A. (2016). Evaluating a visual-acoustic simulation for wind park assessment. *Landscape and Urban Planning 153*, 180-197.

Manzo, L. C., & Perkins, D. D. (2006). Finding common ground: the importance of place attachment to community participation and planning. *J. Plan. Lit. 20*(4), 335–350.

Marmo, C., Cartwright, W., and Yuille, J. (2010). Knowledge in (geo)visualisation: The relationship between seeing and thinking. In *Proceedings of GeoCart 2010*, 123-132. Auckland, New Zealand.

Martínez, M. L., Intralawan, A., Vázquez, G., Pérez-Maqueo, O., Sutton, P., & Landgrave, R. (2007). The coasts of our world: Ecological, economic and social importance. *Ecological Economics 63*(2-3), 254–272.

Maurer, A. L. (1989). Sidney Spit Provincial Marine Park – Wildlife Viewing Development Plan. Parks Library, Government of British Columbia. Victoria, BC.

McDonald, P. S., Jensen, G. C., & Armstrong, D. A. (2001). The competitive and predatory impacts of the nonindigenous crab *Carcinus maenas* (L.) on early benthic phase Dungeness crab Cancer magister Dana. *J. Exp. Marine Biol. Ecol. 258*, 39–54. doi: 10.1016/S0022-0981(00)00344-0

McElduff, L., Peel, D., and Lloyd, M. G. (2013). Informing a framework for coastal planning on the island of Ireland. *Town Planning Review*, *84*(4), 419–440.

McKenna, J., Quinn, R. J., Donnelly, D. J., & Cooper, J. A. G. (2008). Accurate mental maps as an aspect of local ecological knowledge (LEK): A case study from Lough Neagh, Northern Ireland. *Ecology and Society 13*(1), 13.

McLain, R., Poe, M., Biedenweg, K., Cerveny, L., Besser, D., & Blahna, D. (2013). Making sense of human ecology mapping: An overview of approaches to integrating socio-spatial data into environmental planning. *Human Ecology, 41*(5), 651-665.

Menard, S. (2004). Six approaches to calculating standardized logistic regression coefficients. *American Statistician 58*, 218–223.

Merchant, S. (2012). Negotiating underwater space: the sensorium, the body and the practice of scuba-diving. *Tour. Stud. 11*, 215–234. doi: 10.1177/1468797611432040

Moseley, C., Desjean-Perrotta, B., & Utley, J. (2009). The Draw-An-Environment Test Rubric (DAET-R): exploring pre-service teachers' mental models of the environment. *Environmental Education Research*, *16*(2), 189-208.

Moskwa, E. C. (2012). Exploring place attachment: an underwater perspective. *Tourism in Marine Environments 8*(1-2), 33-46.

Myers, E. P. (2005). Review of progress on VDatum, a vertical datum transformation tool. In *Marine Technology Society/IEEE OCEANS Conference*. Washington, D.C.

Natori, Y., & Chenoweth, R. (2008). Differences in rural landscape perceptions and preferences between farmers and naturalists. *Journal of Environmental Psychology*, *28*(3), 250–267.

NCC. (n.d.). NCC and the sea [*webpage*]. Nature Conservancy Canada. Victoria, British Columbia. Retrieved from http://www.natureconservancy.ca/en/where-we-work/british-columbia/stories/ncc-and-the-sea.html

Newell, R., & Canessa, R. (2015). Seeing, believing, and feeling: The relationship between sense of place and geovisualization research. *Spaces and Flows: An International Journal of Urban and ExtraUrban Studies 6*(4), 15-30. doi: 10.18848/2154-8676/CGP/v06i04/53779

Newell, R., & Canessa, R. (2017). Picturing a place by the sea: Geovisualizations as place-based tools for collaborative coastal management. *Ocean & Coastal Management 141*, 29-42. doi: 10.1016/j.ocecoaman.2017.03.002

Newell, R., & Canessa, R. (In review). From sense of place to visualization of place: Examining people-place relationships for insight on developing geovisualizations. *Heliyon*.

Newell, R., Canessa, R., & Sharma, T. (2017). Modelling both the space and place of coastal environments: Exploring an approach for developing realistic geovisualizations of coastal places. *Frontiers in Marine Science 4*, 87. doi: 10.3389/fmars.2017.00087

Newell, R., Canessa, R., & Sharma, T. (In print). Visualizing our options for coastal places: Exploring realistic immersive geovisualizations as tools for inclusive approaches to coastal planning and management. *Frontiers in Marine Science.*

Nöllenburg, M. (2007). Geographic visualization. In Kerren, A., Ebert, A., & Meyer, J. (Eds.) *Human-Centered Visualization Environments*, 257-294. Springer Berlin Heidelberg.

Nordstrom K. (2003). Restoring naturally functioning beaches and dunes on developed coasts using compromise management solutions: an agenda for action. In: Dallmeyer D., (Ed) *Values at Sea: Ethics for the Marine Environment*, 204-229. The University of Georgia Press: Athens, Georgia.

O'Boyle, R., & Jamieson, G. (2006). Observations on the implementation of ecosystem-based management: Experiences on Canada's east and west coasts. *Fisheries Research*, *79*(1-2), 1–12.

O'Neill, J. D., Costa, M., & Sharma, T. (2011). Remote sensing of shallow coastal benthic substrates: in situ spectra and mapping of eelgrass (Zostera marina) in the Gulf Islands National Park Reserve of Canada. *Remote Sens. 3*, 975–1005. doi: 10.3390/rs3050975

O'Neill, S., McCall, R., Smyth, M., & Benyon, D. (2005). Probing the sense of place. In *Proceedings of the Seventh International Workshop on Presence*, 104–111. Valencia, Spain.

Onwuegbuzie, A. J., Dickinson, W. B., Leech, N. L., & Zoran, A. G. (2009). A qualitative framework for collecting and analyzing data in focus group research. *Int. J. Qualit. Methods 8*, 1–21. doi: 10.1177/160940690900800301

Orland, B., Budthimedhee, K., & Uusitalo, J. (2001). Considering virtual worlds as representations of landscape realities and as tools for landscape planning. *Landscape and Urban Planning 54*(1-4), 139–148. doi: 10.1016/S0169-2046(01)00132-3

Orth, R. J., Carruthers, T. J., Dennison, W. C., Duarte, C. M., Fourqurean, J. W., Heck, K. L., Hughes, R., Kendrick, G, Kenworthy, W. J., Olyarnik, S., Short, F. T., Waycott, M., and Williams, S. (2006). A global crisis for seagrass ecosystems, *Bioscience 56* (12), 987–996.

Panelli, R., Allen, D., Ellison, B., Kelly, A., John, A., & Tipa, G. (2008). Beyond Bluff oysters? Place identity and ethnicity in a peripheral coastal setting. *Journal of Rural Studies 24*(1), 41–55.

Parks Canada (2012). 2012 Visitor's Guide - Gulf Islands National Park Reserve [*PDF document*]. Government of Canada. Retrieved from http://publications.gc.ca/collections/collection_2012/pc/R61-24-2012-eng.pdf

Parks Canada. (2014). Student rates of pay - Effective January 1, 2014 [*webpage*]. Government of Canada. Retrieved from https://www.tbs-sct.gc.ca/psm-fpfm/pay-remuneration/rates-taux/student-etudiants-eng.asp

Parks Canada. (n.d.). Sidney Spit (Sidney Island). Gulf Islands National Park Reserve of Canada. Government of Canada. Retrieved from http://www.pc.gc.ca/pn-np/bc/gulf/carte-map-nfl.aspx#a28

Pettit, C., Bishop, I., Sposito, V., Aurambout, J.-P., & Sheth, F. (2012). Developing a multi-scale visualisation framework for use in climate change response. *Landscape Ecology 27*(4), 487-508.

Phadke, R. (2010). Steel forests or smoke stacks: the politics of visualisation in the Cape Wind controversy. *Environmental Politics 19*(1), 1–20. doi: 10.1080/09644010903396051

Pickaver, A. H., Gilbert, C., & Breton, F. (2004). An indicator set to measure the progress in the implementation of integrated coastal zone management in Europe. *Ocean & Coastal Management 47*(9-10), 449–462.

Poe, M. R., Norman, K. C., & Levin, P. S. (2014). Cultural dimensions of socioecological systems: Key connections and guiding principles for conservation in coastal environments. *Conservation Letters 7*(3), 166-175. doi: 10.1111/conl.12068

Pomeroy, R. S. (1996). Community-based and co-management institutions for sustainable coastal fisheries management in Southeast Asia. *Ocean & Coastal Management. 27*(3), 143–162.

Pomeroy, R. S., Katon, B. M., & Harkes, I. (2001). Conditions affecting the success of fisheries co-management: lessons from Asia. *Marine Policy*, *25*(3), 197–208.

Pompe, J. J., & Rinehart, J. R. (1999). Establishing fees for beach protection: paying for a public good. *Coastal Management 27*(1), 57–67.

Proshansky, H. M., Fabian, A. K., & Kaminoff, R. (1983). Place-identity: Physical world socialization of the self. *Journal of Environmental Psychology 3*, 57–83.

Raaijmakers, Q. A., Van Hoof, A., Hart, H. T., Verbogt, T. F., & Vollebergh, W. A. (2000). Adolescents' midpoint response on Likert-type scale items: Neutral or missing values. *International Journal of Public Opinion Research 12*(2), 208–216.

Ramic-Brkic, B., Chalmers, A., Sadzak, A., Debattista, K., & Sultanic, S. (2013). Exploring multiple modalities for selective rendering of virtual environments. In *Proceedings of the 29th Spring Conference on Computer Graphics*, ACM, 91-98. Smolenice, Slovakia.

Raymond, C. M., Brown, G., & Weber, D. (2010). The measurement of place attachment: Personal, community, and environmental connections. *Journal of Environmental Psychology*, *30*(4), 422-434.

Relph, E. (1970). An inquiry into the relations between phenomenology and geography. *The Canadian Geographer/Le Géographe canadien 14*(3), 193-201.

Rockloff, S. F., & Lockie, S. (2004). Participatory tools for coastal zone management: use of stakeholder analysis and social mapping in Australia. *Journal of Coastal Conservation*, *10*(1), 81-92.

Rose, C. (1986). The comedy of the commons: custom, commerce, and inherently public property, *Univ. Chicago Law Rev. 53*(3), 711–781.

Ruiz-Frau, A., Edwards-Jones, G., & Kaiser, M. (2011). Mapping stakeholder values for coastal zone management. *Mar. Ecol. Prog. Ser. 434*, 239–249.

Sáenz-Arroyo, A., Roberts, C., Torre, J., Cariño-Olvera, M., and Enríquez-Andrade, R. (2005). Rapidly shifting environmental baselines among fishers of the Gulf of California. *Proceedings of the Royal Society B: Biological Sciences* 272(1575), 1957-1962.

Salter, J. D., Campbell, C., Journeay, M., & Sheppard, S. R. J. (2009). The digital workshop: exploring the use of interactive and immersive visualisation tools in participatory planning. *Journal of Environmental Management 90*, 2090-2101. doi: 10.1016/j.jenvman.2007.08.023

Scannell, L., & Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of Environmental Psychology 30*(3), 289–297.

Schroth, O., Hayek, U. W., Lange, E., Sheppard, S. R. J., & Schmid, W. A. (2011). Multiple-case study of landscape visualizations as a tool in transdisciplinary planning workshops. *Landscape Journal 30*(1), 53-71. doi: 10.3368/lj.30.1.53

Schroth, O., Pond, E., Muir-Owen, S., Campbell, C., & Sheppard, S. R. J. (2009). Tools for the understanding of spatio-temporal climate scenarios in local planning: Kimberley (BC) case study. Swiss National Science Foundation (Report PBEZP1-122976): Zurich, Switzerland.

Schroth, O., Pond, E., & Sheppard, S. R. J. (2015). Evaluating presentation formats of local climate change in community planning with regard to process and outcomes. *Landscape and Urban Planning 142*, 147-158.

Seidel, J., & Kelle, U. (1995). Different functions of coding in the analysis of textual data. *Computer-aided qualitative data analysis: Theory, methods and practice*, 52–61. Sage: London.

Shackeroff, J. M., Hazen, E. L., & Crowder, L. B. (2009). The oceans as peopled seascapes. In K. L. McLeod & H. M. Leslie (Eds.), *Ecosystem-Based Management for the Oceans*, 33-54. Island Press: Washington, D.C.

Shahidul Islam, S. M., & Tanaka, M. (2004). Impacts of pollution on coastal and marine ecosystems including coastal and marine fisheries and approach for management: A review and synthesis. *Marine Pollution Bulletin 48*(7-8), 624-49.

Shaw, A., Sheppard, S., Burch, S., Flanders, D., Wiek, A., Carmichael, J., Robinson, J., & Cohen, S. (2009). Making local futures tangible - synthesizing, downscaling, and visualizing climate change scenarios for participatory capacity building. *Global Environmental Change 19*(4), 447-463. doi: 10.1016/j.gloenvcha.2009.04.002

Shepardson, D. P., Wee, B., Priddy, M., & Harbor, J. (2007). Students' mental models of the environment. *Journal of Research in Science Teaching 44*(2), 327-348.

Sheppard, S. R. J. (2001). Guidance for crystal ball gazers: Developing a code of ethics for landscape visualization. *Landscape and Urban Planning 54*(1-4), 183–199. doi: 10.1016/S0169-2046(01)00135-9

Sheppard, S. R. J., Shaw, A., Flanders, D., Burch, S., Wiek, A., Carmichael, J., Robinson, J., & Cohen, S. (2011). Future visioning of local climate change: A framework for community engagement and planning with scenarios and visualisation. *Futures 43*(4), 400-412. doi: 10.1016/j.futures.2011.01.009

Simmonds, M. P., Dolman, S. J., Jasny, M., Parsons, E. C. M., & Weilgart, L., (2014). Marine Noise Pollution - Increasing recognition but need for more practical action. *Journal of Ocean Technology, 9*(1): 71-90.

Smith, E. L., Bishop, I. D., Williams, K. J. H., & Ford, R. M. (2012). Scenario Chooser: An interactive approach to eliciting public landscape preferences. *Landscape and Urban Planning, 106*(3), 230-243. doi: 10.1016/j.landurbplan.2012.03.013

Smyth D. (2008). Just add water? Taking indigenous protected areas into sea country. In: Smyth D. and Ward G.K., (Eds.), *Protecting Country: Indigenous Governance and Management of Protected Areas,* 95–109. Australian Institute of Aboriginal and Torres Strait Islander Studies: Canberra.

Soini, K., Vaarala, H., & Pouta, E. (2012). Residents' sense of place and landscape perceptions at the rural–urban interface. *Landscape and Urban Planning 104*(1), 124-134.

Sorensen, J. (1997). National and international efforts at integrated coastal management: Definitions, achievements, and lessons. *Coastal Management 25*(1), 3–41. doi: 10.1080/08920759709362308

Spurgeon, J. (1999). The socio-economic costs and benefits of coastal habitat rehabilitation and creation. *Marine Pollution Bulletin 37*(8), 373-382.

Statistics Canada. (2011). Boundary files, reference guide (92-160-G). Government of Canada. Retrieved from http://www5.statcan.gc.ca/olc-cel/olc.action?objId=92-160-G&objType=2&lang=en&limit=0

Statistics Canada. (2012). Focus on geography series, 2011 Census. Statistics Canada Catalogue (no. 98-310-XWE2011004): Ottawa, Ontario.

Stedman, R. C. (2003). Is it really just a social construction? The contribution of the physical environment to sense of place. *Soc. Natl. Res. 16*, 671–685. doi: 10.1080/08941920309189

Sterne, J. (2003). *The audible past: Cultural origins of sound reproduction*. Durham, NC: Duke University Press.

Stocker, L., Burke, G., Kennedy, D., & Wood, D. (2012). Sustainability and climate adaptation: Using Google Earth to engage stakeholders. *Ecological Economics 80,* 15–24.

Stocker, L., & Kennedy, D. (2009). Cultural models of the coast in Australia: Toward sustainability. *Coastal Management 37*(5), 387-404. doi: 10.1080/08920750902855998

Stocker, L., & Kennedy, D. (2013). Artistic representations of the sea and coast: Implications for sustainability. *Landsc. J. Int. Centre Landsc. Lang. 4*(2), 28.

Stojanovic, T., Ballinger, R. C., & Lalwani, C. S. (2004). Successful integrated coastal management: Measuring it with research and contributing to wise practice. *Ocean & Coastal Management 47*(5-6), 273–298.

Stojanovic, T., & Barker, N. (2008). Improving governance through local Coastal Partnerships in the UK. *Geographical Journal 174*(4), 344–360.

Tabet, L., & Fanning, L. (2012). Integrated coastal zone management under authoritarian rule: An evaluation framework of coastal governance in Egypt. *Ocean & Coastal Management*, *61*, 1–9.

Thompson, R. (2007). Cultural models and shoreline social conflict. *Coastal Management*, *35*(2-3), 211–237. 10.1080/08920750601042294

Thompson, A. W., & Prokopy, L. S. (2016). The role of sense of place in collaborative planning. *Journal of Sustainability Education 11*, 1-19.

Tress, B., & Tress, G. (2003). Scenario visualisation for participatory landscape planning—a study from Denmark. *Landscape and Urban Planning 64*, 161–178. doi: 10.1016/S0169-2046(02)00219-0

Trimble, M., & Berkes, F. (2013). Participatory research towards co-management: lessons from artisanal fisheries in coastal Uruguay. *Journal of environmental management 128*, 768–78.

Tsvetanov, T. G., & Shah, F. (2013). The economic value of delaying adaptation to sea-level rise: an application to coastal properties in Connecticut. *Clim. Change 121*(2), 177–193.

Tuan, Y. F. (1975). Place: An experiential perspective. *Geographical Review 65*, 151-165. doi: 10.2307/213970

Tuan, Y. F. (1977). *Space and place: The perspective of experience*. University of Minnesota Press: Minneapolis, MN.

Turner, P., & Turner, S. (2004). Insideness and outsideness: Characterizing the experiences of real and virtual places. In *Seventh Annual International Workshop on Presence*, 340-346. Valencia, Spain.

Turner, P., Turner, S., & Burrows, L. (2013). Creating a sense of place with a deliberately constrained virtual environment. *Int. J. Cogn. Perform. Supp. 1*, 54–68. doi: 10.1504/IJCPS.2013.053554

Turner, S., Turner, P., Caroll, F., O'Neill, S., Benyon, D., McCall, R., & Smyth, M. (2003). Re-creating the botanics: Towards a sense of place in virtual environments. In *Third UK Environmental Psychology Conference*. Aberdeen, UK.

Urquhart, J., & Acott, T. (2014). A sense of place in cultural ecosystem services: The case of Cornish fishing communities. *Society and Natural Resources 27*(1), 3-19.

Vaske, J. J., & Kobrin, K. C. (2001). Place attachment and environmentally responsible behavior. *The Journal of Environmental Education*, *32*(4), 16–21.

VIEA (2016). State of the Island economic report 2016 [*PDF document*]. Prepared by MNP LLP for the Vancouver Island Economic Alliance. Nanaimo, British Columbia. Retrieved from http://viea.ca/wp-content/uploads/2016/04/2016-VIEA-Economic-Report-Web.pdf

Vorkinn, M., & Riese, H. (2001). Environmental concern in a local context: the significance of place attachment. *Environment and Behavior 33*(2), 249–263. doi: 10.1177/00139160121972972

Williams, D. R., & Roggenbuck, J. W. (1989). Measuring place attachment: Some preliminary results. In L. H. McAvoy, & D. Howard (Eds.), *Abstracts of the 1989 Leisure Research Symposium* (p. 32). National Recreation and Park Association: Arlington, VA.

Williams, D., & Stewart, S. (1998). Sense of place: an elusive concept that is finding a home in ecosystem management. *Journal of Forestry 96*(5), 18-23.

Williams, D., & Vaske, J. (2003). The measurement of place attachment: validity and generalizability of a psychometric approach. *Forest Science 49*(6), 830–840.

Williams, K. J., Weston, M. A., Henry, S., & Maguire, G. S. (2009). Birds and beaches, dogs and leashes: Dog owners' sense of obligation to leash dogs on beaches in Victoria, Australia. *Human Dimensions of Wildlife 14*(2), 89-101.

Williams, K., Ford, R., Bishop, I., & Smith, E. L. (2012). Evaluating different ways of managing forested landscapes. In R. Beilin, K. Williams, & G. Moore (Eds.) *Reshaping Environments*, 65-81. Oxford University Press: Oxford, UK.

Williams, R., Wright, A. J., Ashe, E., Blight, L. K., Bruintjes, R., Canessa, R., Clark, C. W., Cullis-Suzuki, S., Dakin, D. T., Erbe, C., Hammond, P. S., Merchant, N. D., O'Hara, P. D., Purser, J., Radford, A. N., Simpson, S. D., Thomas, L., & Wale, M. A. (2015). Impacts of anthropogenic noise on marine life: Publication patterns, new discoveries, and future directions in research and management. *Ocean & Coastal Management 115*, 17-24. doi: 10.1016/j.ocecoaman.2015.05.021

Williams. R., Ashe, E., Blight, L., Jasny, M., and Nowlan, L. (2014). Marine mammals and ocean noise: Future directions and information needs with respect to science, policy and law in Canada. *Marine Pollution Bulletin 86*, 29-38. doi: 10.1016/j.marpolbul.2014.05.056

Wood, N., & Lavery, P. (2000). Monitoring seagrass ecosystem health – The role of perception in defining health and indicators. *Ecosys. Health 6*, 134–148. doi: 10.1046/j.1526-0992.2000.00015.x

Worboys, M. F., & Duckham, M. (2004). *GIS: A computing perspective* (2nd ed.). CRC press: Boca Raton, FL.

Yanghee, K., & Baylor, A. L. (2006). A social-cognitive framework for pedagogical agents as learning companions. *Educational Technology Research and Development 54*(6), 569-596.

Yu, T., Behm, H., Bill, R., & Kang, J. (2017). Audio-visual perception of new wind parks. *Landscape and Urban Planning 165*, 1-10.

Yung, L., Freimund, W. A., & Belsky, J. M. (2003). The politics of place: Understanding meaning, common ground, and political difference on the Rocky Mountain Front. *Forest Science*, *49*(6), 855-866.

Appendices

Appendix A. Ethics certificates of approval

University of Victoria

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Certificate of Approval

PRINCIPAL INVESTIGATOR:	**Cathryn Brandon**	**ETHICS PROTOCOL NUMBER** Minimal Risk - Delegated	**14-200**
UVic STATUS:	**Ph.D. Student**	ORIGINAL APPROVAL DATE:	04-Jul-14
UVic DEPARTMENT:	**GEOG**	APPROVED ON:	04-Jul-14
SUPERVISOR:	**Dr. Rosaline Canessa**	APPROVAL EXPIRY DATE:	03-Jul-15

PROJECT TITLE: **Seascape Geovisualization Evaluation and Assessment**

RESEARCH TEAM MEMBER
Co-principal Investigator: Robert Newell (UVic PhD Student)
Research Supervisor: Rosaline Canessa (UVic)
Research Partners: Tara Sharma (Parks Canada), Alison Barratt (Shaw Ocean Discovery Centre), Tina Kelly (Shaw Ocean Discovery Centre)

DECLARED PROJECT FUNDING: **SSHRC (under Dr. R. Canessa)**

CONDITIONS OF APPROVAL

This Certificate of Approval is valid for the above term provided there is no change in the protocol.

Modifications
To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.

Renewals
Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.

Project Closures
When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.

Certification

This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.

[redacted]

Dr. Rachael Scarth
Associate Vice-President Research Operations

14-200 Brandon, Cathryn

Certificate Issued On: 20-Mar-15

University of Victoria
Office of Research Services | Human Research Ethics Board
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Certificate of Renewed Approval

PRINCIPAL INVESTIGATOR:	Cathryn Brandon	ETHICS PROTOCOL NUMBER Minimal Risk Review - Delegated	14-200
UVic STATUS:	Ph.D. Student	ORIGINAL APPROVAL DATE:	04-Jul-14
UVic DEPARTMENT:	GEOG	RENEWED ON:	16-Jun-15
SUPERVISOR:	Dr. Rosaline Canessa	APPROVAL EXPIRY DATE:	03-Jul-16

PROJECT TITLE: Seascape Geovisualization Evaluation and Assessment

RESEARCH TEAM MEMBERS: Co-principal Investigator: Robert Newell (UVic PhD Student)
Research Supervisor: Rosaline Canessa (UVic)
Research Partners: Tara Sharma (Parks Canada), Alison Barratt (Shaw Ocean Discovery Centre), Tina Kelly (Shaw Ocean Discovery Centre)

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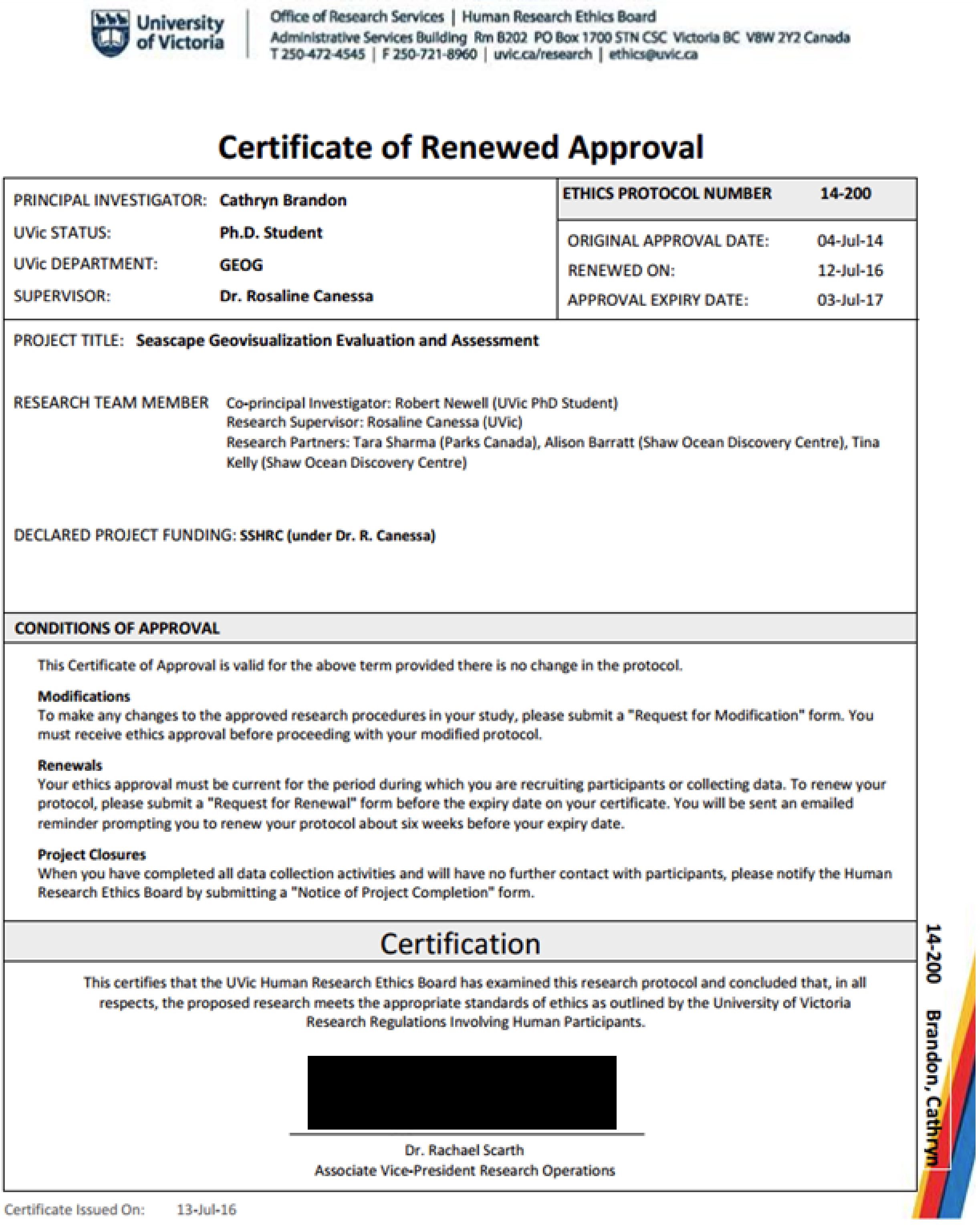
[redacted]

Dr. Rachael Scarth
Acting Associate Vice-President, Research

Certificate Issued On: 16-Jun-15

14-200 Brandon, Cathryn



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Certificate of Renewed Approval

PRINCIPAL INVESTIGATOR:	**Cathryn Brandon**
UVic STATUS:	**Ph.D. Student**
UVic DEPARTMENT:	**GEOG**
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ETHICS PROTOCOL NUMBER	**14-200**
ORIGINAL APPROVAL DATE:	04-Jul-14
RENEWED ON:	12-Jul-16
APPROVAL EXPIRY DATE:	03-Jul-17

PROJECT TITLE: **Seascape Geovisualization Evaluation and Assessment**

RESEARCH TEAM MEMBER
Co-principal Investigator: Robert Newell (UVic PhD Student)
Research Supervisor: Rosaline Canessa (UVic)
Research Partners: Tara Sharma (Parks Canada), Alison Barratt (Shaw Ocean Discovery Centre), Tina Kelly (Shaw Ocean Discovery Centre)

DECLARED PROJECT FUNDING: **SSHRC (under Dr. R. Canessa)**

CONDITIONS OF APPROVAL

This Certificate of Approval is valid for the above term provided there is no change in the protocol.

Modifications
To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.

Renewals
Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.

Project Closures
When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.

Certification

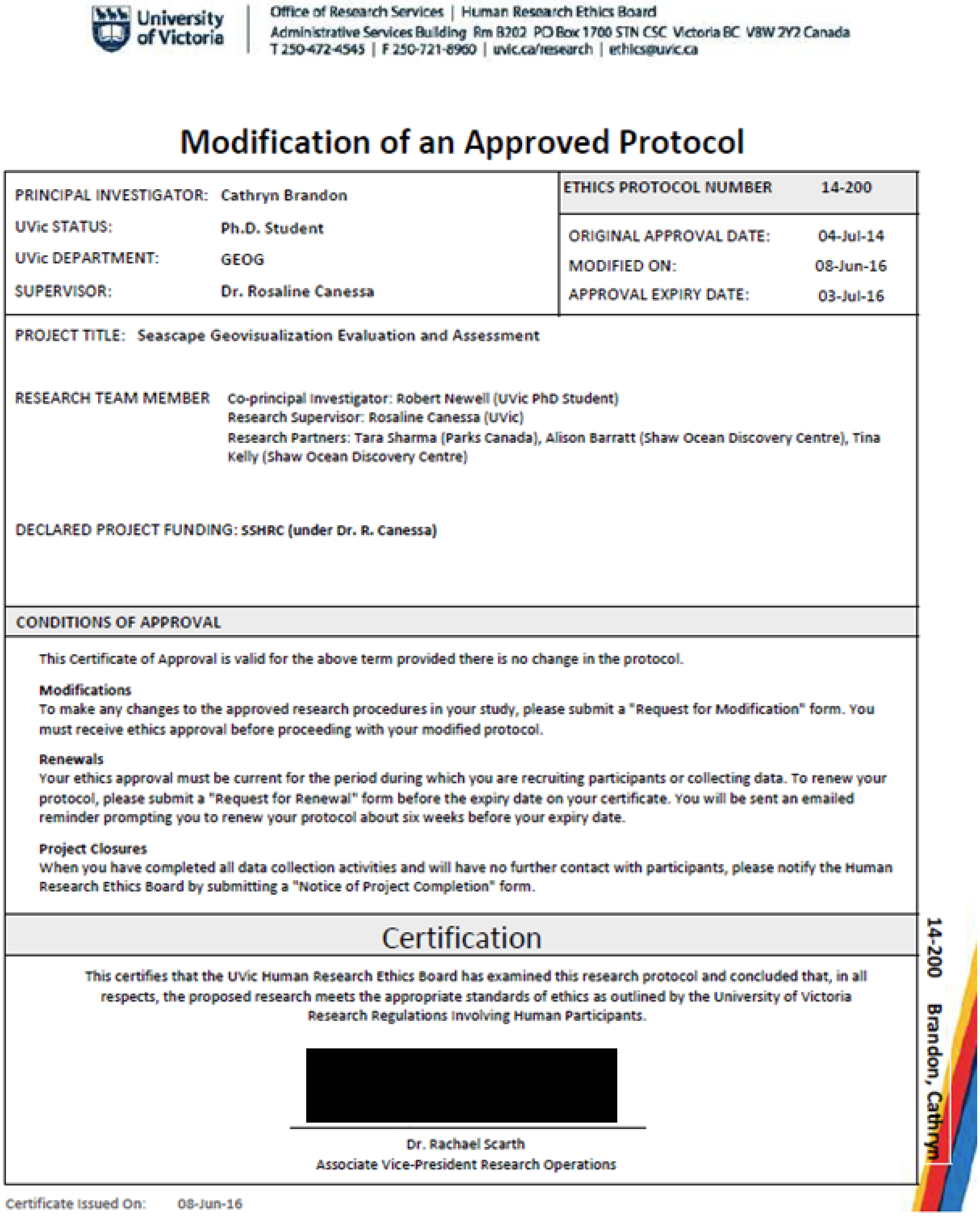
This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.

[redacted]

Dr. Rachael Scarth
Associate Vice-President Research Operations

Certificate Issued On: 13-Jul-16

14-200 Brandon, Cathryn



University of Victoria

Office of Research Services | Human Research Ethics Board
Administrative Services Building Rm B202 PO Box 1700 STN CSC Victoria BC V8W 2Y2 Canada
T 250-472-4545 | F 250-721-8960 | uvic.ca/research | ethics@uvic.ca

Modification of an Approved Protocol

PRINCIPAL INVESTIGATOR:	Cathryn Brandon	ETHICS PROTOCOL NUMBER	14-200
UVic STATUS:	Ph.D. Student	ORIGINAL APPROVAL DATE:	04-Jul-14
UVic DEPARTMENT:	GEOG	MODIFIED ON:	08-Jun-16
SUPERVISOR:	Dr. Rosaline Canessa	APPROVAL EXPIRY DATE:	03-Jul-16

PROJECT TITLE: Seascape Geovisualization Evaluation and Assessment

RESEARCH TEAM MEMBER Co-principal Investigator: Robert Newell (UVic PhD Student)
Research Supervisor: Rosaline Canessa (UVic)
Research Partners: Tara Sharma (Parks Canada), Alison Barratt (Shaw Ocean Discovery Centre), Tina Kelly (Shaw Ocean Discovery Centre)

DECLARED PROJECT FUNDING: SSHRC (under Dr. R. Canessa)

CONDITIONS OF APPROVAL

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Renewals
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Project Closures
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Certification

This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.

[redacted]

Dr. Rachael Scarth
Associate Vice-President Research Operations

Certificate Issued On: 08-Jun-16

14-200 Brandon, Cathryn

Human Research Ethics Board
Office of Research Services
Administrative Services Building
PO Box 1700 STN CSC
Victoria British Columbia V8W 2Y2 Canada
Tel 250-472-4545, Fax 250-721-8960
ethics@uvic.ca www.research.uvic.ca

University of Victoria

Certificate of Approval

PRINCIPAL INVESTIGATOR:	**Cathryn Brandon**	**ETHICS PROTOCOL NUMBER** Minimal Risk - Delegated	**14-201**
UVic STATUS:	**Ph.D. Student**	ORIGINAL APPROVAL DATE:	04-Jul-14
UVic DEPARTMENT:	**GEOG**	APPROVED ON:	04-Jul-14
SUPERVISOR:	**Dr. Rosaline Canessa**	APPROVAL EXPIRY DATE:	03-Jul-15

PROJECT TITLE: **Coastal and Underwater Mental Imagery and Conceptualizations of Place**

RESEARCH TEAM MEMBER
Co-principal Investigator: Robert Newell (UVic PhD Student)
Research Supervisor: Rosaline Canessa (UVic)
Research Partners: Tara Sharma (Parks Canada), Alison Barratt (Shaw Ocean Discovery Centre), Tina Kelly (Shaw Ocean Discovery Centre)

DECLARED PROJECT FUNDING: **SSHRC (under Dr. R. Canessa)**

CONDITIONS OF APPROVAL

This Certificate of Approval is valid for the above term provided there is no change in the protocol.

Modifications
To make any changes to the approved research procedures in your study, please submit a "Request for Modification" form. You must receive ethics approval before proceeding with your modified protocol.

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Your ethics approval must be current for the period during which you are recruiting participants or collecting data. To renew your protocol, please submit a "Request for Renewal" form before the expiry date on your certificate. You will be sent an emailed reminder prompting you to renew your protocol about six weeks before your expiry date.

Project Closures
When you have completed all data collection activities and will have no further contact with participants, please notify the Human Research Ethics Board by submitting a "Notice of Project Completion" form.

Certification

This certifies that the UVic Human Research Ethics Board has examined this research protocol and concluded that, in all respects, the proposed research meets the appropriate standards of ethics as outlined by the University of Victoria Research Regulations Involving Human Participants.

[redacted]

Dr. Rachael Scarth
Associate Vice-President Research Operations

Certificate Issued On: 20-Mar-15

14-201 Brandon, Cathryn

University of Victoria | Office of Research Services | Human Research Ethics Board
Administrative Services Building Rm B202 PO Box 1700 STN CSC Victoria BC V8W 2Y2 Canada
T 250-472-4545 | F 250-721-8960 | uvic.ca/research | ethics@uvic.ca

Certificate of Renewed Approval

PRINCIPAL INVESTIGATOR:	Cathryn Brandon	ETHICS PROTOCOL NUMBER Minimal Risk Review - Delegated	14-201
UVic STATUS:	Ph.D. Student	ORIGINAL APPROVAL DATE:	04-Jul-14
UVic DEPARTMENT:	GEOG	RENEWED ON:	16-Jun-15
SUPERVISOR:	Dr. Rosaline Canessa	APPROVAL EXPIRY DATE:	03-Jul-16

PROJECT TITLE: Coastal and Underwater Mental Imagery and Conceptualizations of Place

RESEARCH TEAM MEMBERS: Co-principal Investigator: Robert Newell (UVic PhD Student)
Research Supervisor: Rosaline Canessa (UVic)
Research Partners: Tara Sharma (Parks Canada), Alison Barratt (Shaw Ocean Discovery Centre), Tina Kelly (Shaw Ocean Discovery Centre)

DECLARED PROJECT FUNDING: **SSHRC (under Dr. R. Canessa); Sara Spencer Research Award (2015)**

CONDITIONS OF APPROVAL

This Certificate of Approval is valid for the above term provided there is no change in the protocol.

Modifications
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Certification

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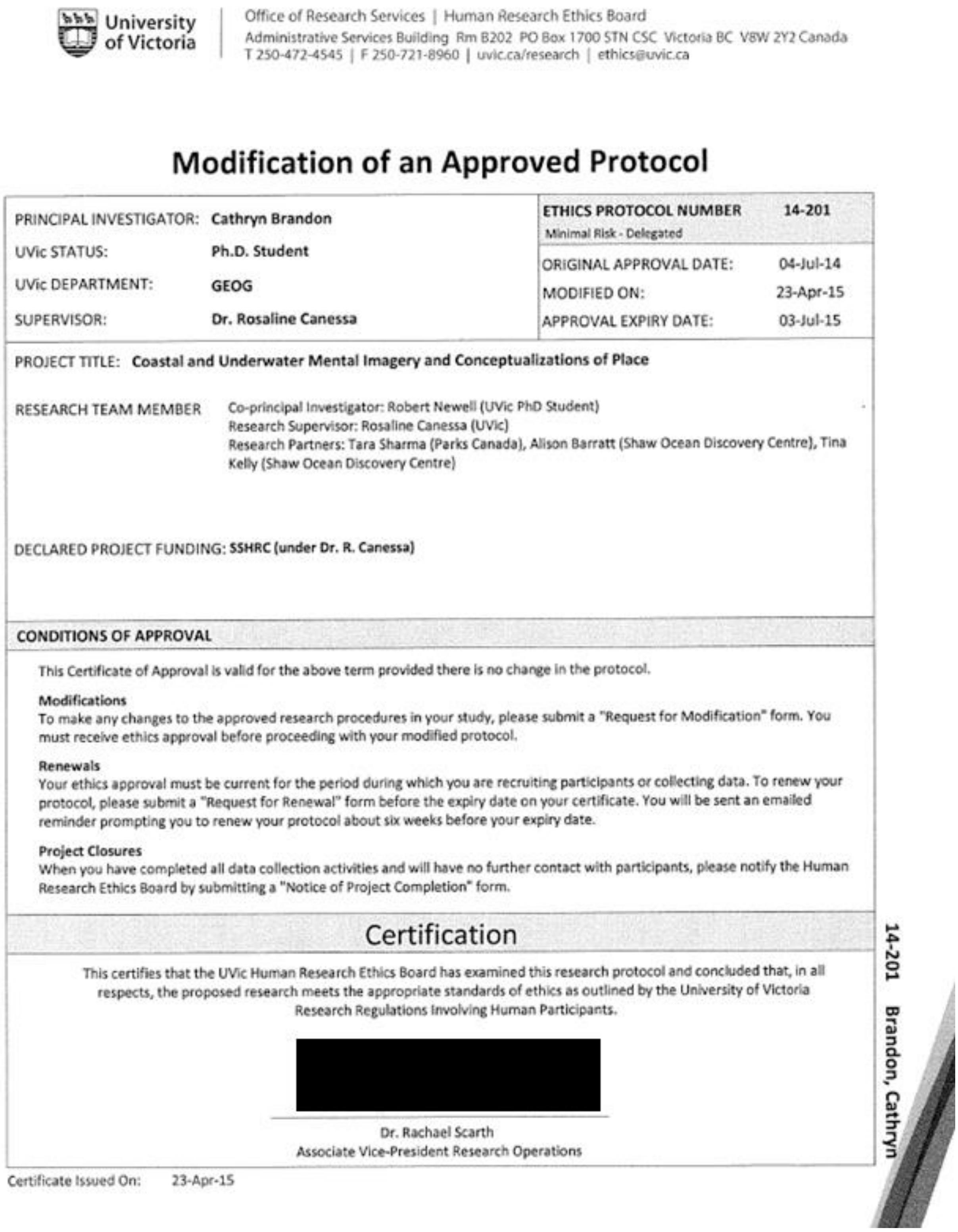
[redacted]

Dr. Rachael Scarth
Acting Associate Vice-President, Research

Certificate Issued On: 16-Jun-15

14-201 Brandon, Cathryn



University of Victoria

Office of Research Services | Human Research Ethics Board
Administrative Services Building Rm B202 PO Box 1700 STN CSC Victoria BC V8W 2Y2 Canada
T 250-472-4545 | F 250-721-8960 | uvic.ca/research | ethics@uvic.ca

Modification of an Approved Protocol

PRINCIPAL INVESTIGATOR: **Cathryn Brandon**
UVic STATUS: **Ph.D. Student**
UVic DEPARTMENT: **GEOG**
SUPERVISOR: **Dr. Rosaline Canessa**

ETHICS PROTOCOL NUMBER **14-201**
Minimal Risk - Delegated
ORIGINAL APPROVAL DATE: 04-Jul-14
MODIFIED ON: 23-Apr-15
APPROVAL EXPIRY DATE: 03-Jul-15

PROJECT TITLE: **Coastal and Underwater Mental Imagery and Conceptualizations of Place**

RESEARCH TEAM MEMBER
Co-principal Investigator: Robert Newell (UVic PhD Student)
Research Supervisor: Rosaline Canessa (UVic)
Research Partners: Tara Sharma (Parks Canada), Alison Barratt (Shaw Ocean Discovery Centre), Tina Kelly (Shaw Ocean Discovery Centre)

DECLARED PROJECT FUNDING: **SSHRC (under Dr. R. Canessa)**

CONDITIONS OF APPROVAL

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Modifications
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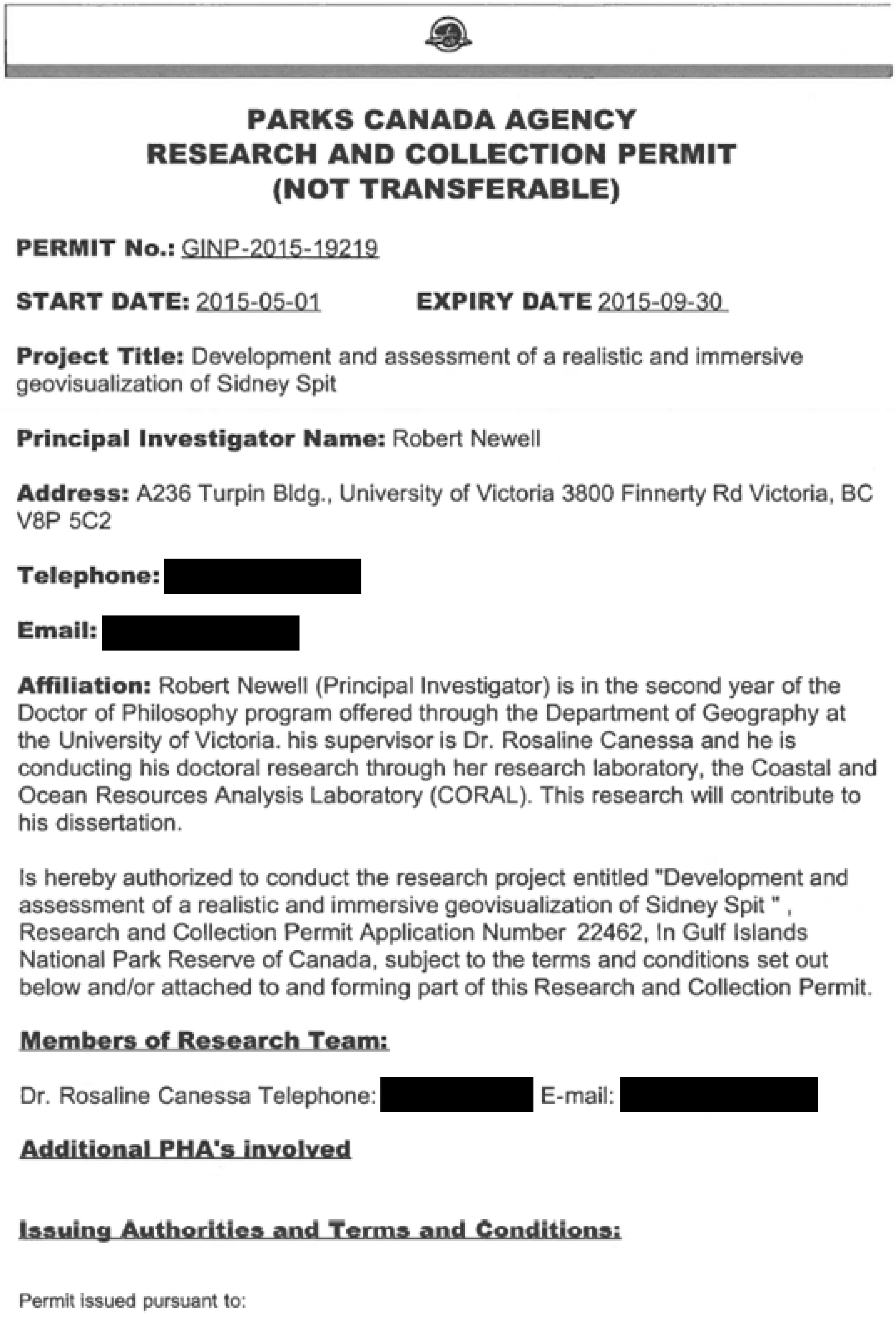
[redacted]

Dr. Rachael Scarth
Associate Vice-President Research Operations

Certificate Issued On: 23-Apr-15

14-201 Brandon, Cathryn

Appendix B. Parks Canada research permit



PARKS CANADA AGENCY
RESEARCH AND COLLECTION PERMIT
(NOT TRANSFERABLE)

PERMIT No.: GINP-2015-19219

START DATE: 2015-05-01 **EXPIRY DATE** 2015-09-30

Project Title: Development and assessment of a realistic and immersive geovisualization of Sidney Spit

Principal Investigator Name: Robert Newell

Address: A236 Turpin Bldg., University of Victoria 3800 Finnerty Rd Victoria, BC V8P 5C2

Telephone: [redacted]

Email: [redacted]

Affiliation: Robert Newell (Principal Investigator) is in the second year of the Doctor of Philosophy program offered through the Department of Geography at the University of Victoria. his supervisor is Dr. Rosaline Canessa and he is conducting his doctoral research through her research laboratory, the Coastal and Ocean Resources Analysis Laboratory (CORAL). This research will contribute to his dissertation.

Is hereby authorized to conduct the research project entitled "Development and assessment of a realistic and immersive geovisualization of Sidney Spit " , Research and Collection Permit Application Number 22462, In Gulf Islands National Park Reserve of Canada, subject to the terms and conditions set out below and/or attached to and forming part of this Research and Collection Permit.

Members of Research Team:

Dr. Rosaline Canessa Telephone: [redacted] E-mail: [redacted]

Additional PHA's involved

Issuing Authorities and Terms and Conditions:

Permit issued pursuant to:

National Historic Parks General Regulations: Section(s) __3(2); __4(2); __12(3)

National Parks Wildlife Regulations: Section __15(1)(a)

National Historic Parks Wildlife and Domestic Animals Regulations: Section __5(1)

Federal Real Property Regulations: __Section 4(2)

Historic Canals Regulations: __Section 11(3)

Saguenay-St. Lawrence Marine Park Act: __Section 10

(Other applicable Act(s) or Regulations)

National General Conditions:

Failure to comply with applicable Heritage Area regulations or the conditions of the permit may constitute grounds to cancel or suspend the permit, refuse to issue future permits, and may be considered as grounds for prosecution under the applicable Act(s) or Regulation(s).

All permit holders must be in possession of a valid permit before the fieldwork commences and at other periods as stated on the permit.

Permits are not transferable and each member of the field work team must have a copy of the valid permit in their possession.

The permit is valid only for the geographic location, the time period, the activities, and under the terms and conditions described on the permit, unless amended and revalidated by the Superintendent.

Restrictions:

The Superintendent may suspend, cancel, or restrict the scope of the permit.

The permit shall cease to be valid if the fieldwork is not started within six months of the date of issue.

Other Acts and Regulations:

The Principal Investigator must abide by applicable regulations and all other federal, provincial, territorial or municipal regulations applying to the Heritage Area.

If requested by the Superintendent, an authorized Heritage Area staff member, or police constable, the Principal Investigator or any team member will identify themselves and show the permit.

Principal Investigator Responsibilities :

A site, or site component(s) that has been excavated or disturbed shall be restored or conserved by the Principal Investigator to the satisfaction of the Superintendent.

The Principal Investigator must advise the Research Coordinator of any adjustments in work location, research plan and methodology, implementation schedule, or main personnel, etc., during the course of the research.

Unless otherwise negotiated, Researchers working in a Heritage Area are required, as a condition of their permit, to submit:

a) A report of progress sixty (60) days following the completion of the field season, unless otherwise agreed with the Research Coordinator;

b) A final report, one (1) electronic copy and three (3) hard copies, no later than eight (8) months following the completion of the field season, unless otherwise agreed with the Research Coordinator;

c) Submission of an online Investigator's Annual Report (IAR) within one year of signing the permit. In the case of a multi-year permits, the principal investigator will submit an IAR for each year of the research.

The reporting requirements above do not replace any reporting requirements set out in any contract between Parks Canada and the Principal Investigator.

The Principal Investigator will be responsible for all members of their party. All field assistants must observe any general or specific conditions of the permit.

The Principal Investigator shall at all times indemnify and save harmless the Crown from and against all claims, demands, loss, costs, damages, actions, suits, or other proceedings, by whosoever made, sustained, brought or prosecuted, in any manner based upon, occasioned by, or attributable to, anything done or omitted by the Principal Investigator or the project personnel in the fulfillment or purported fulfillment of any of the conditions of the Permit.

General Conditions Governing Social Science Research

Special Conditions:

All permit holders must report to the research coordinator who will validate the permit annually before the fieldwork commences and at other periods as stated on the permit.

It is highly likely that you will encounter visitors while conducting your research. To facilitate their cooperation and to increase their understanding of how your work is contributing to better management and understanding of the park's natural and cultural features, you should be prepared to explain your work. If it is necessary for visitors to be temporarily excluded from the study area, then arrangements must be made in conjunction with the Park Superintendent or delegate.

Parks Canada strives to make research in the parks and sites accessible to the public and stakeholders. To support this, researchers are required to provide a 500-800 word article describing their research for purposes of public outreach. In addition, Parks Canada may request a presentation of results in a public forum for parks staff and interested stakeholders.

Any damage resulting from a permit holder's activities shall be reported promptly to the superintendent. The permit holders may be responsible to repair all damage promptly. Permit holders will be financially responsible for any damage resulting from their activities.

All garbage or other materials must be packed out and deposited in a proper garbage receptacle.

At the conclusion of research or collection activities in the park, the permit holder will restore the research site to its original condition to the satisfaction of the park superintendent.

All non-permanent plot markers must be removed from the site following field activities. Any permanent or long term markers must be approved by Parks Canada and made inconspicuous to other users.

The permittee must supply the issuing officer with a copy of all reports or written material and data resulting from the research in digital and hardcopy format. Additional copies may be requested on a cost recovery basis.

The permittee must advise the park of any adjustments in work location or methods made during the course of the research.

The permittee shall respect the zone 1 or no-go areas and take care not to impact the habitats of species-at-risk found in the park. They must ensure that they do not stay in areas where their presence is disruptive to the nighthawks. They must take care around sensitive vegetation areas and not trample the vegetation. A map will be provided indicating sensitive vegetation areas as well as known nighthawk nesting locations to the permittee.

The permittee must ensure that they do not capture pictures of people. In case it is inadvertently done the permittee must blur the image to prevent identification.

The permittee shall make this tool available to Parks Canada for education, enhancing visitor experience, and for planning and management purposes.

Principal Investigator Signature

I, Robert Newell , the Project Principal Investigator, accept all the stated Research and Collection Permit terms and conditions.

[redacted]

Date (yyyy/mm/dd)

Approval:

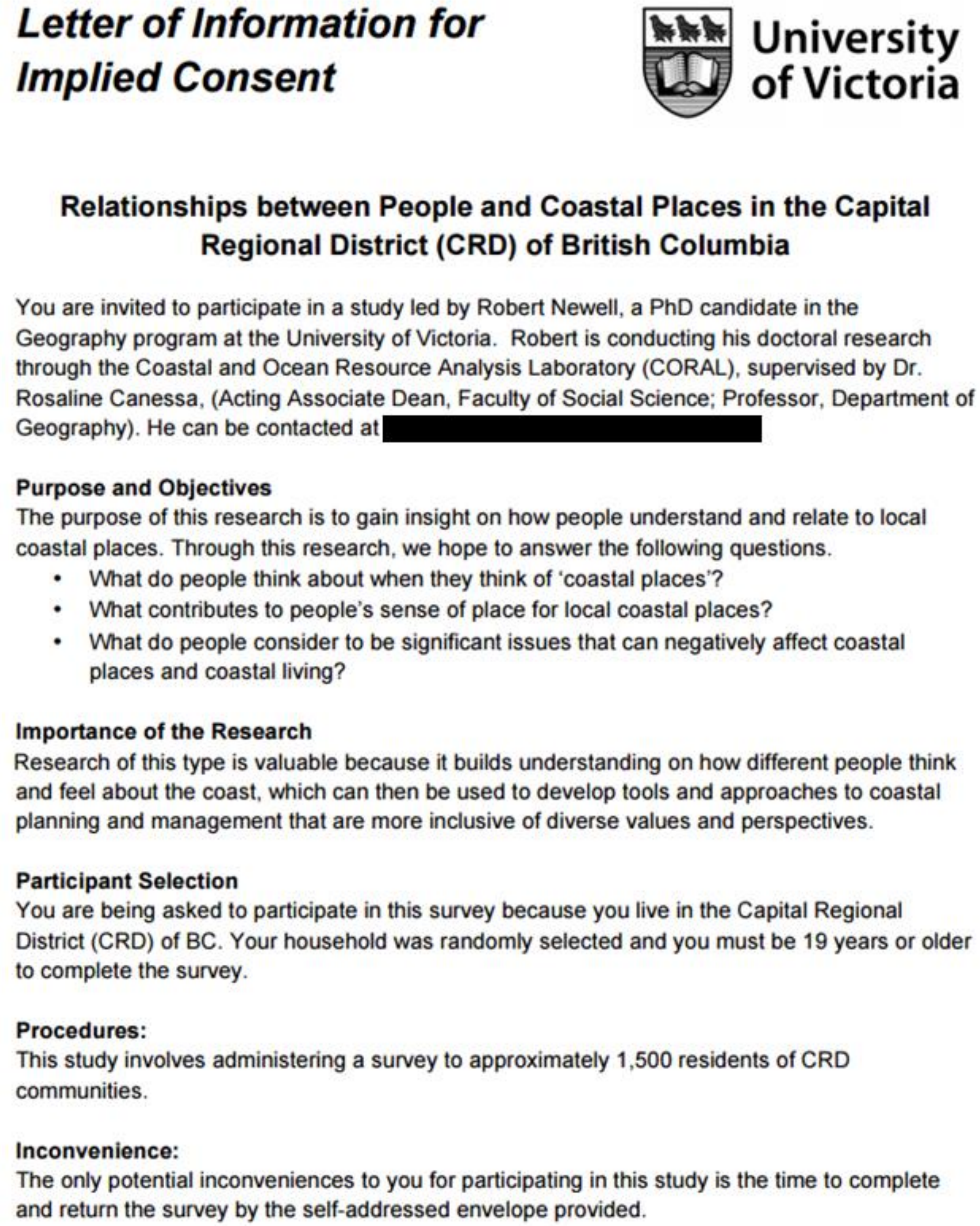
[redacted]

Date (yyyy/mm/dd)

Parks Canada Contact

Tara Sharma
Gulf Islands National Park Reserve of Canada
2220 Harbour Road
Sidney, British Columbia, V8L 2P6
(250) 654-4010
Tara.Sharma@pc.gc.ca

Appendix C. Letter of information for implied consent (included with survey)



Letter of Information for Implied Consent

University of Victoria

Relationships between People and Coastal Places in the Capital Regional District (CRD) of British Columbia

You are invited to participate in a study led by Robert Newell, a PhD candidate in the Geography program at the University of Victoria. Robert is conducting his doctoral research through the Coastal and Ocean Resource Analysis Laboratory (CORAL), supervised by Dr. Rosaline Canessa, (Acting Associate Dean, Faculty of Social Science; Professor, Department of Geography). He can be contacted at [redacted]

Purpose and Objectives

The purpose of this research is to gain insight on how people understand and relate to local coastal places. Through this research, we hope to answer the following questions.

- What do people think about when they think of 'coastal places'?
- What contributes to people's sense of place for local coastal places?
- What do people consider to be significant issues that can negatively affect coastal places and coastal living?

Importance of the Research

Research of this type is valuable because it builds understanding on how different people think and feel about the coast, which can then be used to develop tools and approaches to coastal planning and management that are more inclusive of diverse values and perspectives.

Participant Selection

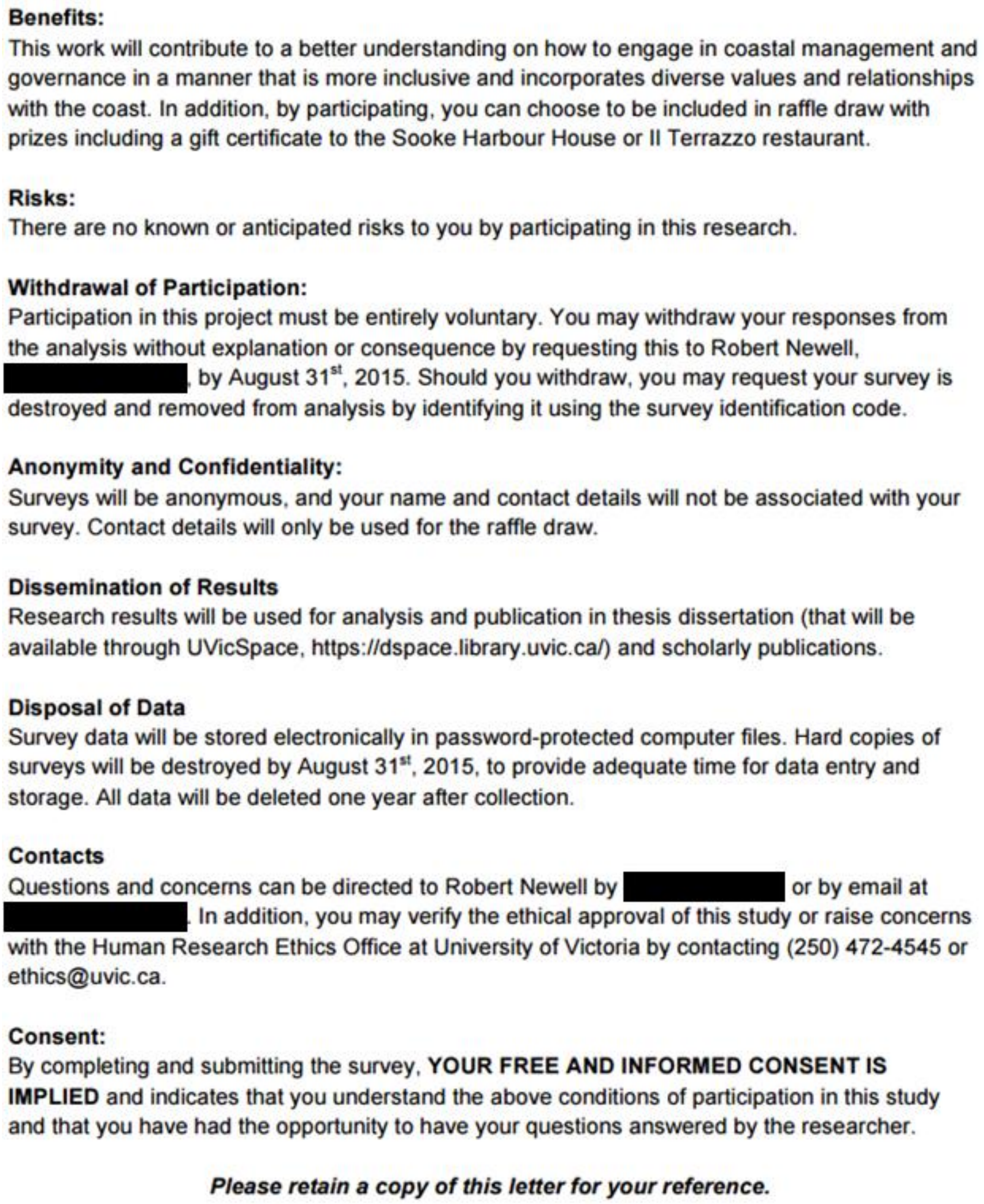
You are being asked to participate in this survey because you live in the Capital Regional District (CRD) of BC. Your household was randomly selected and you must be 19 years or older to complete the survey.

Procedures:

This study involves administering a survey to approximately 1,500 residents of CRD communities.

Inconvenience:

The only potential inconveniences to you for participating in this study is the time to complete and return the survey by the self-addressed envelope provided.



Benefits:

This work will contribute to a better understanding on how to engage in coastal management and governance in a manner that is more inclusive and incorporates diverse values and relationships with the coast. In addition, by participating, you can choose to be included in raffle draw with prizes including a gift certificate to the Sooke Harbour House or Il Terrazzo restaurant.

Risks:

There are no known or anticipated risks to you by participating in this research.

Withdrawal of Participation:

Participation in this project must be entirely voluntary. You may withdraw your responses from the analysis without explanation or consequence by requesting this to Robert Newell, [redacted], by August 31st, 2015. Should you withdraw, you may request your survey is destroyed and removed from analysis by identifying it using the survey identification code.

Anonymity and Confidentiality:

Surveys will be anonymous, and your name and contact details will not be associated with your survey. Contact details will only be used for the raffle draw.

Dissemination of Results

Research results will be used for analysis and publication in thesis dissertation (that will be available through UVicSpace, https://dspace.library.uvic.ca/) and scholarly publications.

Disposal of Data

Survey data will be stored electronically in password-protected computer files. Hard copies of surveys will be destroyed by August 31st, 2015, to provide adequate time for data entry and storage. All data will be deleted one year after collection.

Contacts

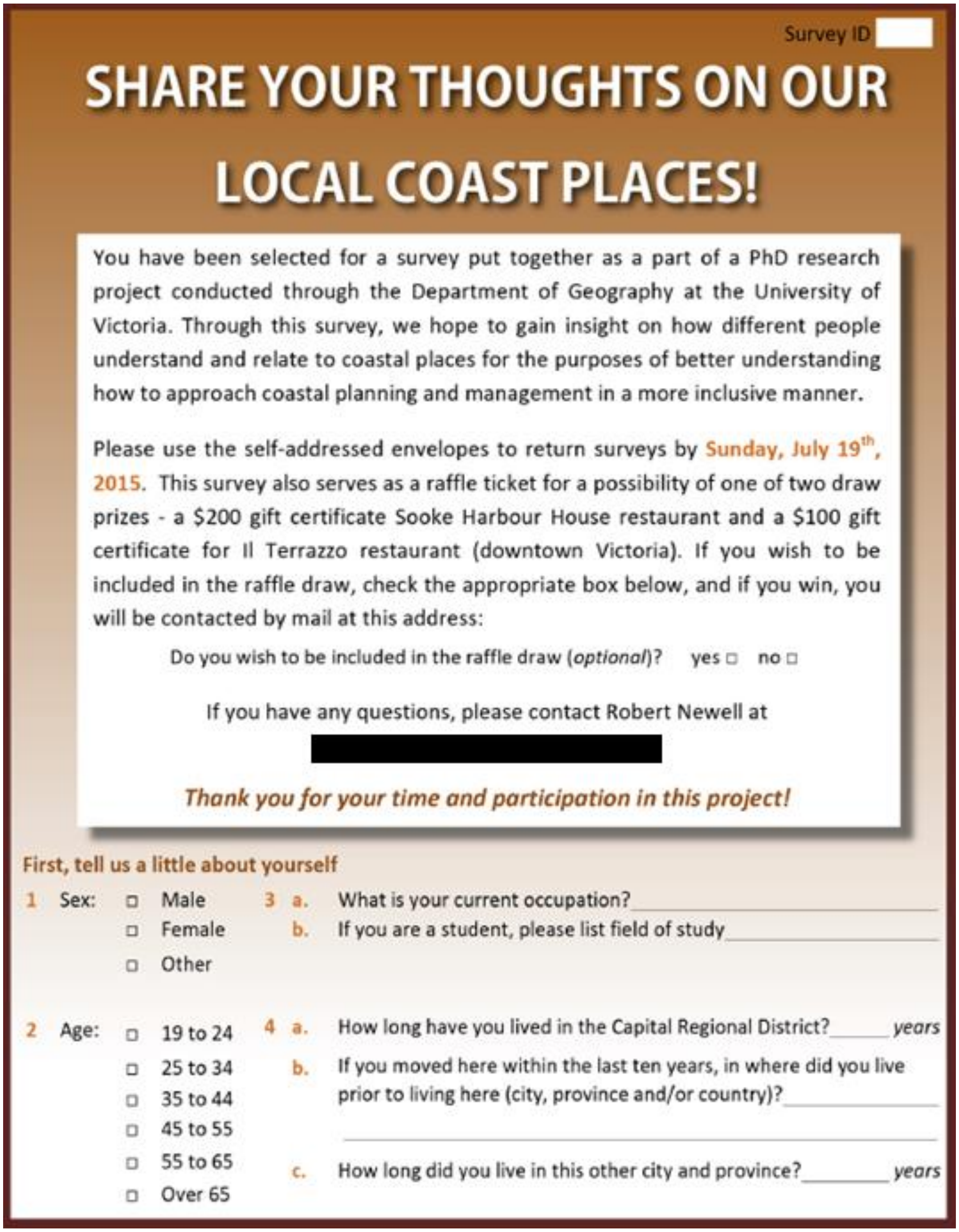
Questions and concerns can be directed to Robert Newell by [redacted] or by email at [redacted]. In addition, you may verify the ethical approval of this study or raise concerns with the Human Research Ethics Office at University of Victoria by contacting (250) 472-4545 or ethics@uvic.ca.

Consent:

By completing and submitting the survey, **YOUR FREE AND INFORMED CONSENT IS IMPLIED** and indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researcher.

Please retain a copy of this letter for your reference.

Appendix D. Survey



Survey ID

SHARE YOUR THOUGHTS ON OUR LOCAL COAST PLACES!

You have been selected for a survey put together as a part of a PhD research project conducted through the Department of Geography at the University of Victoria. Through this survey, we hope to gain insight on how different people understand and relate to coastal places for the purposes of better understanding how to approach coastal planning and management in a more inclusive manner.

Please use the self-addressed envelopes to return surveys by Sunday, July 19th, 2015. This survey also serves as a raffle ticket for a possibility of one of two draw prizes - a $200 gift certificate Sooke Harbour House restaurant and a $100 gift certificate for Il Terrazzo restaurant (downtown Victoria). If you wish to be included in the raffle draw, check the appropriate box below, and if you win, you will be contacted by mail at this address:

Do you wish to be included in the raffle draw (*optional*)? yes ☐ no ☐

If you have any questions, please contact Robert Newell at

[redacted]

Thank you for your time and participation in this project!

First, tell us a little about yourself

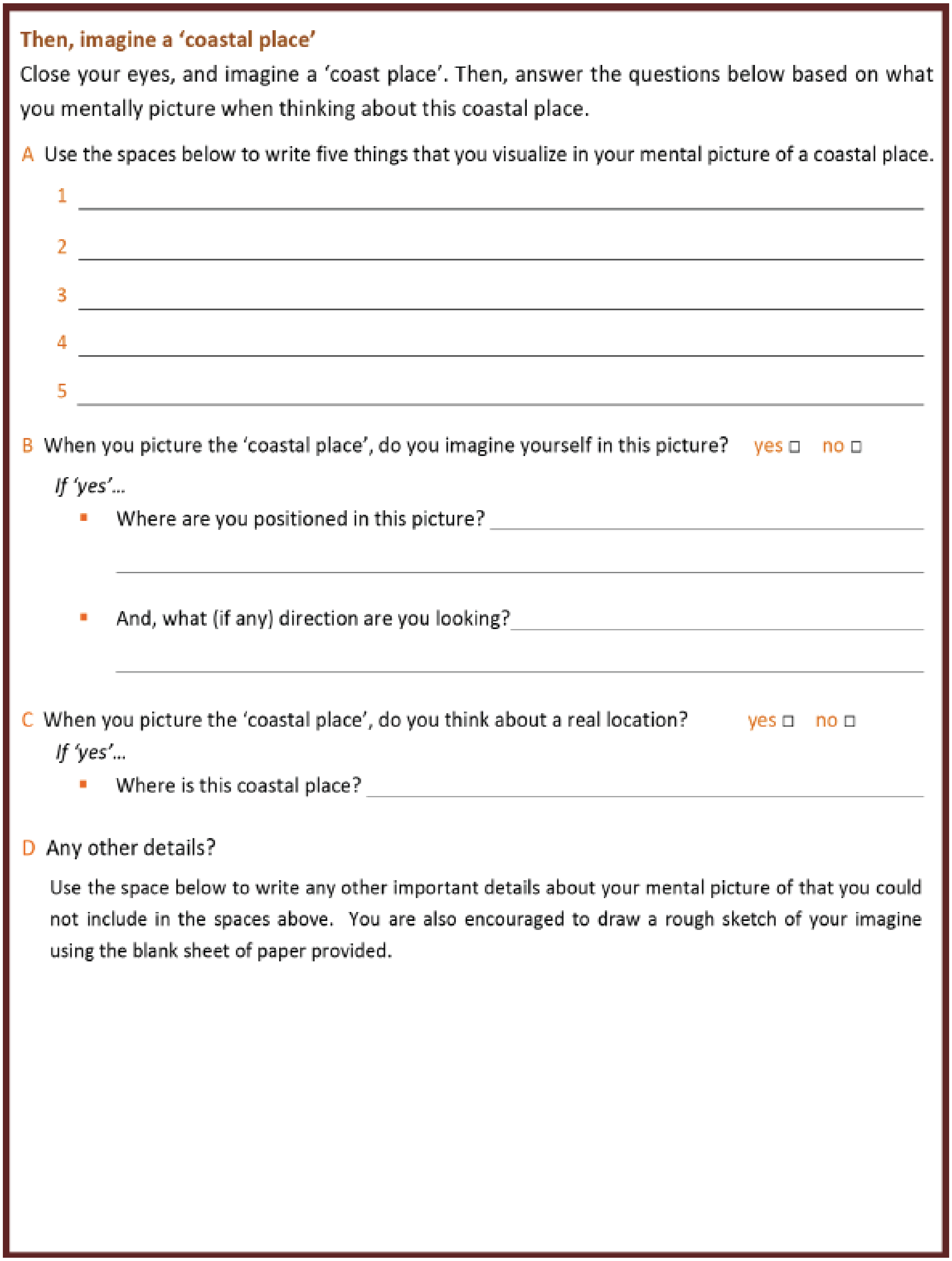
1 Sex:
☐ Male
☐ Female
☐ Other

2 Age:
☐ 19 to 24
☐ 25 to 34
☐ 35 to 44
☐ 45 to 55
☐ 55 to 65
☐ Over 65

3 a. What is your current occupation?____________
b. If you are a student, please list field of study____________

4 a. How long have you lived in the Capital Regional District?______ *years*
b. If you moved here within the last ten years, in where did you live prior to living here (city, province and/or country)?____________
____
c. How long did you live in this other city and province?______ *years*

Note: The page above is displayed as how the survey was printed, and as can be seen, the printed surveys contained an error in which age 55 overlaps two age categories (‘45 to 55’ and ‘55 to 65’). Although this creates some uncertainty in how respondents idenfied their age, ultimately this uncertainty has minimal effect on the analysis and interpretation of results. The analysis invovled categorizing people by general age ranges rather than looking at differences between particular years. In addition, some respondents appeared to notice the error, and thus identified a less ambigious age range in their survey. As this error has minimal effect on the study, the ‘45 to 55’ age category is discussed as ‘45 to 54’ in order to avoid confusion; however, for the sake of transparency, the error has been pointed out here.



Then, imagine a 'coastal place'

Close your eyes, and imagine a 'coast place'. Then, answer the questions below based on what you mentally picture when thinking about this coastal place.

A Use the spaces below to write five things that you visualize in your mental picture of a coastal place.

1 ____________________

2 ____________________

3 ____________________

4 ____________________

5 ____________________

B When you picture the 'coastal place', do you imagine yourself in this picture? yes ☐ no ☐

If 'yes'...

- Where are you positioned in this picture? ____________________
- And, what (if any) direction are you looking? ____________________

C When you picture the 'coastal place', do you think about a real location? yes ☐ no ☐

If 'yes'...

- Where is this coastal place? ____________________

D Any other details?

Use the space below to write any other important details about your mental picture of that you could not include in the spaces above. You are also encouraged to draw a rough sketch of your imagine using the blank sheet of paper provided.

Following that, share your thoughts and feelings around living near the ocean

Below are statements about living near and/or experiencing the coast. Please circle the appropriate corresponding number that best indicates your level of agreement with each of the statements.

1 – strongly disagree 2 – disagree 3 – mildly disagree 4 – mildly agree 5 – agree 6 – strongly agree

1	I feel 'at home' when I am near the coast.	1	2	3	4	5	6
2	It is important that the coast provides the local community with places to interact and socialize.	1	2	3	4	5	6
3	I would miss the coast if I moved away from it.	1	2	3	4	5	6
4	One of the things I enjoy most about being near the coast is the view of the ocean.	1	2	3	4	5	6
5	It is important that I live on the coast because of local employment opportunities.	1	2	3	4	5	6
6	I feel connected to the local coastal environment.	1	2	3	4	5	6
7	It is important that the coast provides opportunities for local tourism.	1	2	3	4	5	6
8	Coasts are particularly valuable places for supporting wildlife and ecosystems.	1	2	3	4	5	6
9	It is important local coastal places are managed properly to ensure that our economy can benefit from nature-based tourism.	1	2	3	4	5	6
10	It is important that local parks are established in coastal areas to provide people with opportunities for outdoor recreation.	1	2	3	4	5	6
11	It is important that coastal places are protected to maintain the health of local nature.	1	2	3	4	5	6
12	I enjoy visiting local coastal areas more than any other type of place.	1	2	3	4	5	6
13	It is important that people have the opportunity to live by the coast and that housing and services are made available to allow for these opportunities.	1	2	3	4	5	6
14	One of the things I enjoy most about the coast is the recreational opportunities it provides.	1	2	3	4	5	6
15	The relationships I have formed with friends and neighbours in this coastal place (i.e., the CRD) are stronger than relationships I have formed elsewhere.	1	2	3	4	5	6
16	It is important for the local economy that coastal places provide us with resources.	1	2	3	4	5	6
17	Local coastal areas are my favourite places to spend time with friends and family.	1	2	3	4	5	6
18	It is important that local coastal places are protected to maintain their special beauty.	1	2	3	4	5	6
19	Coasts should be protected so that our families, friends and communities can continue to enjoy these places together.	1	2	3	4	5	6
20	One of the things I enjoy most about the coast is the local wildlife and nature	1	2	3	4	5	6
21	Local coastal areas are some of my favourite places for activities I like to do.	1	2	3	4	5	6

Finally, let us know your biggest concerns for coastal places and coastal living

Below are potential concerns related to coastal places and coastal living. Please circle the appropriate corresponding number that best indicates the extent to which you think any of the following would be significant cause for concern if experienced in local coastal places.

1 – not concerned   2 – a little concerned   3 – somewhat concerned   4 – concerned   5 – highly concerned   6 – a top concern

1	Impacts from people living aboard boats	1	2	3	4	5	6
2	Impacts from fisheries	1	2	3	4	5	6
3	Impacts from recreational boating	1	2	3	4	5	6
4	Wastewater pollution	1	2	3	4	5	6
5	Loss of wildlife habitat	1	2	3	4	5	6
6	Garbage in ocean	1	2	3	4	5	6
7	Declining salmon populations	1	2	3	4	5	6
8	Declining orca populations	1	2	3	4	5	6
9	Coastal erosion and loss of beachfront	1	2	3	4	5	6
10	Decreased public access to shoreline	1	2	3	4	5	6
11	Loss of recreational opportunities on the coast	1	2	3	4	5	6
12	Conflicts between access/use and protection of the shoreline	1	2	3	4	5	6
13	Loss of tourism opportunities on the coast	1	2	3	4	5	6
14	Limited commercial fishing opportunities	1	2	3	4	5	6
15	Declining seabird populations	1	2	3	4	5	6
16	Limited opportunities for recreational boating	1	2	3	4	5	6
17	Economic impacts from loss of coastal resources	1	2	3	4	5	6
18	Increased restrictions on commercial shoreline development	1	2	3	4	5	6
19	Decreased private property rights in coastal areas	1	2	3	4	5	6
20	Limited recreational fishing opportunities	1	2	3	4	5	6
21	Increased development in coastal areas	1	2	3	4	5	6
22	Impacts from transport vessels	1	2	3	4	5	6
23	Garbage on beaches	1	2	3	4	5	6
24	Loss of eelgrass	1	2	3	4	5	6

More thoughts to share?

We encourage you use the provided blank sheet of paper to elaborate on any of your responses to this survey and express what you feel is particularly special (if anything) about coastal places.

Thank you again for your time and participation!

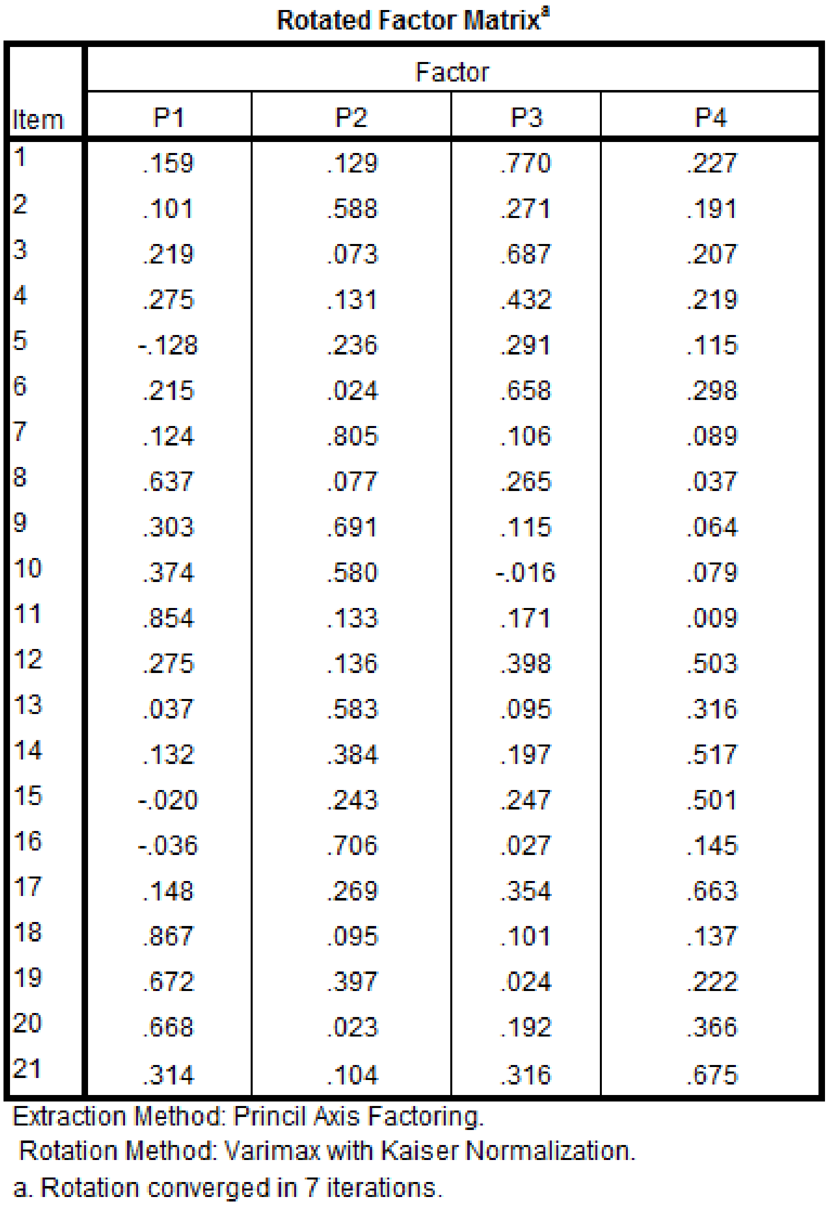
Appendix E. SPSS output from factor analysis

Sense of place items

1. I feel ‘at home’ when living near the coast
2. It is important that the coast provides the local community with places to interact and socialize
3. I would miss the coast if I moved away from it
4. One of the things I enjoy most about living near the coast is the view of the ocean
5. It is important that I live on the coast because of the employment opportunities it provides
6. I feel connected to the local coastal environment
7. It is important that the coast provides opportunities for local tourism
8. Coasts are particularly valuable places for supporting wildlife and ecological processes
9. It is important local coastal places are protected to ensure that our economy can benefit from nature-based tourism
10. It is important that local parks are established in coastal areas to provide opportunities for outdoor recreation
11. It is important that coastal places are protected to maintain the health of local nature
12. I enjoy visiting local coastal areas more than any other type of place
13. It is important that people have the opportunity to live by the coast and adequate housing and services are made available to allow for these opportunities
14. One of the things I enjoy most about local coast places is the recreational opportunities they provides
15. The relationships I have formed with friends and neighbours in this coastal place (i.e., the CRD) are stronger than relationships I have formed elsewhere
16. The relationships I have formed with friends and neighbours in this coastal place (i.e., the CRD) are stronger than relationships I have formed elsewhere
17. Local coastal areas are my favourite places to spend time with friends and family
18. It is important that local coastal places are protected to maintain their special beauty
19. Coast should be protected so that our families, friends and communities can continue to enjoy these places together
20. One of the things I enjoy most about the coast is the local wildlife and nature
21. Local coastal areas are some of my favourite places for activities I like to do

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Rotated Factor Matrix[a]

Item	Factor			
	P1	P2	P3	P4
1	.159	.129	.770	.227
2	.101	.588	.271	.191
3	.219	.073	.687	.207
4	.275	.131	.432	.219
5	-.128	.236	.291	.115
6	.215	.024	.658	.298
7	.124	.805	.106	.089
8	.637	.077	.265	.037
9	.303	.691	.115	.064
10	.374	.580	-.016	.079
11	.854	.133	.171	.009
12	.275	.136	.398	.503
13	.037	.583	.095	.316
14	.132	.384	.197	.517
15	-.020	.243	.247	.501
16	-.036	.706	.027	.145
17	.148	.269	.354	.663
18	.867	.095	.101	.137
19	.672	.397	.024	.222
20	.668	.023	.192	.366
21	.314	.104	.316	.675

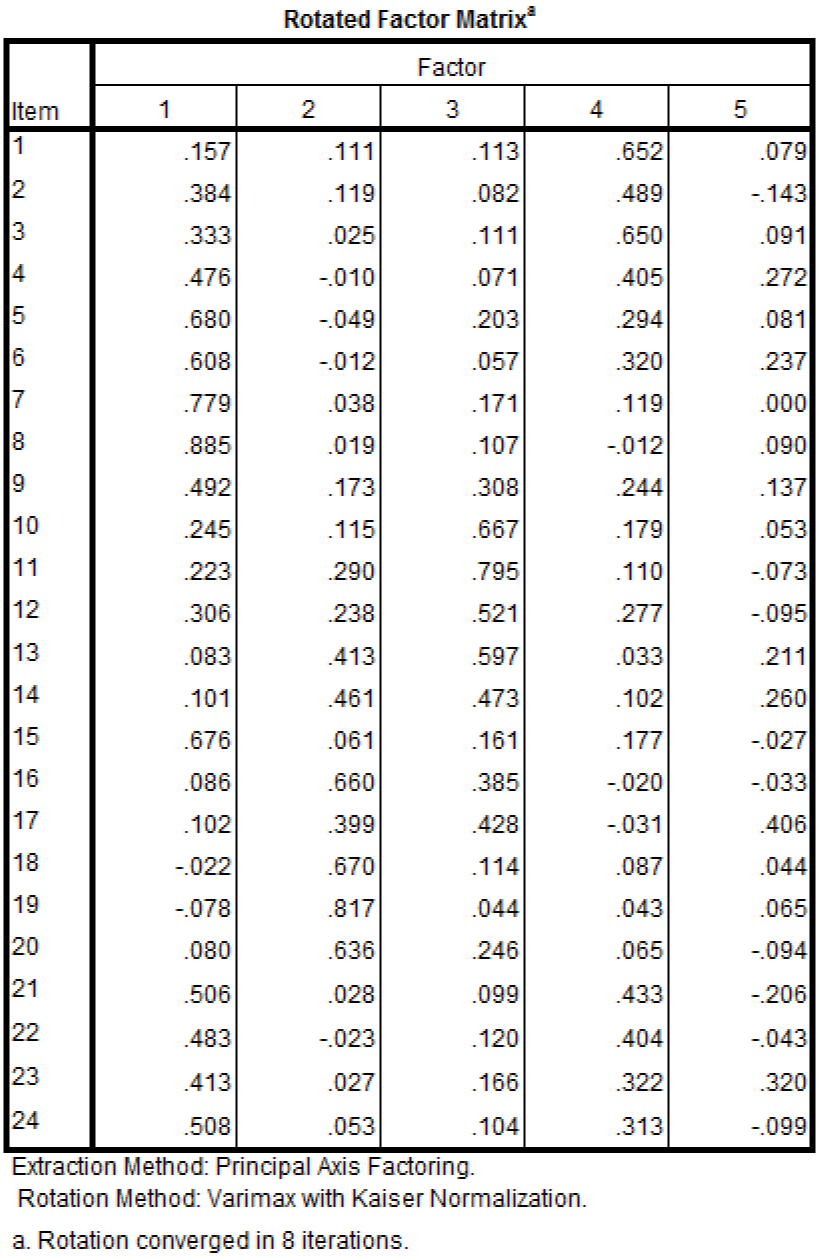
Extraction Method: Princil Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

Coastal concerns items

1. Impacts from people living aboard boats
2. Impacts from fisheries
3. Impacts from recreational boating
4. Wastewater pollution
5. Loss of wildlife habitat
6. Garbage in ocean
7. Declining salmon populations
8. Declining orca populations
9. Coastal erosion and loss of beachfront
10. Decreased public access to shoreline
11. Loss of recreational opportunities on the coast
12. Conflicts between access/use and protection of the shoreline
13. Loss of tourism opportunities on the coast
14. Limited commercial fishing opportunities
15. Declining seabird populations
16. Limited opportunities for recreational boating
17. Economic impacts from loss of coastal resources
18. Increased restrictions on commercial shoreline development
19. Decreased private property rights in coastal areas
20. Limited recreational fishing opportunities
21. Increased development in coastal areas
22. Impacts from transport vessels
23. Garbage on beaches
24. Loss of eelgrass

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Rotated Factor Matrix[a]

Item	Factor				
	1	2	3	4	5
1	.157	.111	.113	.652	.079
2	.384	.119	.082	.489	-.143
3	.333	.025	.111	.650	.091
4	.476	-.010	.071	.405	.272
5	.680	-.049	.203	.294	.081
6	.608	-.012	.057	.320	.237
7	.779	.038	.171	.119	.000
8	.885	.019	.107	-.012	.090
9	.492	.173	.308	.244	.137
10	.245	.115	.667	.179	.053
11	.223	.290	.795	.110	-.073
12	.306	.238	.521	.277	-.095
13	.083	.413	.597	.033	.211
14	.101	.461	.473	.102	.260
15	.676	.061	.161	.177	-.027
16	.086	.660	.385	-.020	-.033
17	.102	.399	.428	-.031	.406
18	-.022	.670	.114	.087	.044
19	-.078	.817	.044	.043	.065
20	.080	.636	.246	.065	-.094
21	.506	.028	.099	.433	-.206
22	.483	-.023	.120	.404	-.043
23	.413	.027	.166	.322	.320
24	.508	.053	.104	.313	-.099

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

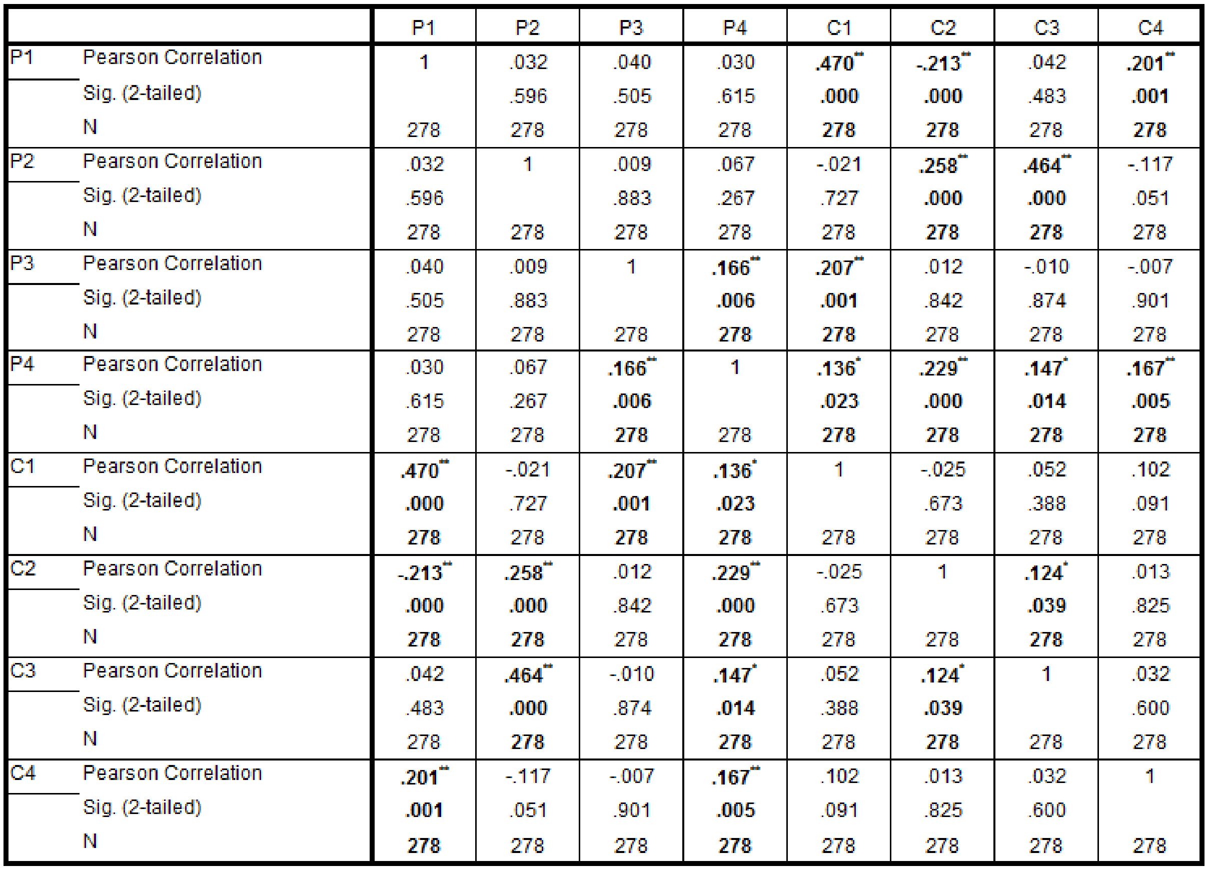
Appendix F. SPSS output from correlation analysis

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



		P1	P2	P3	P4	C1	C2	C3	C4
P1	Pearson Correlation	1	.032	.040	.030	.470**	-.213**	.042	.201**
	Sig. (2-tailed)		.596	.505	.615	.000	.000	.483	.001
	N	278	278	278	278	278	278	278	278
P2	Pearson Correlation	.032	1	.009	.067	-.021	.258**	.464**	-.117
	Sig. (2-tailed)	.596		.883	.267	.727	.000	.000	.051
	N	278	278	278	278	278	278	278	278
P3	Pearson Correlation	.040	.009	1	.166**	.207**	.012	-.010	-.007
	Sig. (2-tailed)	.505	.883		.006	.001	.842	.874	.901
	N	278	278	278	278	278	278	278	278
P4	Pearson Correlation	.030	.067	.166**	1	.136*	.229**	.147*	.167**
	Sig. (2-tailed)	.615	.267	.006		.023	.000	.014	.005
	N	278	278	278	278	278	278	278	278
C1	Pearson Correlation	.470**	-.021	.207**	.136*	1	-.025	.052	.102
	Sig. (2-tailed)	.000	.727	.001	.023		.673	.388	.091
	N	278	278	278	278	278	278	278	278
C2	Pearson Correlation	-.213**	.258**	.012	.229**	-.025	1	.124*	.013
	Sig. (2-tailed)	.000	.000	.842	.000	.673		.039	.825
	N	278	278	278	278	278	278	278	278
C3	Pearson Correlation	.042	.464**	-.010	.147*	.052	.124*	1	.032
	Sig. (2-tailed)	.483	.000	.874	.014	.388	.039		.600
	N	278	278	278	278	278	278	278	278
C4	Pearson Correlation	.201**	-.117	-.007	.167**	.102	.013	.032	1
	Sig. (2-tailed)	.001	.051	.901	.005	.091	.825	.600	
	N	278	278	278	278	278	278	278	278

**. Correlation is significant at the 0.01 level (2-tailed).

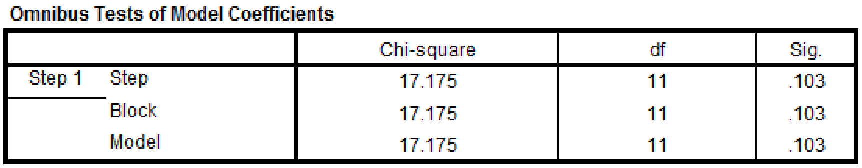
* Correlation is significant at the 0.05 level (2-tailed).

Appendix G. SPSS output from survey binomial regression analysis

Ocean surface (Cat1)

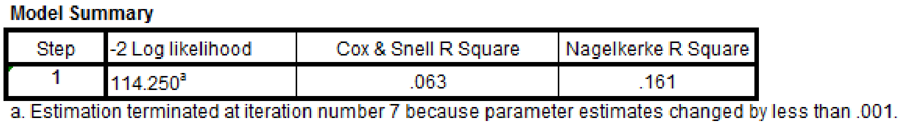
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

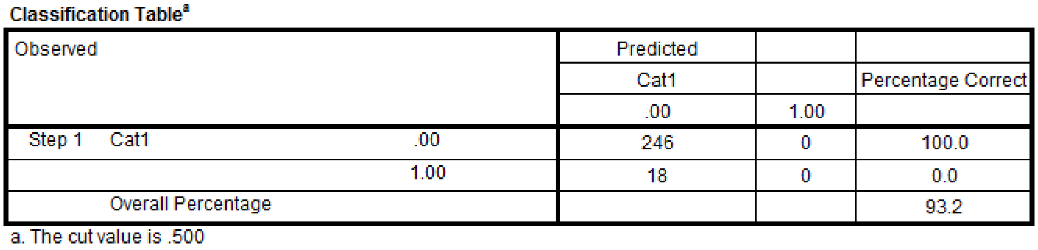
		Chi-square	df	Sig.
Step 1	Step	17.175	11	.103
	Block	17.175	11	.103
	Model	17.175	11	.103



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	114.250[a]	.063	.161

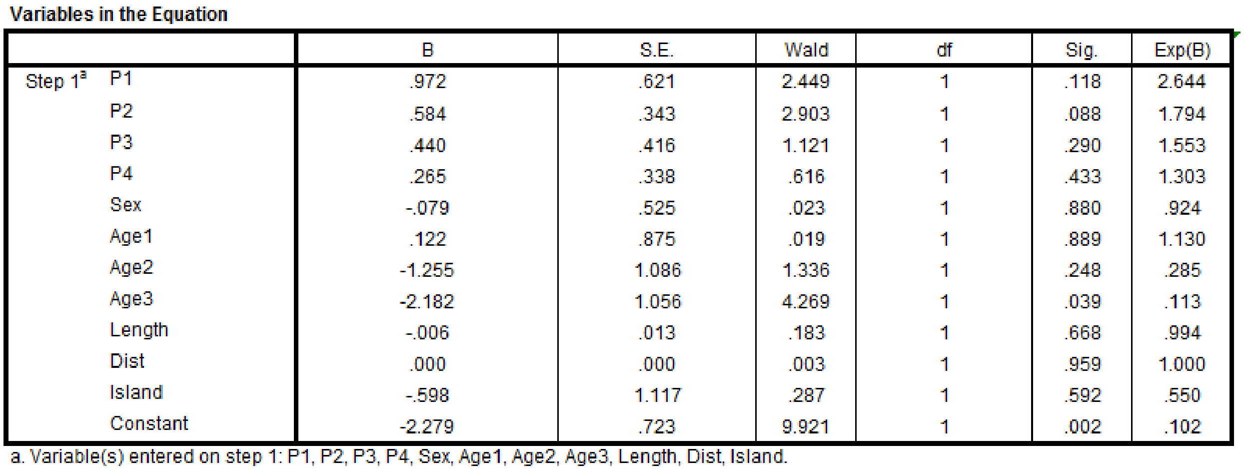
a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat1		Percentage Correct
			.00	1.00	
Step 1	Cat1	.00	246	0	100.0
		1.00	18	0	0.0
	Overall Percentage				93.2

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.972	.621	2.449	1	.118	2.644
	P2	.584	.343	2.903	1	.088	1.794
	P3	.440	.416	1.121	1	.290	1.553
	P4	.265	.338	.616	1	.433	1.303
	Sex	-.079	.525	.023	1	.880	.924
	Age1	.122	.875	.019	1	.889	1.130
	Age2	-1.255	1.086	1.336	1	.248	.285
	Age3	-2.182	1.056	4.269	1	.039	.113
	Length	-.006	.013	.183	1	.668	.994
	Dist	.000	.000	.003	1	.959	1.000
	Island	-.598	1.117	.287	1	.592	.550
	Constant	-2.279	.723	9.921	1	.002	.102

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Viewshed (Cat2)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	14.247	11	.220
	Block	14.247	11	.220
	Model	14.247	11	.220

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	345.651[a]	.053	.071

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat2		Percentage Correct
			.00	1.00	
Step 1	Cat2	.00	121	31	79.6
		1.00	77	35	31.3
	Overall Percentage				59.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.049	.142	.117	1	.732	.953
	P2	.340	.149	5.232	1	.022	1.405
	P3	.208	.160	1.696	1	.193	1.231
	P4	-.195	.154	1.598	1	.206	.823
	Sex	-.002	.270	.000	1	.994	.998
	Age1	.464	.548	.715	1	.398	1.590
	Age2	-.405	.441	.843	1	.358	.667
	Age3	-.245	.307	.636	1	.425	.783
	Length	-.006	.007	.668	1	.414	.994
	Dist	.000	.000	3.513	1	.061	1.000
	Island	-.286	.428	.447	1	.504	.751
	Constant	.294	.373	.621	1	.431	1.342

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Sky (Cat3)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	7.956	11	.717
	Block	7.956	11	.717
	Model	7.956	11	.717

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	183.054[a]	.030	.058

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat3		Percentage Correct
			.00	1.00	
Step 1	Cat3	.00	233	0	100.0
		1.00	31	0	0.0
	Overall Percentage				88.3

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.132	.207	.404	1	.525	.877
	P2	-.081	.199	.166	1	.684	.922
	P3	.243	.249	.955	1	.329	1.276
	P4	-.385	.214	3.233	1	.072	.681
	Sex	.158	.408	.151	1	.698	1.172
	Age1	-.876	1.093	.642	1	.423	.416
	Age2	-.156	.616	.064	1	.800	.855
	Age3	-.789	.532	2.201	1	.138	.454
	Length	-.003	.011	.072	1	.788	.997
	Dist	.000	.000	.000	1	.988	1.000
	Island	.033	.622	.003	1	.957	1.034
	Constant	-1.824	.559	10.633	1	.001	.161

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Wildlife (Cat4)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	21.032	11	.033
	Block	21.032	11	.033
	Model	21.032	11	.033

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	321.557[a]	.077	.105

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat4		Percentage Correct
			.00	1.00	
Step 1	Cat4	.00	25	68	26.9
		1.00	13	158	92.4
	Overall Percentage				69.3

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.429	.160	7.155	1	.007	1.535
	P2	-.040	.150	.072	1	.788	.960
	P3	.287	.165	3.042	1	.081	1.333
	P4	.170	.159	1.148	1	.284	1.186
	Sex	.242	.283	.731	1	.392	1.274
	Age1	.427	.634	.452	1	.501	1.532
	Age2	-.021	.454	.002	1	.963	.979
	Age3	-.018	.324	.003	1	.956	.982
	Length	-.012	.008	2.465	1	.116	.988
	Dist	.000	.000	.397	1	.528	1.000
	Island	.411	.481	.732	1	.392	1.509
	Constant	.732	.392	3.492	1	.062	2.079

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Terrestrial wildlife (Cat5)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	17.578	11	.092
	Block	17.578	11	.092
	Model	17.578	11	.092

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	138.618[a]	.064	.144

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat5		Percentage Correct
			.00	1.00	
Step 1	Cat5	.00	241	0	100.0
		1.00	22	1	4.3
	Overall Percentage				91.7

a. The cut value is .500

Variables in the Equation

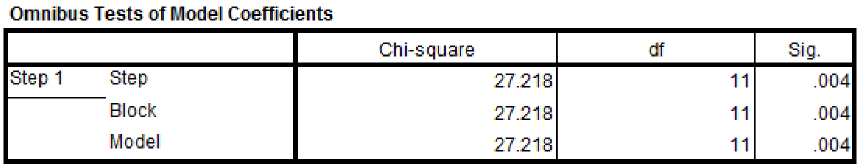
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.333	.343	.942	1	.332	1.395
	P2	-.446	.220	4.107	1	.043	.640
	P3	.536	.416	1.664	1	.197	1.710
	P4	.340	.305	1.243	1	.265	1.405
	Sex	.577	.498	1.343	1	.246	1.782
	Age1	1.632	.756	4.659	1	.031	5.113
	Age2	-1.169	1.117	1.096	1	.295	.311
	Age3	.332	.538	.379	1	.538	1.393
	Length	.001	.014	.003	1	.953	1.001
	Dist	.000	.000	.047	1	.829	1.000
	Island	.437	.668	.428	1	.513	1.548
	Constant	-3.107	.717	18.773	1	.000	.045

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Marine wildlife (Cat6)

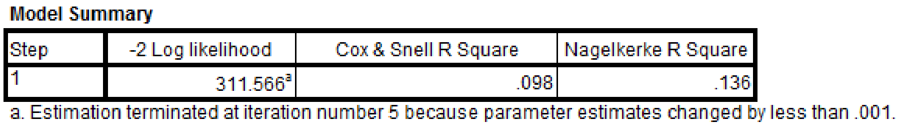
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

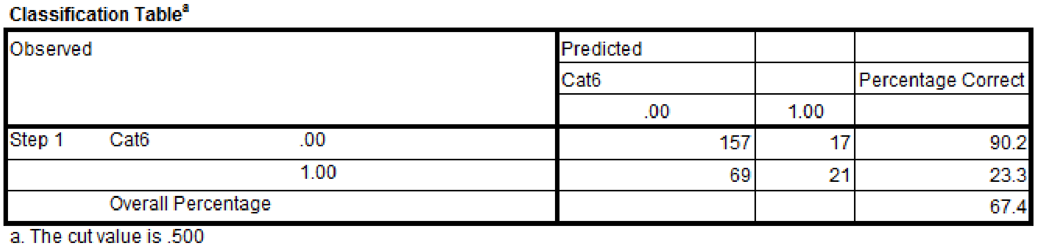
		Chi-square	df	Sig.
Step 1	Step	27.218	11	.004
	Block	27.218	11	.004
	Model	27.218	11	.004



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	311.566[a]	.098	.136

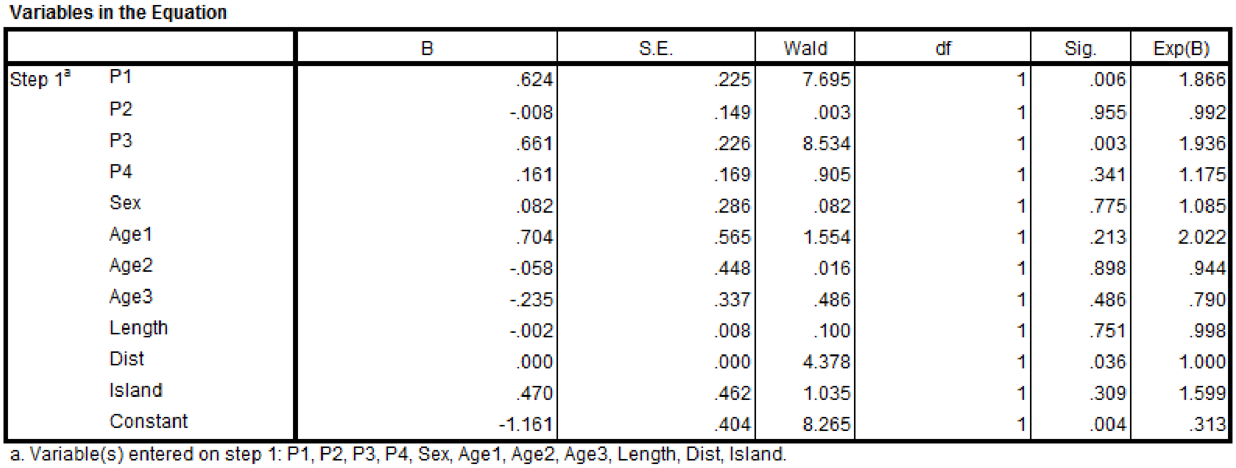
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat6		Percentage Correct
			.00	1.00	
Step 1	Cat6	.00	157	17	90.2
		1.00	69	21	23.3
	Overall Percentage				67.4

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.624	.225	7.695	1	.006	1.866
	P2	-.008	.149	.003	1	.955	.992
	P3	.661	.226	8.534	1	.003	1.936
	P4	.161	.169	.905	1	.341	1.175
	Sex	.082	.286	.082	1	.775	1.085
	Age1	.704	.565	1.554	1	.213	2.022
	Age2	-.058	.448	.016	1	.898	.944
	Age3	-.235	.337	.486	1	.486	.790
	Length	-.002	.008	.100	1	.751	.998
	Dist	.000	.000	4.378	1	.036	1.000
	Island	.470	.462	1.035	1	.309	1.599
	Constant	-1.161	.404	8.265	1	.004	.313

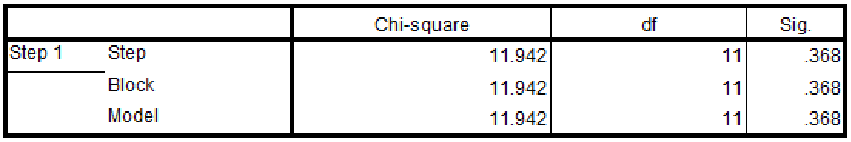
a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Domestic animals (Cat7)

Sense of place variables (P)

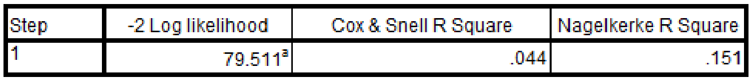
- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients



		Chi-square	df	Sig.
Step 1	Step	11.942	11	.368
	Block	11.942	11	.368
	Model	11.942	11	.368

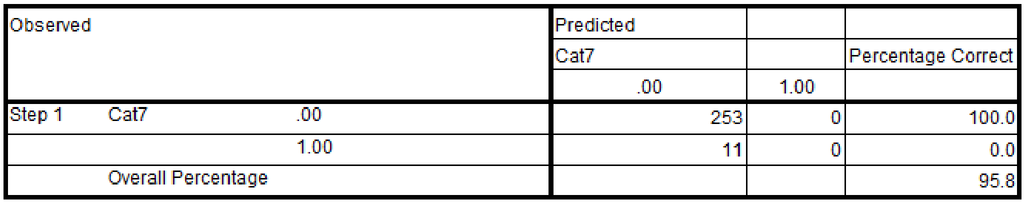
Model Summary



Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	79.511[a]	.044	.151

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

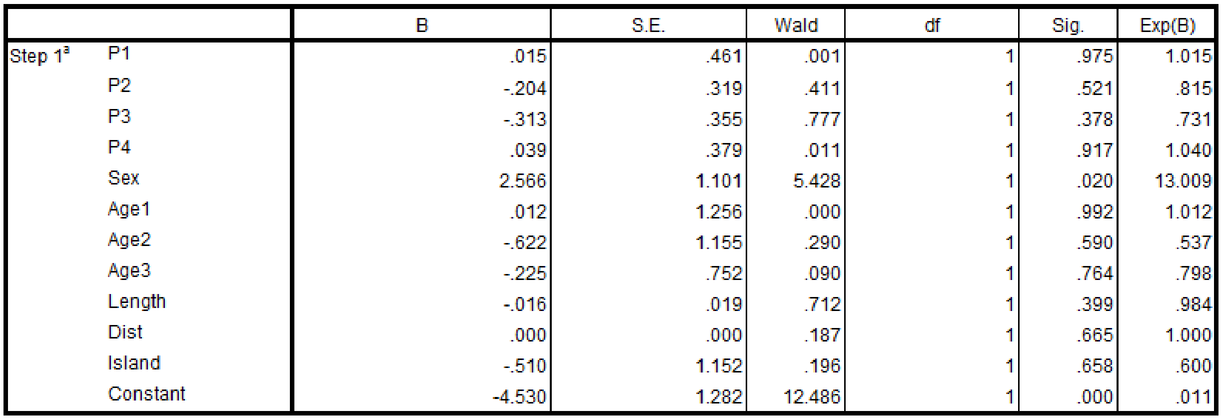
Classification Table[a]



Observed			Predicted		
			Cat7		Percentage Correct
			.00	1.00	
Step 1	Cat7	.00	253	0	100.0
		1.00	11	0	0.0
	Overall Percentage				95.8

a. The cut value is .500

Variables in the Equation



		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.015	.461	.001	1	.975	1.015
	P2	-.204	.319	.411	1	.521	.815
	P3	-.313	.355	.777	1	.378	.731
	P4	.039	.379	.011	1	.917	1.040
	Sex	2.566	1.101	5.428	1	.020	13.009
	Age1	.012	1.256	.000	1	.992	1.012
	Age2	-.622	1.155	.290	1	.590	.537
	Age3	-.225	.752	.090	1	.764	.798
	Length	-.016	.019	.712	1	.399	.984
	Dist	.000	.000	.187	1	.665	1.000
	Island	-.510	1.152	.196	1	.658	.600
	Constant	-4.530	1.282	12.486	1	.000	.011

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Marine invertebrates (Cat8)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	22.364	11	.022
	Block	22.364	11	.022
	Model	22.364	11	.022

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	184.218[a]	.081	.150

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat8		Percentage Correct
			.00	1.00	
Step 1	Cat8	.00	228	1	99.6
		1.00	35	0	0.0
	Overall Percentage				86.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.468	.309	2.289	1	.130	1.596
	P2	-.208	.204	1.039	1	.308	.813
	P3	.399	.283	1.985	1	.159	1.490
	P4	-.165	.228	.524	1	.469	.848
	Sex	.100	.406	.061	1	.805	1.105
	Age1	1.300	.667	3.799	1	.051	3.668
	Age2	.887	.550	2.600	1	.107	2.429
	Age3	.203	.500	.165	1	.685	1.225
	Length	.008	.011	.506	1	.477	1.008
	Dist	.001	.000	7.883	1	.005	1.001
	Island	.395	.705	.313	1	.576	1.484
	Constant	-3.418	.637	28.771	1	.000	.033

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Birds (Cat9)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	12.866	11	.302
	Block	12.866	11	.302
	Model	12.866	11	.302

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	298.460[a]	.048	.069

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat9		Percentage Correct
			.00	1.00	
Step 1	Cat9	.00	189	2	99.0
		1.00	68	5	6.8
	Overall Percentage				73.5

a. The cut value is .500

Variables in the Equation

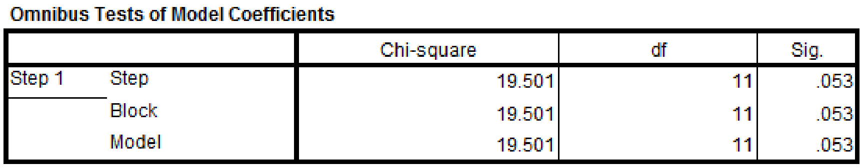
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.419	.214	3.844	1	.050	1.520
	P2	.092	.160	.330	1	.566	1.096
	P3	.195	.196	.993	1	.319	1.215
	P4	.135	.176	.587	1	.444	1.145
	Sex	.049	.296	.028	1	.868	1.051
	Age1	.777	.554	1.965	1	.161	2.175
	Age2	-.543	.514	1.117	1	.291	.581
	Age3	.138	.334	.170	1	.680	1.148
	Length	-.007	.008	.710	1	.399	.993
	Dist	.000	.000	.366	1	.545	1.000
	Island	.259	.468	.308	1	.579	1.296
	Constant	-.996	.408	5.967	1	.015	.369

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Land birds (Cat10)

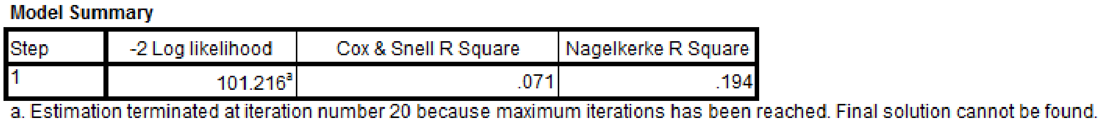
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

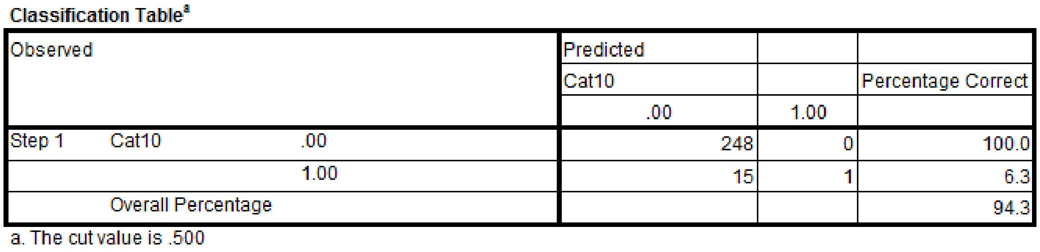
		Chi-square	df	Sig.
Step 1	Step	19.501	11	.053
	Block	19.501	11	.053
	Model	19.501	11	.053



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	101.216[a]	.071	.194

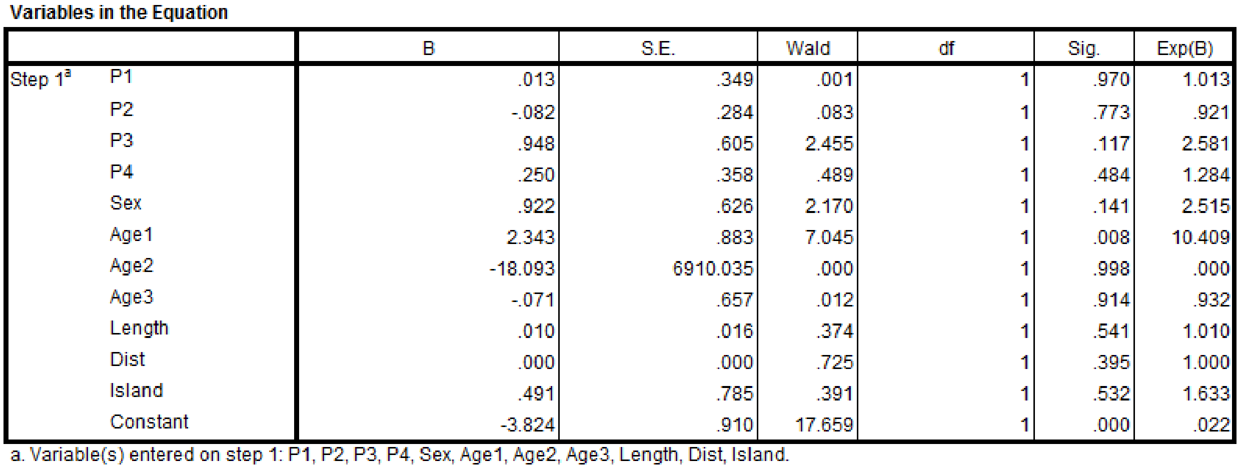
a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.



Classification Table[a]

Observed			Predicted		
			Cat10		Percentage Correct
			.00	1.00	
Step 1	Cat10	.00	248	0	100.0
		1.00	15	1	6.3
	Overall Percentage				94.3

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.013	.349	.001	1	.970	1.013
	P2	-.082	.284	.083	1	.773	.921
	P3	.948	.605	2.455	1	.117	2.581
	P4	.250	.358	.489	1	.484	1.284
	Sex	.922	.626	2.170	1	.141	2.515
	Age1	2.343	.883	7.045	1	.008	10.409
	Age2	-18.093	6910.035	.000	1	.998	.000
	Age3	-.071	.657	.012	1	.914	.932
	Length	.010	.016	.374	1	.541	1.010
	Dist	.000	.000	.725	1	.395	1.000
	Island	.491	.785	.391	1	.532	1.633
	Constant	-3.824	.910	17.659	1	.000	.022

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Aquatic birds (Cat11)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	28.797	11	.002
	Block	28.797	11	.002
	Model	28.797	11	.002

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	259.000[a]	.103	.156

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat11		Percentage Correct
			.00	1.00	
Step 1	Cat11	.00	202	0	100.0
		1.00	61	1	1.6
	Overall Percentage				76.9

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.483	.248	3.782	1	.052	1.621
	P2	-.037	.166	.050	1	.823	.963
	P3	.296	.231	1.636	1	.201	1.344
	P4	.055	.188	.087	1	.768	1.057
	Sex	.417	.321	1.683	1	.195	1.517
	Age1	.472	.618	.583	1	.445	1.604
	Age2	-2.528	1.050	5.798	1	.016	.080
	Age3	-.254	.356	.510	1	.475	.776
	Length	.003	.009	.163	1	.687	1.003
	Dist	.000	.000	4.857	1	.028	1.000
	Island	-.366	.507	.523	1	.470	.693
	Constant	-.944	.434	4.724	1	.030	.389

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Land plants (Cat12)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	22.721	11	.019
	Block	22.721	11	.019
	Model	22.721	11	.019

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	342.715[a]	.082	.110

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat12		Percentage Correct
			.00	1.00	
Step 1	Cat12	.00	97	41	70.3
		1.00	58	68	54.0
	Overall Percentage				62.5

a. The cut value is .500

Variables in the Equation

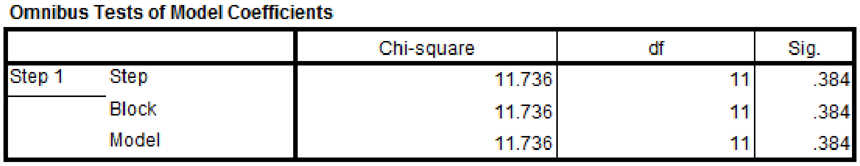
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.066	.140	.220	1	.639	1.068
	P2	-.003	.141	.000	1	.984	.997
	P3	.131	.154	.723	1	.395	1.140
	P4	.072	.153	.222	1	.638	1.075
	Sex	.213	.270	.624	1	.430	1.238
	Age1	1.141	.571	4.000	1	.045	3.131
	Age2	.990	.429	5.313	1	.021	2.690
	Age3	.510	.305	2.799	1	.094	1.665
	Length	-.007	.007	.981	1	.322	.993
	Dist	.000	.000	1.197	1	.274	1.000
	Island	1.100	.455	5.847	1	.016	3.003
	Constant	-.232	.370	.392	1	.531	.793

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Boats (Cat13)

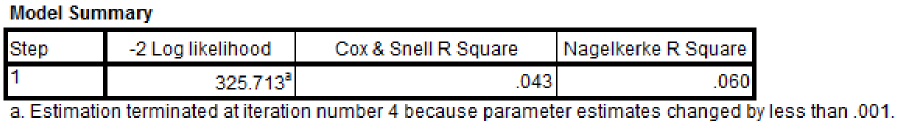
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

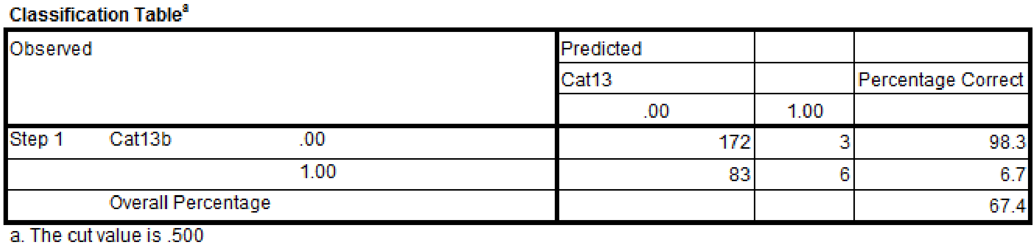
		Chi-square	df	Sig.
Step 1	Step	11.736	11	.384
	Block	11.736	11	.384
	Model	11.736	11	.384



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	325.713[a]	.043	.060

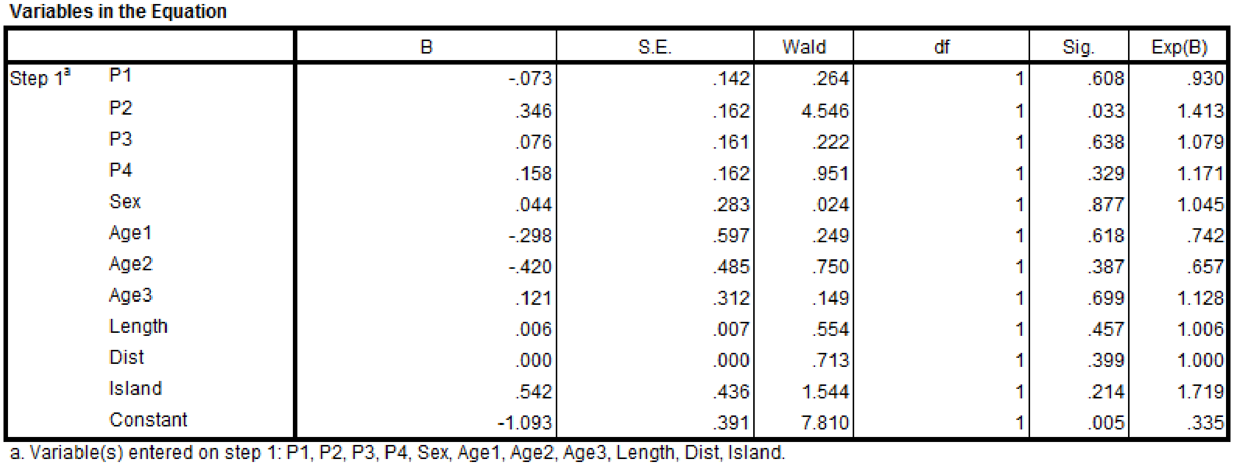
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat13		Percentage Correct
			.00	1.00	
Step 1	Cat13b	.00	172	3	98.3
		1.00	83	6	6.7
	Overall Percentage				67.4

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.073	.142	.264	1	.608	.930
	P2	.346	.162	4.546	1	.033	1.413
	P3	.076	.161	.222	1	.638	1.079
	P4	.158	.162	.951	1	.329	1.171
	Sex	.044	.283	.024	1	.877	1.045
	Age1	-.298	.597	.249	1	.618	.742
	Age2	-.420	.485	.750	1	.387	.657
	Age3	.121	.312	.149	1	.699	1.128
	Length	.006	.007	.554	1	.457	1.006
	Dist	.000	.000	.713	1	.399	1.000
	Island	.542	.436	1.544	1	.214	1.719
	Constant	-1.093	.391	7.810	1	.005	.335

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Large boats (Cat14)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	16.171	11	.135
	Block	16.171	11	.135
	Model	16.171	11	.135

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	178.836[a]	.059	.114

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat14		Percentage Correct
			.00	1.00	
Step 1	Cat14	.00	232	0	100.0
		1.00	32	0	0.0
	Overall Percentage				87.9

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.213	.209	1.045	1	.307	.808
	P2	.648	.274	5.580	1	.018	1.913
	P3	.087	.234	.138	1	.710	1.091
	P4	-.210	.224	.880	1	.348	.811
	Sex	.148	.415	.128	1	.721	1.160
	Age1	-1.108	1.103	1.010	1	.315	.330
	Age2	.356	.585	.371	1	.543	1.428
	Age3	-1.087	.579	3.530	1	.060	.337
	Length	-.004	.011	.150	1	.699	.996
	Dist	.000	.000	.171	1	.679	1.000
	Island	.962	.577	2.776	1	.096	2.616
	Constant	-2.063	.579	12.678	1	.000	.127

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Small boats (Cat15)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	25.419	11	.008
	Block	25.419	11	.008
	Model	25.419	11	.008

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	218.808[a]	.092	.152

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat15		Percentage Correct
			.00	1.00	
Step 1	Cat15	.00	218	0	100.0
		1.00	45	1	2.2
	Overall Percentage				83.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.350	.264	1.762	1	.184	1.419
	P2	.381	.212	3.222	1	.073	1.463
	P3	.902	.353	6.512	1	.011	2.464
	P4	.085	.208	.167	1	.683	1.089
	Sex	.331	.364	.826	1	.363	1.392
	Age1	-.525	.835	.394	1	.530	.592
	Age2	-1.273	.793	2.579	1	.108	.280
	Age3	-.331	.404	.673	1	.412	.718
	Length	.015	.009	2.482	1	.115	1.015
	Dist	.000	.000	.522	1	.470	1.000
	Island	.248	.579	.184	1	.668	1.282
	Constant	-2.471	.526	22.063	1	.000	.085

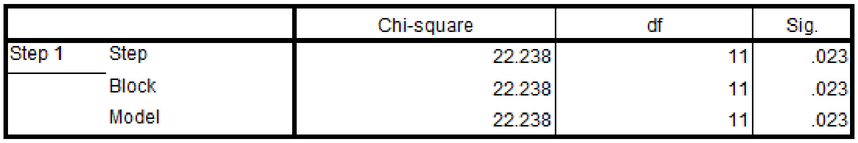
a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Marine environment (Cat16)

Sense of place variables (P)

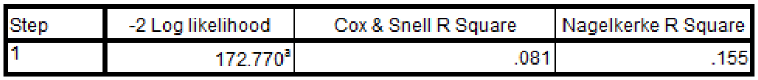
- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients



		Chi-square	df	Sig.
Step 1	Step	22.238	11	.023
	Block	22.238	11	.023
	Model	22.238	11	.023

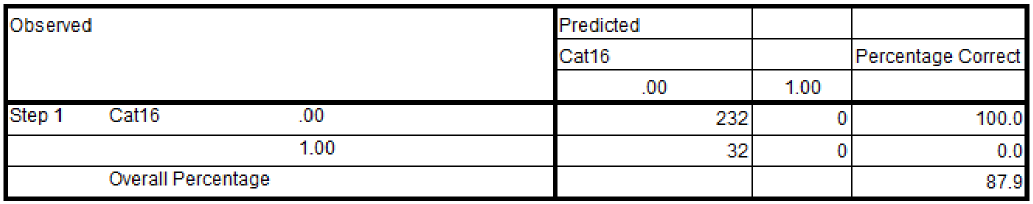
Model Summary



Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	172.770[a]	.081	.155

a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.

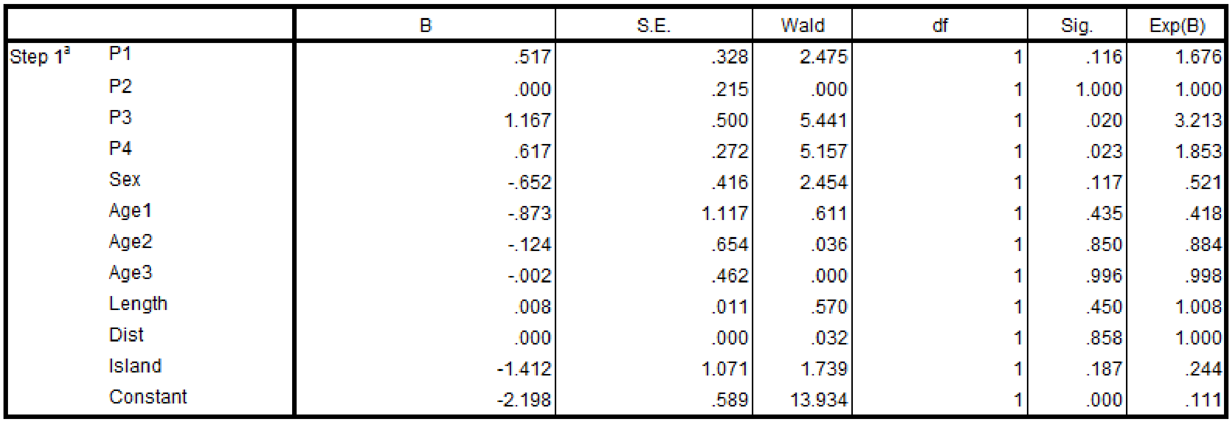
Classification Table[a]



Observed			Predicted		
			Cat16		Percentage Correct
			.00	1.00	
Step 1	Cat16	.00	232	0	100.0
		1.00	32	0	0.0
	Overall Percentage				87.9

a. The cut value is .500

Variables in the Equation



		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.517	.328	2.475	1	.116	1.676
	P2	.000	.215	.000	1	1.000	1.000
	P3	1.167	.500	5.441	1	.020	3.213
	P4	.617	.272	5.157	1	.023	1.853
	Sex	-.652	.416	2.454	1	.117	.521
	Age1	-.873	1.117	.611	1	.435	.418
	Age2	-.124	.654	.036	1	.850	.884
	Age3	-.002	.462	.000	1	.996	.998
	Length	.008	.011	.570	1	.450	1.008
	Dist	.000	.000	.032	1	.858	1.000
	Island	-1.412	1.071	1.739	1	.187	.244
	Constant	-2.198	.589	13.934	1	.000	.111

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

People (Cat17)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	18.747	11	.066
	Block	18.747	11	.066
	Model	18.747	11	.066

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	248.759[a]	.069	.108

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat17		Percentage Correct
			.00	1.00	
Step 1	Cat17	.00	209	1	99.5
		1.00	52	2	3.7
	Overall Percentage				79.9

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.128	.161	.630	1	.428	.880
	P2	.142	.183	.602	1	.438	1.152
	P3	-.087	.186	.217	1	.641	.917
	P4	.538	.210	6.567	1	.010	1.712
	Sex	.457	.344	1.769	1	.183	1.579
	Age1	-.109	.724	.023	1	.880	.897
	Age2	.877	.492	3.175	1	.075	2.403
	Age3	.036	.385	.009	1	.926	1.036
	Length	.013	.009	2.050	1	.152	1.013
	Dist	.000	.000	1.442	1	.230	1.000
	Island	1.052	.492	4.583	1	.032	2.865
	Constant	-2.624	.517	25.758	1	.000	.073

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Human activity (Cat18)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	18.044	11	.081
	Block	18.044	11	.081
	Model	18.044	11	.081

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	113.380[a]	.066	.168

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Classification Table[a]

Observed			Predicted		
			Cat18		Percentage Correct
			.00	1.00	
Step 1	Cat18	.00	246	0	100.0
		1.00	18	0	0.0
	Overall Percentage				93.2

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.000	.286	.000	1	1.000	1.000
	P2	.191	.306	.389	1	.533	1.210
	P3	-.315	.264	1.427	1	.232	.730
	P4	.325	.340	.912	1	.340	1.384
	Sex	1.061	.608	3.044	1	.081	2.889
	Age1	.788	.933	.713	1	.398	2.200
	Age2	-18.219	7011.707	.000	1	.998	.000
	Age3	-.156	.588	.071	1	.790	.855
	Length	.009	.014	.410	1	.522	1.009
	Dist	.000	.000	.047	1	.829	1.000
	Island	1.595	.640	6.208	1	.013	4.927
	Constant	-3.806	.847	20.193	1	.000	.022

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Recreation (Cat19)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	15.183	11	.174
	Block	15.183	11	.174
	Model	15.183	11	.174

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	310.346[a]	.056	.079

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat19		Percentage Correct
			.00	1.00	
Step 1	Cat19	.00	177	6	96.7
		1.00	76	5	6.2
	Overall Percentage				68.9

a. The cut value is .500

Variables in the Equation

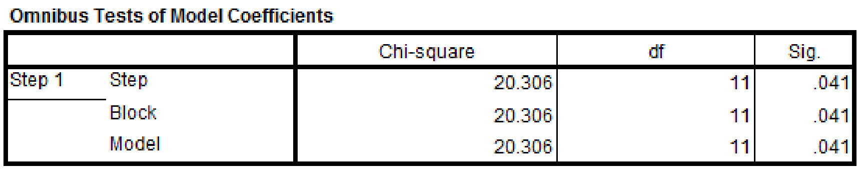
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.082	.172	.230	1	.632	1.086
	P2	.349	.165	4.450	1	.035	1.417
	P3	.216	.185	1.368	1	.242	1.241
	P4	.162	.169	.926	1	.336	1.176
	Sex	.259	.290	.797	1	.372	1.296
	Age1	-.044	.582	.006	1	.940	.957
	Age2	-.140	.463	.091	1	.762	.869
	Age3	-.313	.336	.870	1	.351	.731
	Length	.003	.008	.183	1	.669	1.003
	Dist	.000	.000	2.038	1	.153	1.000
	Island	-.342	.511	.448	1	.503	.710
	Constant	-1.226	.405	9.177	1	.002	.293

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Land recreation (Cat20)

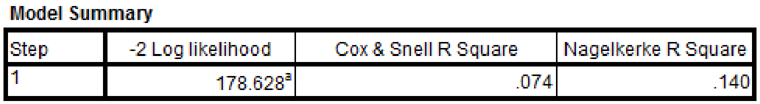
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

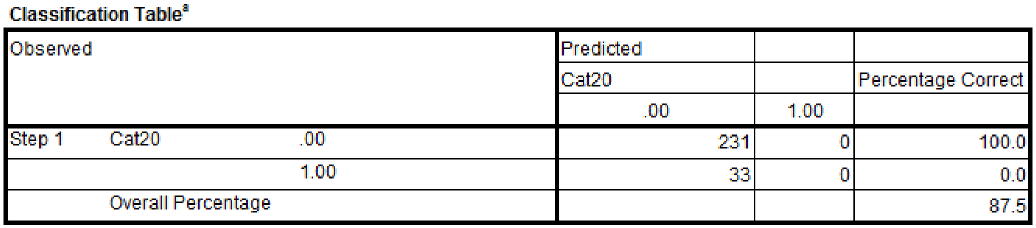
		Chi-square	df	Sig.
Step 1	Step	20.306	11	.041
	Block	20.306	11	.041
	Model	20.306	11	.041



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	178.628[a]	.074	.140

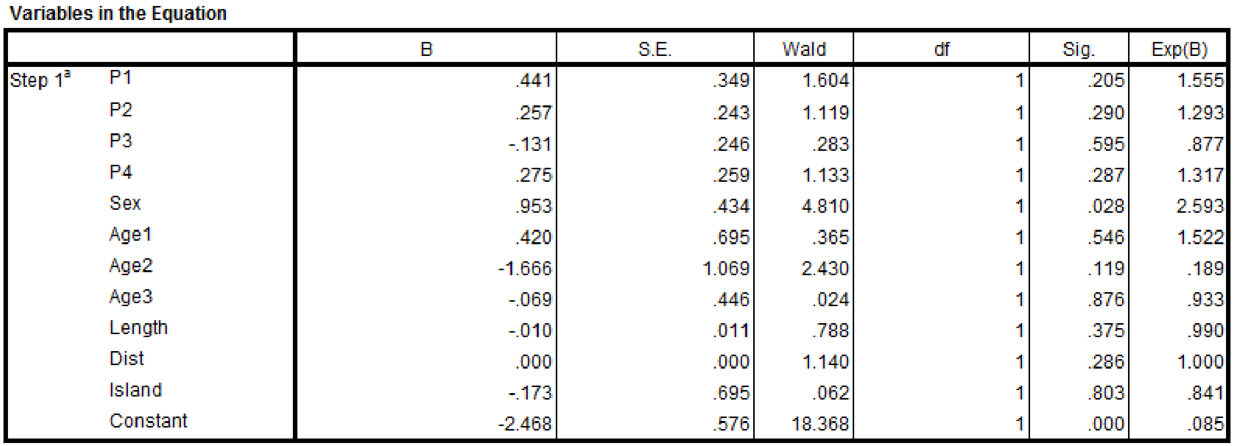
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat20		Percentage Correct
			.00	1.00	
Step 1	Cat20	.00	231	0	100.0
		1.00	33	0	0.0
	Overall Percentage				87.5

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.441	.349	1.604	1	.205	1.555
	P2	.257	.243	1.119	1	.290	1.293
	P3	-.131	.246	.283	1	.595	.877
	P4	.275	.259	1.133	1	.287	1.317
	Sex	.953	.434	4.810	1	.028	2.593
	Age1	.420	.695	.365	1	.546	1.522
	Age2	-1.666	1.069	2.430	1	.119	.189
	Age3	-.069	.446	.024	1	.876	.933
	Length	-.010	.011	.788	1	.375	.990
	Dist	.000	.000	1.140	1	.286	1.000
	Island	-.173	.695	.062	1	.803	.841
	Constant	-2.468	.576	18.368	1	.000	.085

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Ocean recreation (Cat21)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	21.905	11	.025
	Block	21.905	11	.025
	Model	21.905	11	.025

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	240.074[a]	.080	.127

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat21		Percentage Correct
			.00	1.00	
Step 1	Cat21	.00	212	0	100.0
		1.00	51	1	1.9
	Overall Percentage				80.7

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.184	.228	.657	1	.418	1.203
	P2	.223	.190	1.387	1	.239	1.250
	P3	.651	.285	5.216	1	.022	1.917
	P4	.028	.194	.022	1	.883	1.029
	Sex	.046	.343	.018	1	.893	1.047
	Age1	-.016	.730	.000	1	.983	.984
	Age2	.228	.529	.186	1	.667	1.256
	Age3	-.045	.396	.013	1	.909	.956
	Length	.020	.009	5.022	1	.025	1.020
	Dist	.000	.000	2.731	1	.098	1.000
	Island	-.313	.670	.218	1	.641	.731
	Constant	-2.623	.511	26.369	1	.000	.073

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Park structures (Cat22)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	11.417	11	.409
	Block	11.417	11	.409
	Model	11.417	11	.409

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	171.375[a]	.042	.085

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat22		Percentage Correct
			.00	1.00	
Step 1	Cat22	.00	235	0	100.0
		1.00	29	0	0.0
	Overall Percentage				89.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.099	.188	.277	1	.598	.906
	P2	.114	.245	.217	1	.641	1.121
	P3	-.071	.237	.091	1	.764	.931
	P4	.546	.276	3.917	1	.048	1.727
	Sex	.066	.438	.022	1	.881	1.068
	Age1	-.090	.854	.011	1	.916	.914
	Age2	-1.237	1.074	1.326	1	.250	.290
	Age3	.130	.459	.081	1	.777	1.139
	Length	.014	.011	1.532	1	.216	1.014
	Dist	.000	.000	1.408	1	.235	1.000
	Island	.190	.694	.075	1	.784	1.209
	Constant	-2.975	.619	23.110	1	.000	.051

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Development (Cat23)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	5.486	11	.905
	Block	5.486	11	.905
	Model	5.486	11	.905

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	250.775[a]	.021	.033

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat23		Percentage Correct
			.00	1.00	
Step 1	Cat23	.00	214	0	100.0
		1.00	50	0	0.0
	Overall Percentage				81.1

a. The cut value is .500

Variables in the Equation

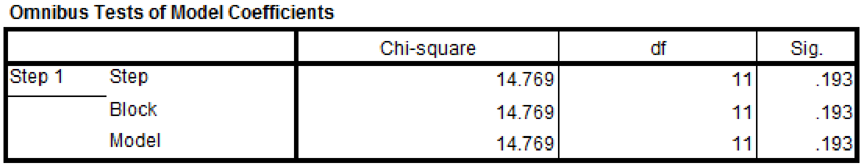
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.036	.165	.048	1	.827	.964
	P2	-.016	.175	.008	1	.928	.984
	P3	-.119	.173	.471	1	.493	.888
	P4	-.140	.186	.560	1	.454	.870
	Sex	-.064	.337	.036	1	.850	.938
	Age1	-.263	.698	.142	1	.706	.768
	Age2	-.587	.590	.989	1	.320	.556
	Age3	-.228	.386	.350	1	.554	.796
	Length	-.004	.009	.175	1	.676	.996
	Dist	.000	.000	.302	1	.583	1.000
	Island	.657	.473	1.926	1	.165	1.928
	Constant	-1.372	.456	9.069	1	.003	.254

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Tranquility (Cat24)

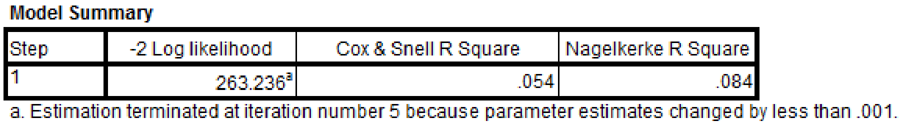
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

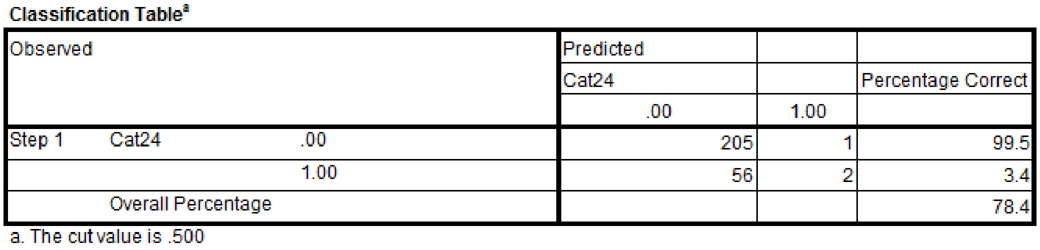
		Chi-square	df	Sig.
Step 1	Step	14.769	11	.193
	Block	14.769	11	.193
	Model	14.769	11	.193



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	263.236[a]	.054	.084

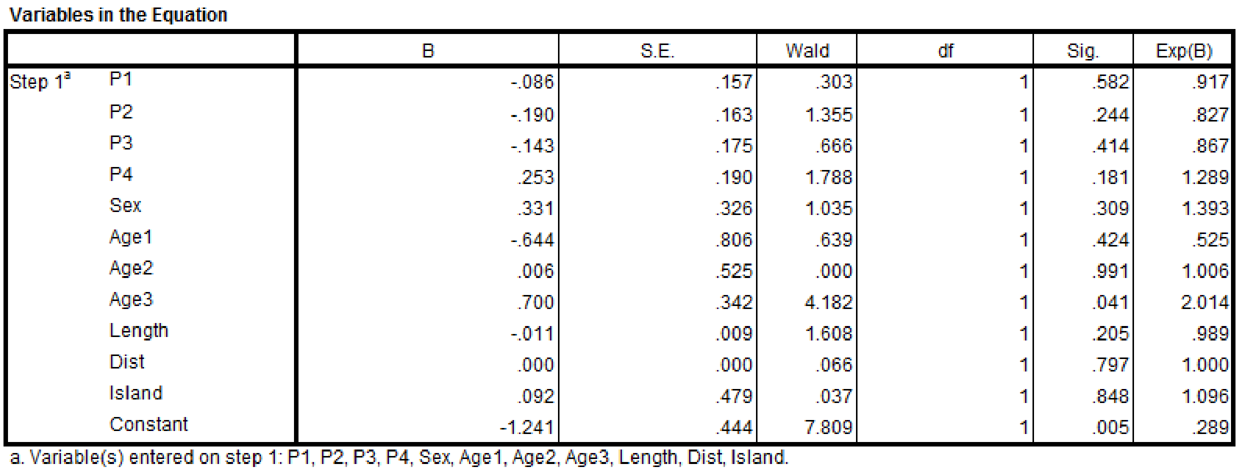
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat24		Percentage Correct
			.00	1.00	
Step 1	Cat24	.00	205	1	99.5
		1.00	56	2	3.4
	Overall Percentage				78.4

a. The cut value is .500



Variables in the Equation

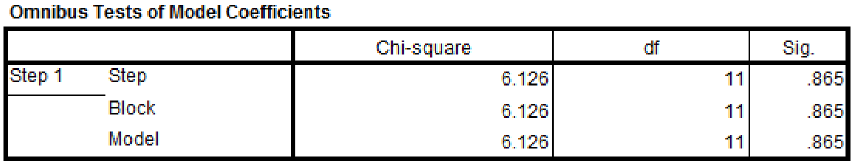
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.086	.157	.303	1	.582	.917
	P2	-.190	.163	1.355	1	.244	.827
	P3	-.143	.175	.666	1	.414	.867
	P4	.253	.190	1.788	1	.181	1.289
	Sex	.331	.326	1.035	1	.309	1.393
	Age1	-.644	.806	.639	1	.424	.525
	Age2	.006	.525	.000	1	.991	1.006
	Age3	.700	.342	4.182	1	.041	2.014
	Length	-.011	.009	1.608	1	.205	.989
	Dist	.000	.000	.066	1	.797	1.000
	Island	.092	.479	.037	1	.848	1.096
	Constant	-1.241	.444	7.809	1	.005	.289

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Environmental quality (Cat25)

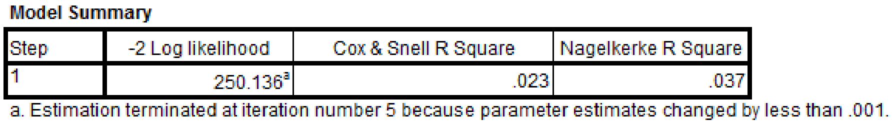
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

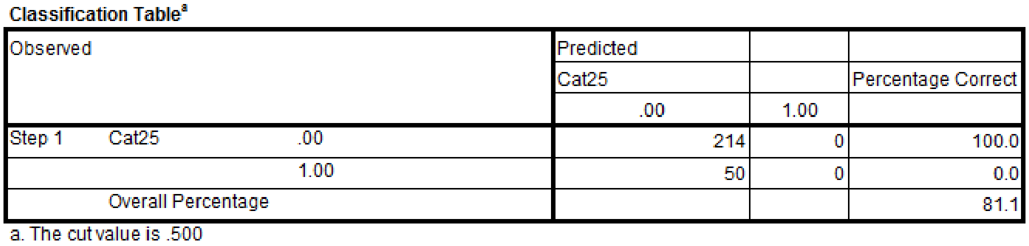
		Chi-square	df	Sig.
Step 1	Step	6.126	11	.865
	Block	6.126	11	.865
	Model	6.126	11	.865



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	250.136[a]	.023	.037

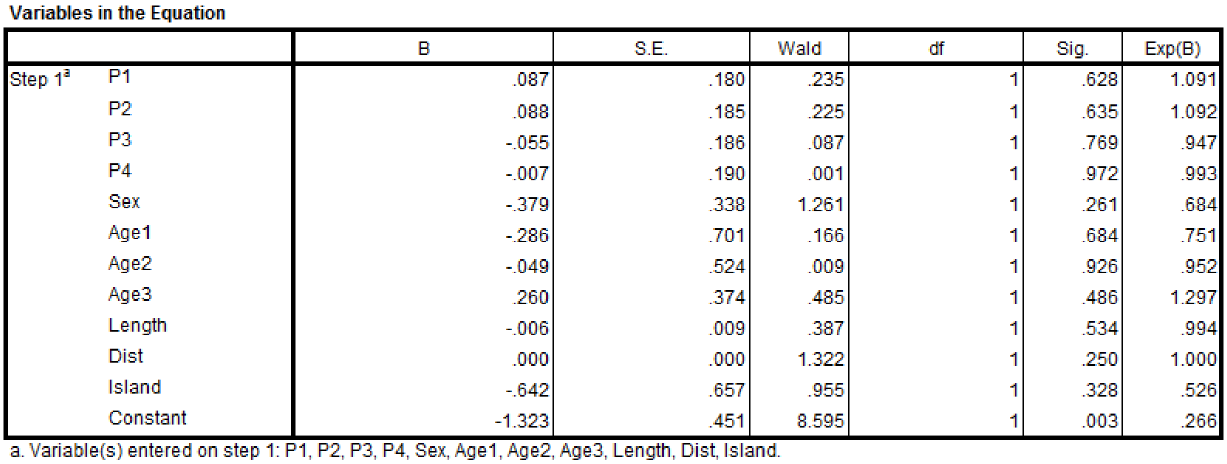
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat25		Percentage Correct
			.00	1.00	
Step 1	Cat25	.00	214	0	100.0
		1.00	50	0	0.0
	Overall Percentage				81.1

a. The cut value is .500



Variables in the Equation

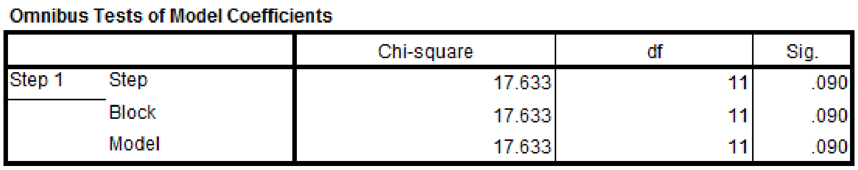
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.087	.180	.235	1	.628	1.091
	P2	.088	.185	.225	1	.635	1.092
	P3	-.055	.186	.087	1	.769	.947
	P4	-.007	.190	.001	1	.972	.993
	Sex	-.379	.338	1.261	1	.261	.684
	Age1	-.286	.701	.166	1	.684	.751
	Age2	-.049	.524	.009	1	.926	.952
	Age3	.260	.374	.485	1	.486	1.297
	Length	-.006	.009	.387	1	.534	.994
	Dist	.000	.000	1.322	1	.250	1.000
	Island	-.642	.657	.955	1	.328	.526
	Constant	-1.323	.451	8.595	1	.003	.266

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Intertidal area (Cat26)

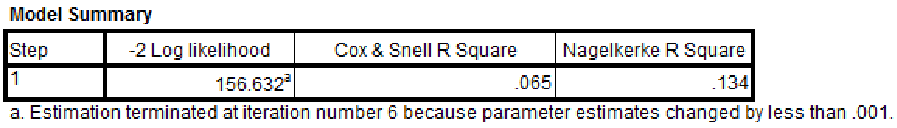
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

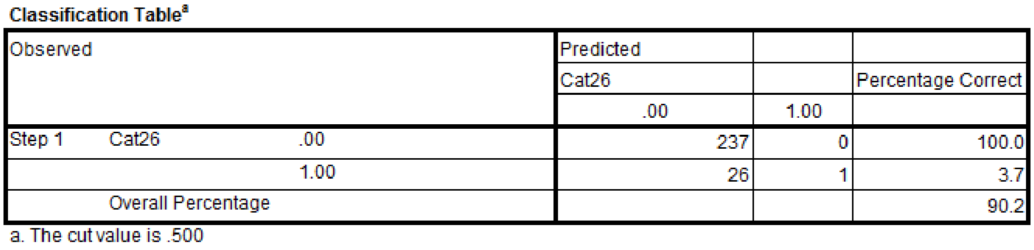
		Chi-square	df	Sig.
Step 1	Step	17.633	11	.090
	Block	17.633	11	.090
	Model	17.633	11	.090



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	156.632[a]	.065	.134

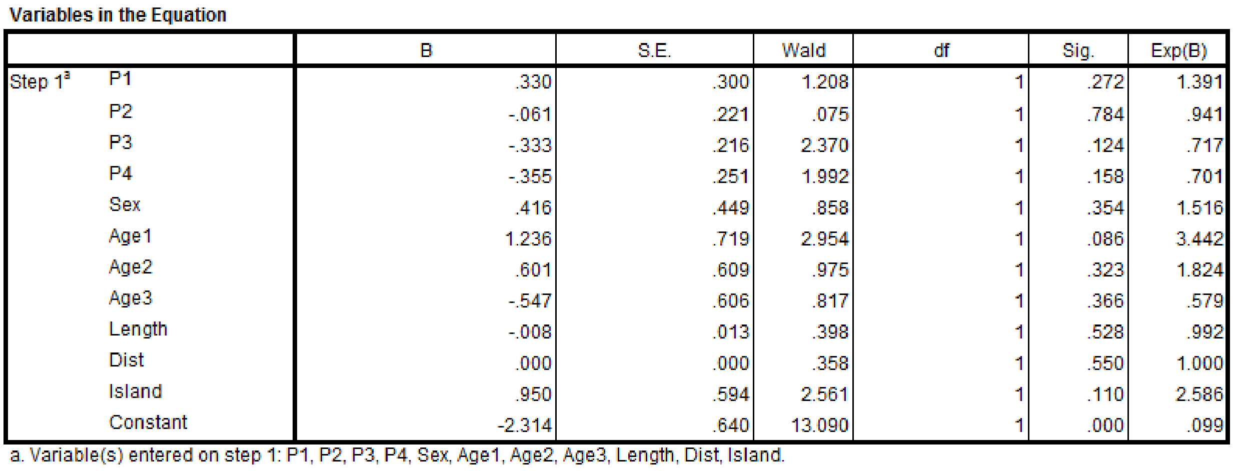
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat26		Percentage Correct
			.00	1.00	
Step 1	Cat26	.00	237	0	100.0
		1.00	26	1	3.7
	Overall Percentage				90.2

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.330	.300	1.208	1	.272	1.391
	P2	-.061	.221	.075	1	.784	.941
	P3	-.333	.216	2.370	1	.124	.717
	P4	-.355	.251	1.992	1	.158	.701
	Sex	.416	.449	.858	1	.354	1.516
	Age1	1.236	.719	2.954	1	.086	3.442
	Age2	.601	.609	.975	1	.323	1.824
	Age3	-.547	.606	.817	1	.366	.579
	Length	-.008	.013	.398	1	.528	.992
	Dist	.000	.000	.358	1	.550	1.000
	Island	.950	.594	2.561	1	.110	2.586
	Constant	-2.314	.640	13.090	1	.000	.099

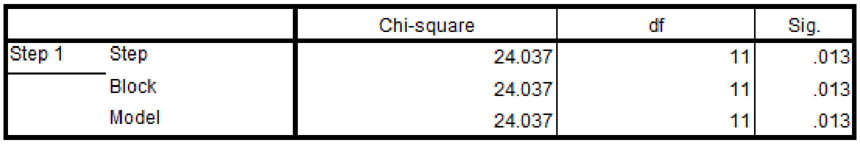
a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Beach textures (Cat27)

Sense of place variables (P)

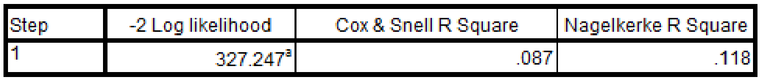
- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients



		Chi-square	df	Sig.
Step 1	Step	24.037	11	.013
	Block	24.037	11	.013
	Model	24.037	11	.013

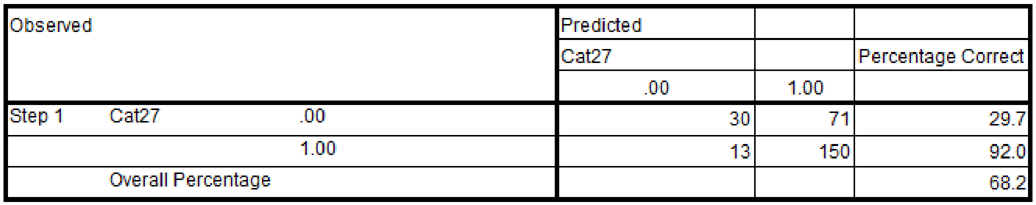
Model Summary



Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	327.247[a]	.087	.118

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

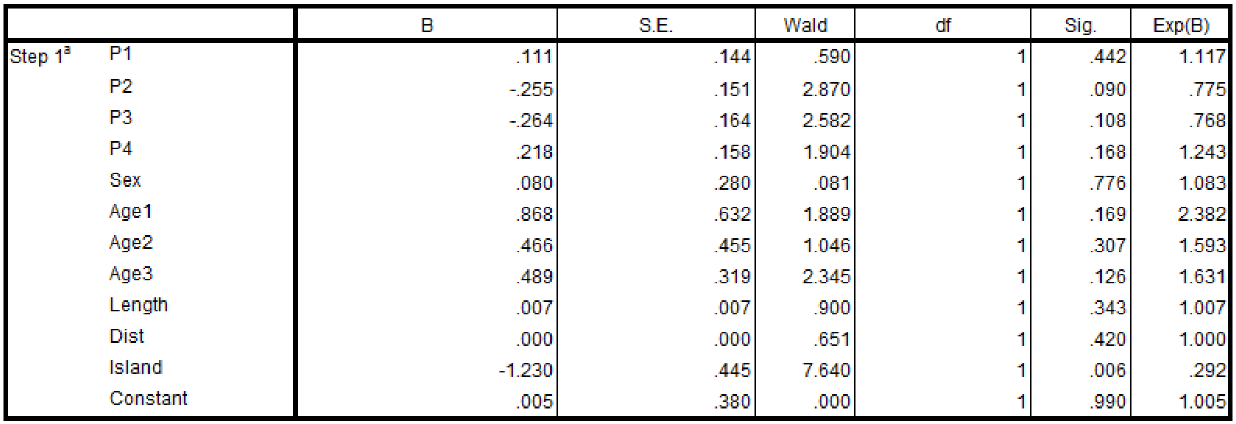
Classification Table[a]



Observed			Predicted		
			Cat27		Percentage Correct
			.00	1.00	
Step 1	Cat27	.00	30	71	29.7
		1.00	13	150	92.0
	Overall Percentage				68.2

a. The cut value is .500

Variables in the Equation



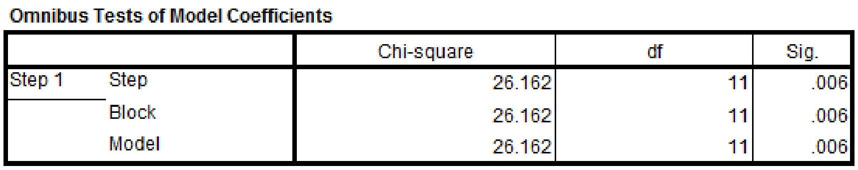
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.111	.144	.590	1	.442	1.117
	P2	-.255	.151	2.870	1	.090	.775
	P3	-.264	.164	2.582	1	.108	.768
	P4	.218	.158	1.904	1	.168	1.243
	Sex	.080	.280	.081	1	.776	1.083
	Age1	.868	.632	1.889	1	.169	2.382
	Age2	.466	.455	1.046	1	.307	1.593
	Age3	.489	.319	2.345	1	.126	1.631
	Length	.007	.007	.900	1	.343	1.007
	Dist	.000	.000	.651	1	.420	1.000
	Island	-1.230	.445	7.640	1	.006	.292
	Constant	.005	.380	.000	1	.990	1.005

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Woody debris (Cat28)

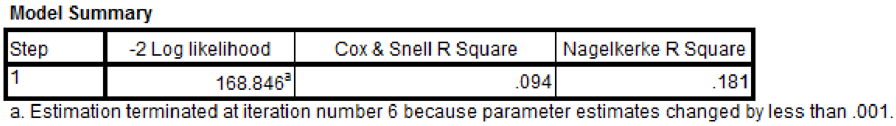
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

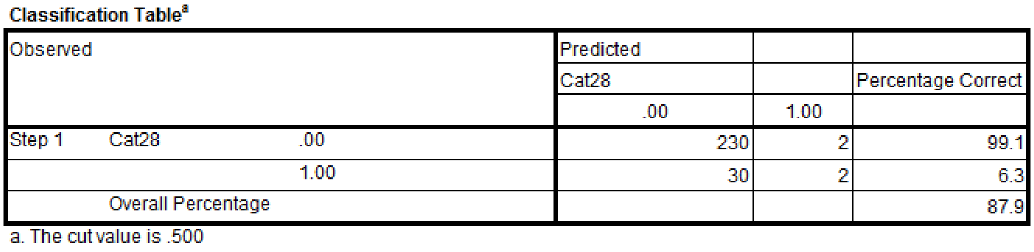
		Chi-square	df	Sig.
Step 1	Step	26.162	11	.006
	Block	26.162	11	.006
	Model	26.162	11	.006



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	168.846[a]	.094	.181

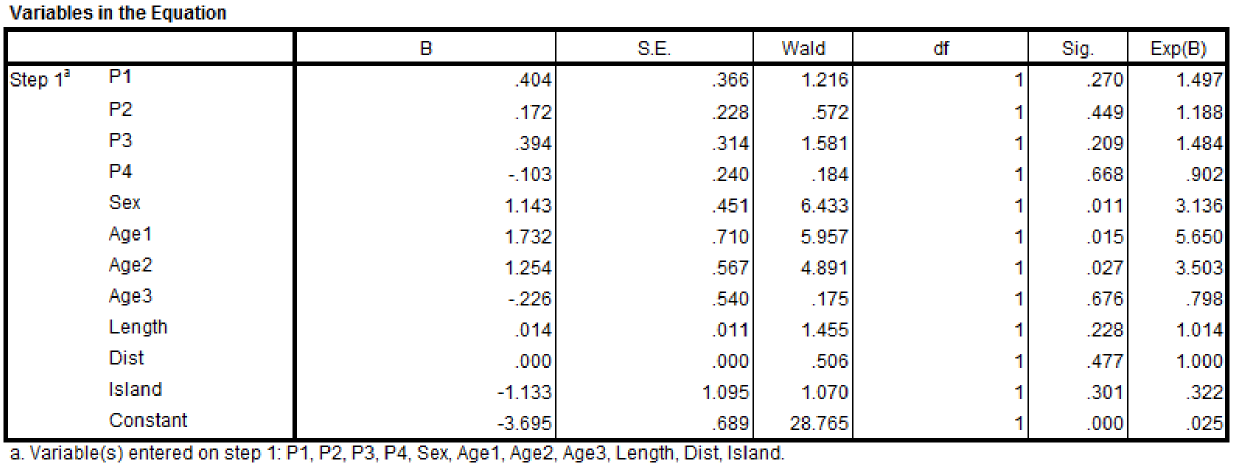
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat28		Percentage Correct
			.00	1.00	
Step 1	Cat28	.00	230	2	99.1
		1.00	30	2	6.3
	Overall Percentage				87.9

a. The cut value is .500



Variables in the Equation

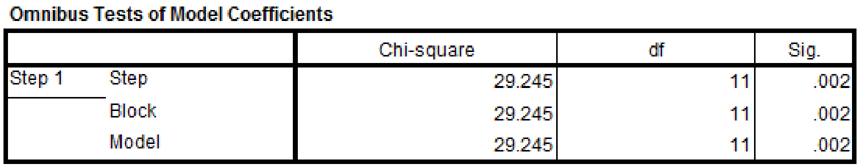
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.404	.366	1.216	1	.270	1.497
	P2	.172	.228	.572	1	.449	1.188
	P3	.394	.314	1.581	1	.209	1.484
	P4	-.103	.240	.184	1	.668	.902
	Sex	1.143	.451	6.433	1	.011	3.136
	Age1	1.732	.710	5.957	1	.015	5.650
	Age2	1.254	.567	4.891	1	.027	3.503
	Age3	-.226	.540	.175	1	.676	.798
	Length	.014	.011	1.455	1	.228	1.014
	Dist	.000	.000	.506	1	.477	1.000
	Island	-1.133	1.095	1.070	1	.301	.322
	Constant	-3.695	.689	28.765	1	.000	.025

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Algae (Cat29)

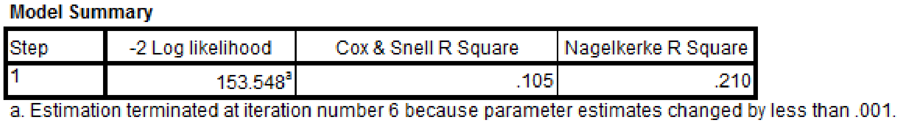
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

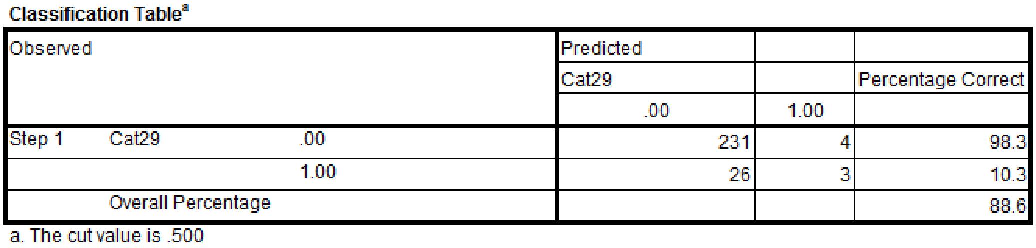
		Chi-square	df	Sig.
Step 1	Step	29.245	11	.002
	Block	29.245	11	.002
	Model	29.245	11	.002



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	153.548[a]	.105	.210

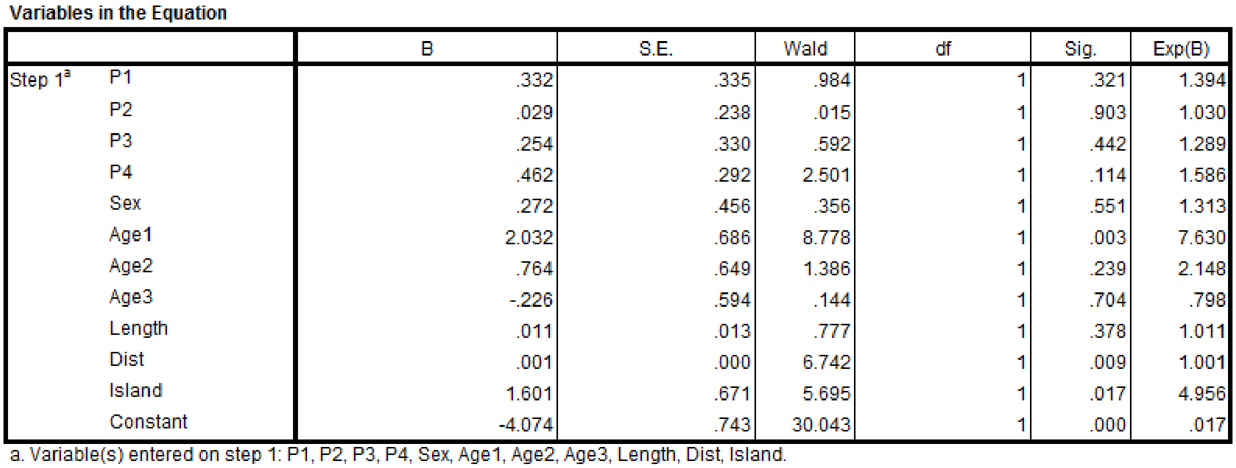
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat29		Percentage Correct
			.00	1.00	
Step 1	Cat29	.00	231	4	98.3
		1.00	26	3	10.3
	Overall Percentage				88.6

a. The cut value is .500



Variables in the Equation

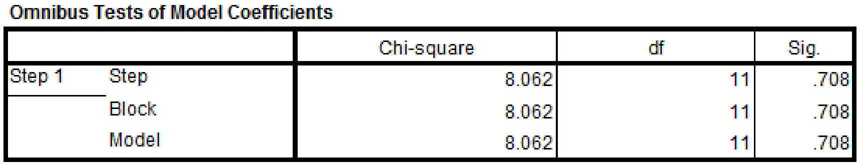
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.332	.335	.984	1	.321	1.394
	P2	.029	.238	.015	1	.903	1.030
	P3	.254	.330	.592	1	.442	1.289
	P4	.462	.292	2.501	1	.114	1.586
	Sex	.272	.456	.356	1	.551	1.313
	Age1	2.032	.686	8.778	1	.003	7.630
	Age2	.764	.649	1.386	1	.239	2.148
	Age3	-.226	.594	.144	1	.704	.798
	Length	.011	.013	.777	1	.378	1.011
	Dist	.001	.000	6.742	1	.009	1.001
	Island	1.601	.671	5.695	1	.017	4.956
	Constant	-4.074	.743	30.043	1	.000	.017

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Dynamics (Cat30)

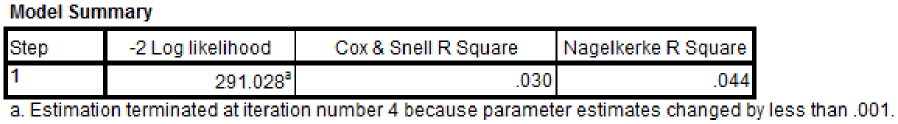
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

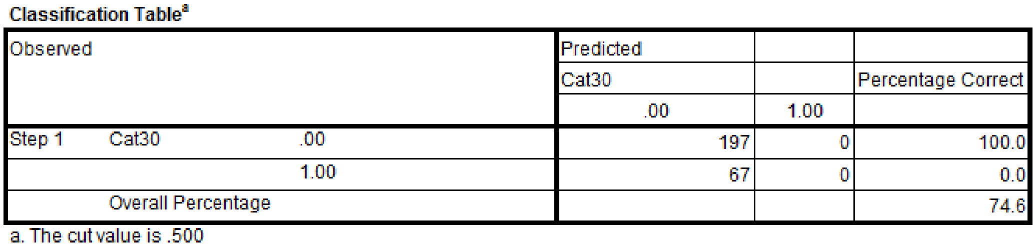
		Chi-square	df	Sig.
Step 1	Step	8.062	11	.708
	Block	8.062	11	.708
	Model	8.062	11	.708



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	291.028[a]	.030	.044

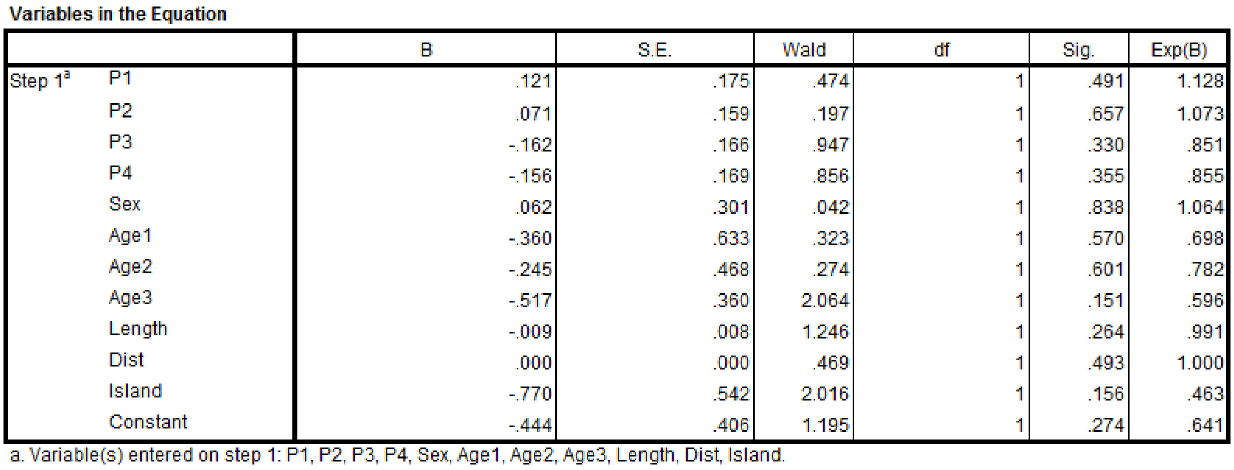
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat30		Percentage Correct
			.00	1.00	
Step 1	Cat30	.00	197	0	100.0
		1.00	67	0	0.0
	Overall Percentage				74.6

a. The cut value is .500



Variables in the Equation

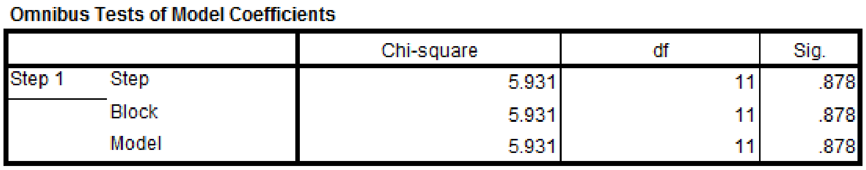
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.121	.175	.474	1	.491	1.128
	P2	.071	.159	.197	1	.657	1.073
	P3	-.162	.166	.947	1	.330	.851
	P4	-.156	.169	.856	1	.355	.855
	Sex	.062	.301	.042	1	.838	1.064
	Age1	-.360	.633	.323	1	.570	.698
	Age2	-.245	.468	.274	1	.601	.782
	Age3	-.517	.360	2.064	1	.151	.596
	Length	-.009	.008	1.246	1	.264	.991
	Dist	.000	.000	.469	1	.493	1.000
	Island	-.770	.542	2.016	1	.156	.463
	Constant	-.444	.406	1.195	1	.274	.641

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Non-visual senses (Cat31)

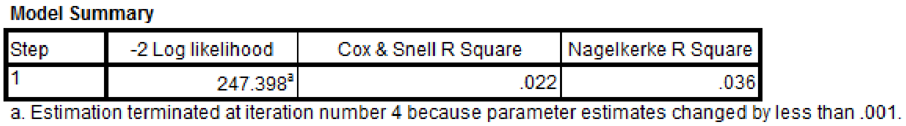
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

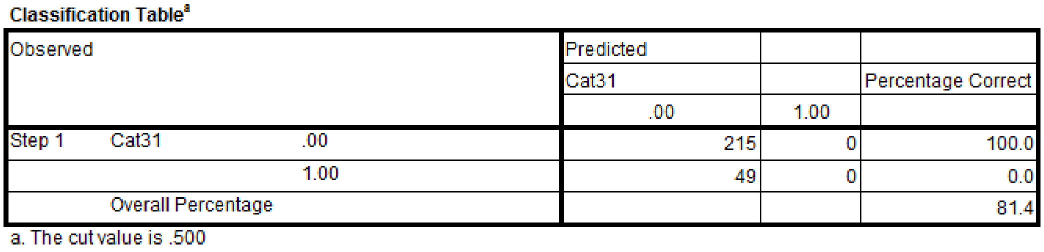
		Chi-square	df	Sig.
Step 1	Step	5.931	11	.878
	Block	5.931	11	.878
	Model	5.931	11	.878



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	247.398[a]	.022	.036

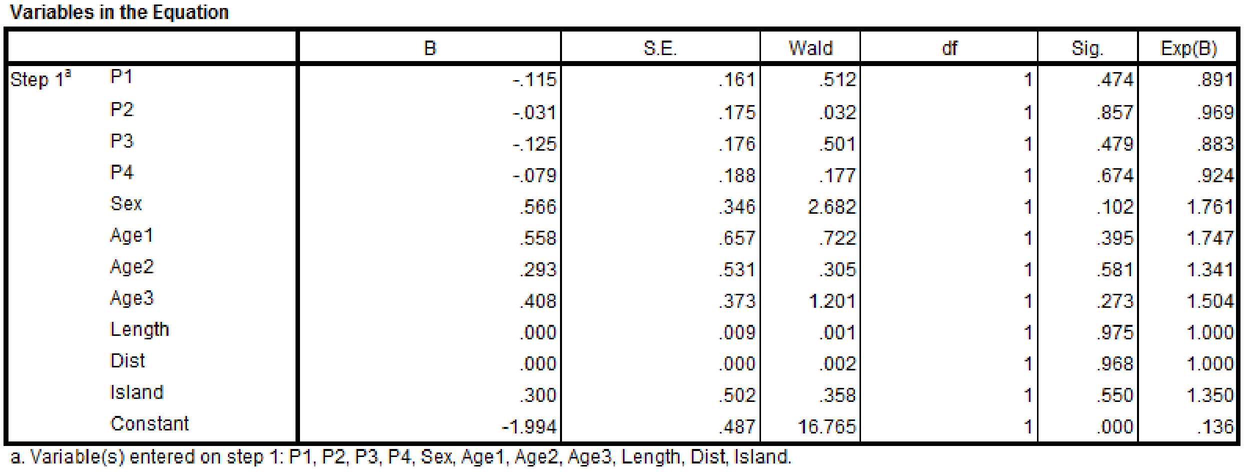
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat31		Percentage Correct
			.00	1.00	
Step 1	Cat31	.00	215	0	100.0
		1.00	49	0	0.0
	Overall Percentage				81.4

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.115	.161	.512	1	.474	.891
	P2	-.031	.175	.032	1	.857	.969
	P3	-.125	.176	.501	1	.479	.883
	P4	-.079	.188	.177	1	.674	.924
	Sex	.566	.346	2.682	1	.102	1.761
	Age1	.558	.657	.722	1	.395	1.747
	Age2	.293	.531	.305	1	.581	1.341
	Age3	.408	.373	1.201	1	.273	1.504
	Length	.000	.009	.001	1	.975	1.000
	Dist	.000	.000	.002	1	.968	1.000
	Island	.300	.502	.358	1	.550	1.350
	Constant	-1.994	.487	16.765	1	.000	.136

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Temperature (Cat32)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	28.165	11	.003
	Block	28.165	11	.003
	Model	28.165	11	.003

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	63.287[a]	.101	.346

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Classification Table[a]

Observed			Predicted		
			Cat32		Percentage Correct
			.00	1.00	
Step 1	Cat32	.00	251	2	99.2
		1.00	10	1	9.1
	Overall Percentage				95.5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.796	.273	8.478	1	.004	.451
	P2	-.340	.355	.918	1	.338	.712
	P3	-.707	.326	4.701	1	.030	.493
	P4	-.582	.374	2.421	1	.120	.559
	Sex	1.089	.775	1.974	1	.160	2.972
	Age1	.066	1.260	.003	1	.958	1.069
	Age2	-.745	1.261	.349	1	.555	.475
	Age3	-.829	.942	.775	1	.379	.436
	Length	-.053	.026	4.174	1	.041	.948
	Dist	.000	.000	.704	1	.402	1.000
	Island	-19.276	6648.460	.000	1	.998	.000
	Constant	-1.977	1.004	3.879	1	.049	.138

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Temperature (Cat33)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	6.697	11	.823
	Block	6.697	11	.823
	Model	6.697	11	.823

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	134.957[a]	.025	.060

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat33		Percentage Correct
			.00	1.00	
Step 1	Cat33	.00	244	0	100.0
		1.00	20	0	0.0
	Overall Percentage				92.4

a. The cut value is .500

Variables in the Equation

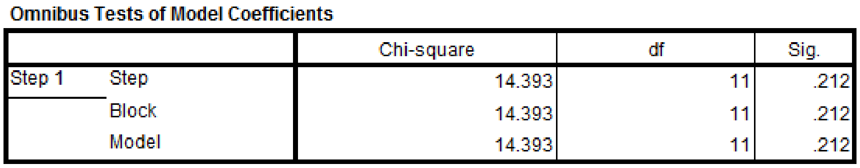
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.049	.298	.027	1	.869	1.050
	P2	.604	.342	3.116	1	.078	1.830
	P3	-.152	.257	.351	1	.554	.859
	P4	-.034	.288	.014	1	.907	.967
	Sex	.280	.506	.306	1	.580	1.323
	Age1	.366	.888	.170	1	.680	1.443
	Age2	-.051	.829	.004	1	.951	.950
	Age3	-.387	.614	.397	1	.529	.679
	Length	.005	.013	.123	1	.726	1.005
	Dist	.000	.000	.385	1	.535	1.000
	Island	.778	.737	1.116	1	.291	2.177
	Constant	-3.163	.729	18.808	1	.000	.042

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagine oneself in the image (Pic1)

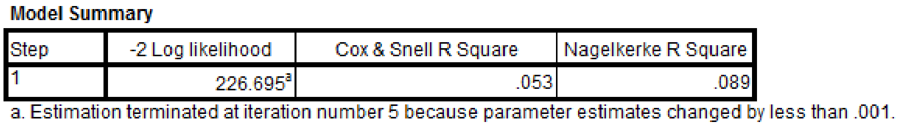
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

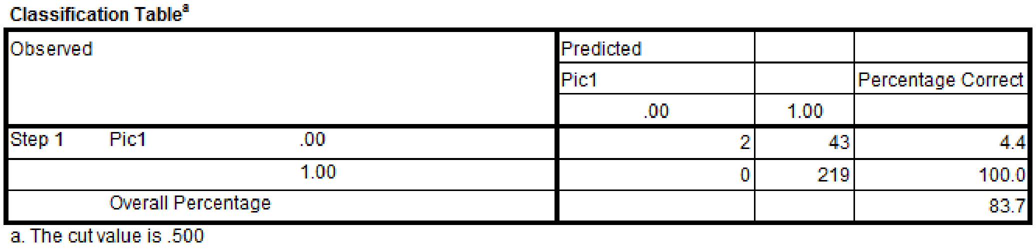
		Chi-square	df	Sig.
Step 1	Step	14.393	11	.212
	Block	14.393	11	.212
	Model	14.393	11	.212



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	226.695[a]	.053	.089

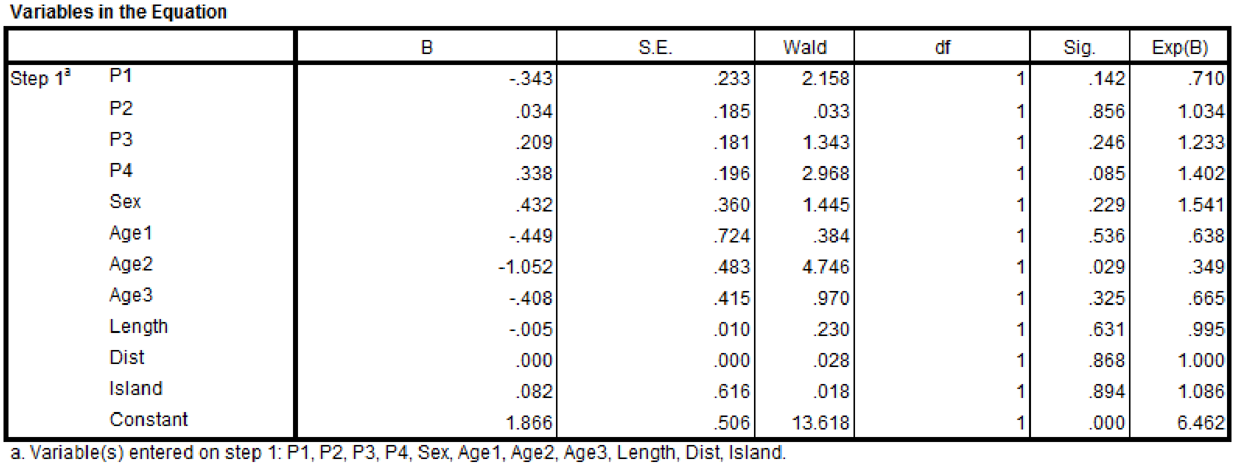
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Pic1		Percentage Correct
			.00	1.00	
Step 1	Pic1	.00	2	43	4.4
		1.00	0	219	100.0
	Overall Percentage				83.7

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.343	.233	2.158	1	.142	.710
	P2	.034	.185	.033	1	.856	1.034
	P3	.209	.181	1.343	1	.246	1.233
	P4	.338	.196	2.968	1	.085	1.402
	Sex	.432	.360	1.445	1	.229	1.541
	Age1	-.449	.724	.384	1	.536	.638
	Age2	-1.052	.483	4.746	1	.029	.349
	Age3	-.408	.415	.970	1	.325	.665
	Length	-.005	.010	.230	1	.631	.995
	Dist	.000	.000	.028	1	.868	1.000
	Island	.082	.616	.018	1	.894	1.086
	Constant	1.866	.506	13.618	1	.000	6.462

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagine oneself on private property (Pic2)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	34.489	11	.000
	Block	34.489	11	.000
	Model	34.489	11	.000

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	74.988[a]	.122	.361

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Classification Table[a]

Observed			Predicted		
			Pic2		Percentage Correct
			.00	1.00	
Step 1	Pic2	.00	249	1	99.6
		1.00	12	2	14.3
	Overall Percentage				95.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.817	.244	11.239	1	.001	.442
	P2	-.137	.273	.251	1	.616	.872
	P3	.157	.348	.203	1	.653	1.170
	P4	-.426	.341	1.562	1	.211	.653
	Sex	1.168	.707	2.724	1	.099	3.214
	Age1	-17.424	8858.442	.000	1	.998	.000
	Age2	-18.044	6474.266	.000	1	.998	.000
	Age3	-1.259	.835	2.272	1	.132	.284
	Length	-.029	.019	2.190	1	.139	.972
	Dist	-.001	.001	4.567	1	.033	.999
	Island	.122	.731	.028	1	.868	1.130
	Constant	-1.545	.890	3.015	1	.082	.213

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagine oneself on a boat (Pic3)

Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	21.520	11	.028
	Block	21.520	11	.028
	Model	21.520	11	.028

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	125.084[a]	.078	.184

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Classification Table[a]

Observed			Predicted		
			Pic3		Percentage Correct
			.00	1.00	
Step 1	Pic3	.00	243	0	100.0
		1.00	20	1	4.8
	Overall Percentage				92.4

a. The cut value is .500

Variables in the Equation

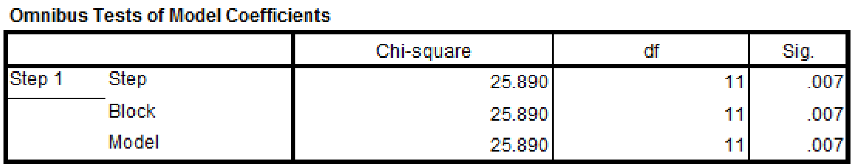
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	-.340	.225	2.276	1	.131	.712
	P2	.180	.305	.347	1	.556	1.197
	P3	.053	.308	.029	1	.864	1.054
	P4	.893	.360	6.168	1	.013	2.443
	Sex	-.559	.525	1.132	1	.287	.572
	Age1	.802	.914	.770	1	.380	2.231
	Age2	-18.084	6986.099	.000	1	.998	.000
	Age3	.661	.527	1.577	1	.209	1.937
	Length	.011	.013	.689	1	.406	1.011
	Dist	.000	.000	1.178	1	.278	1.000
	Island	-.277	.834	.111	1	.740	.758
	Constant	-2.681	.711	14.239	1	.000	.068

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagining perspective as looking toward ocean (Pic4)

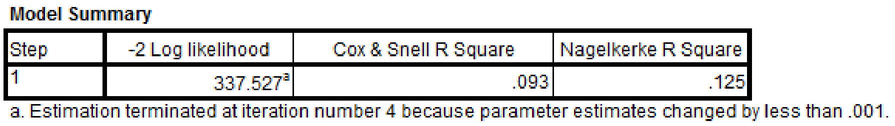
Sense of place variables (P)

- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)



Omnibus Tests of Model Coefficients

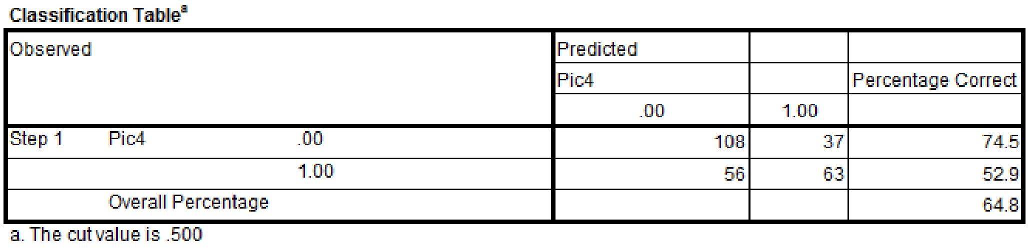
		Chi-square	df	Sig.
Step 1	Step	25.890	11	.007
	Block	25.890	11	.007
	Model	25.890	11	.007



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	337.527[a]	.093	.125

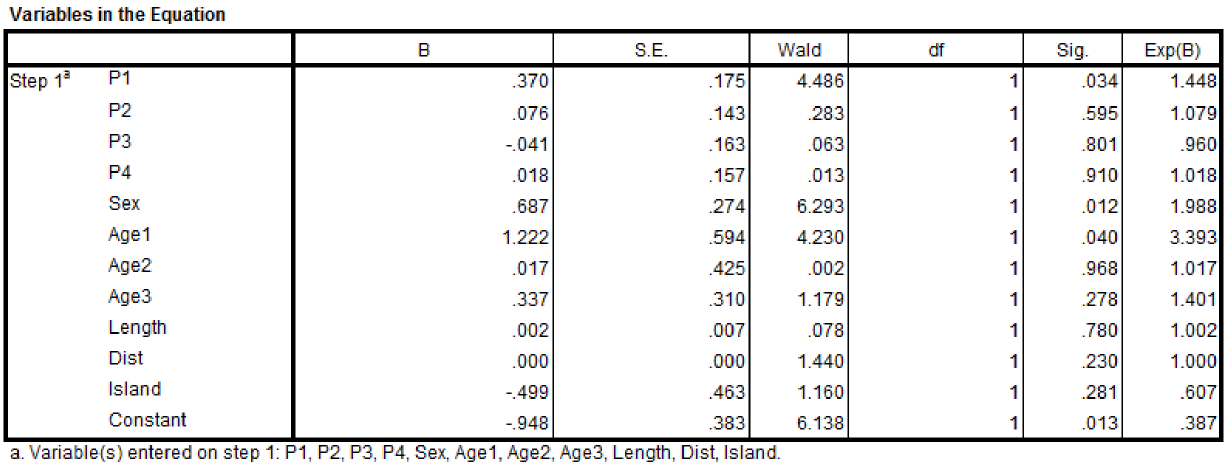
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Pic4		Percentage Correct
			.00	1.00	
Step 1	Pic4	.00	108	37	74.5
		1.00	56	63	52.9
	Overall Percentage				64.8

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.370	.175	4.486	1	.034	1.448
	P2	.076	.143	.283	1	.595	1.079
	P3	-.041	.163	.063	1	.801	.960
	P4	.018	.157	.013	1	.910	1.018
	Sex	.687	.274	6.293	1	.012	1.988
	Age1	1.222	.594	4.230	1	.040	3.393
	Age2	.017	.425	.002	1	.968	1.017
	Age3	.337	.310	1.179	1	.278	1.401
	Length	.002	.007	.078	1	.780	1.002
	Dist	.000	.000	1.440	1	.230	1.000
	Island	-.499	.463	1.160	1	.281	.607
	Constant	-.948	.383	6.138	1	.013	.387

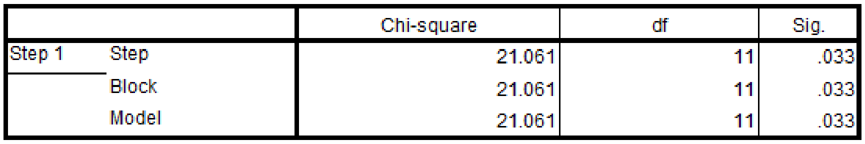
a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagining a specific real-world place (Real)

Sense of place variables (P)

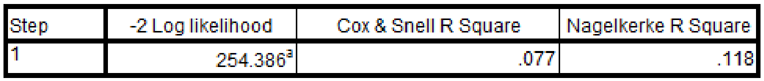
- Nature protection values (P1)
- Community and economic well-being values (P2)
- Place identity (P3)
- Place dependence (P4)

Omnibus Tests of Model Coefficients



		Chi-square	df	Sig.
Step 1	Step	21.061	11	.033
	Block	21.061	11	.033
	Model	21.061	11	.033

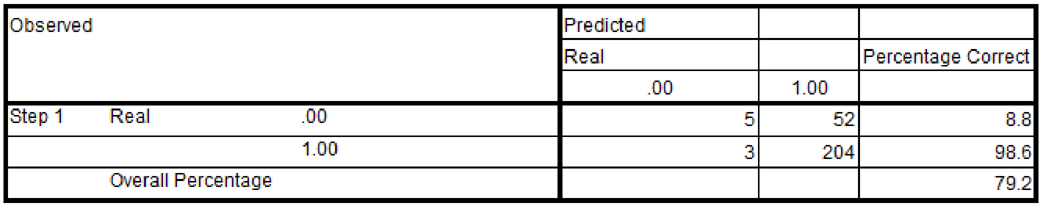
Model Summary



Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	254.386[a]	.077	.118

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

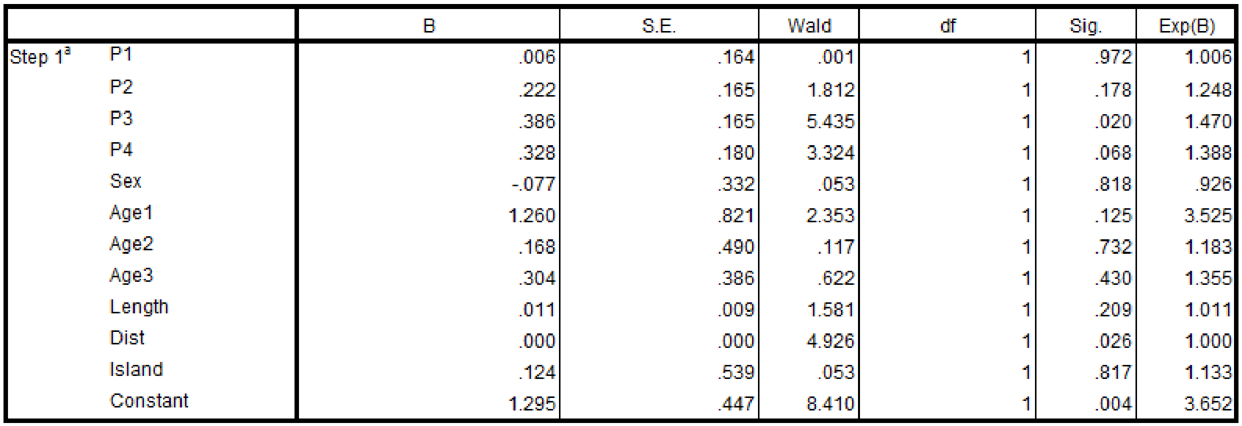
Classification Table[a]



Observed			Predicted		
			Real		Percentage Correct
			.00	1.00	
Step 1	Real	.00	5	52	8.8
		1.00	3	204	98.6
	Overall Percentage				79.2

a. The cut value is .500

Variables in the Equation



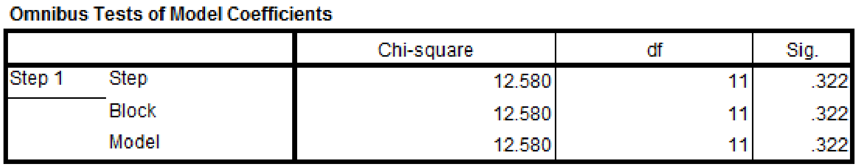
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	P1	.006	.164	.001	1	.972	1.006
	P2	.222	.165	1.812	1	.178	1.248
	P3	.386	.165	5.435	1	.020	1.470
	P4	.328	.180	3.324	1	.068	1.388
	Sex	-.077	.332	.053	1	.818	.926
	Age1	1.260	.821	2.353	1	.125	3.525
	Age2	.168	.490	.117	1	.732	1.183
	Age3	.304	.386	.622	1	.430	1.355
	Length	.011	.009	1.581	1	.209	1.011
	Dist	.000	.000	4.926	1	.026	1.000
	Island	.124	.539	.053	1	.817	1.133
	Constant	1.295	.447	8.410	1	.004	3.652

a. Variable(s) entered on step 1: P1, P2, P3, P4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Ocean surface (Cat1)

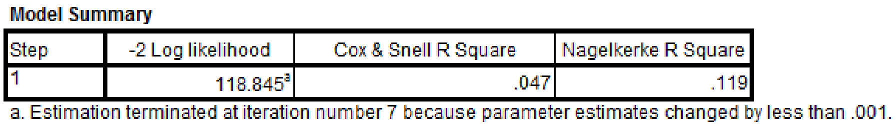
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

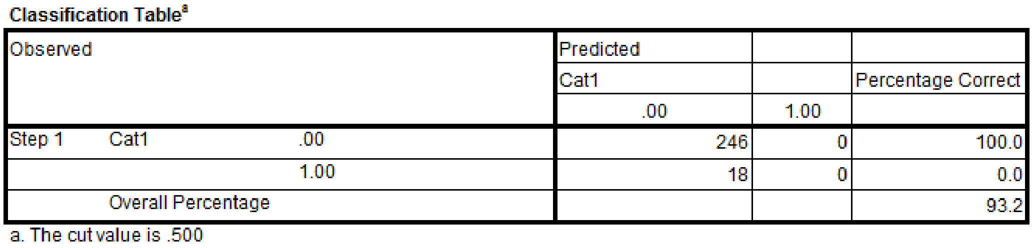
		Chi-square	df	Sig.
Step 1	Step	12.580	11	.322
	Block	12.580	11	.322
	Model	12.580	11	.322



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	118.845[a]	.047	.119

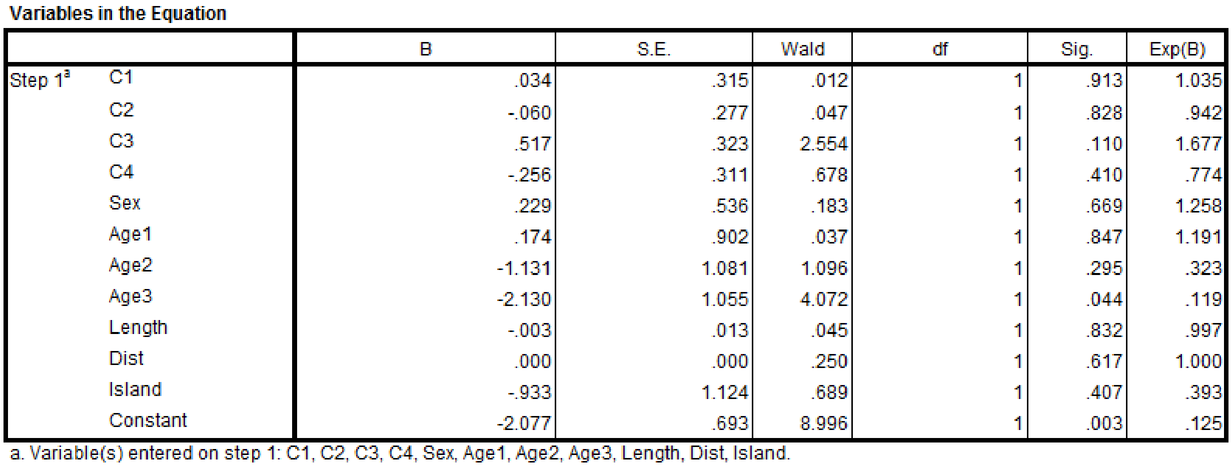
a. Estimation terminated at iteration number 7 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat1		Percentage Correct
			.00	1.00	
Step 1	Cat1	.00	246	0	100.0
		1.00	18	0	0.0
	Overall Percentage				93.2

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.034	.315	.012	1	.913	1.035
	C2	-.060	.277	.047	1	.828	.942
	C3	.517	.323	2.554	1	.110	1.677
	C4	-.256	.311	.678	1	.410	.774
	Sex	.229	.536	.183	1	.669	1.258
	Age1	.174	.902	.037	1	.847	1.191
	Age2	-1.131	1.081	1.096	1	.295	.323
	Age3	-2.130	1.055	4.072	1	.044	.119
	Length	-.003	.013	.045	1	.832	.997
	Dist	.000	.000	.250	1	.617	1.000
	Island	-.933	1.124	.689	1	.407	.393
	Constant	-2.077	.693	8.996	1	.003	.125

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Viewshed (Cat2)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	9.861	11	.543
	Block	9.861	11	.543
	Model	9.861	11	.543

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	350.036[a]	.037	.049

a. Estimation terminated at iteration number 3 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat2		Percentage Correct
			.00	1.00	
Step 1	Cat2	.00	134	18	88.2
		1.00	81	31	27.7
	Overall Percentage				62.5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.025	.147	.029	1	.864	.975
	C2	.077	.144	.284	1	.594	1.080
	C3	-.116	.151	.595	1	.441	.890
	C4	-.273	.162	2.856	1	.091	.761
	Sex	.127	.277	.211	1	.646	1.136
	Age1	.265	.558	.225	1	.635	1.303
	Age2	-.570	.438	1.691	1	.193	.566
	Age3	-.303	.307	.970	1	.325	.739
	Length	-.004	.007	.244	1	.621	.996
	Dist	.000	.000	1.868	1	.172	1.000
	Island	-.563	.439	1.647	1	.199	.570
	Constant	.159	.367	.188	1	.665	1.172

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Sky (Cat3)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	9.856	11	.543
	Block	9.856	11	.543
	Model	9.856	11	.543

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	181.154[a]	.037	.071

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat3		Percentage Correct
			.00	1.00	
Step 1	Cat3	.00	233	0	100.0
		1.00	31	0	0.0
	Overall Percentage				88.3

a. The cut value is .500

Variables in the Equation

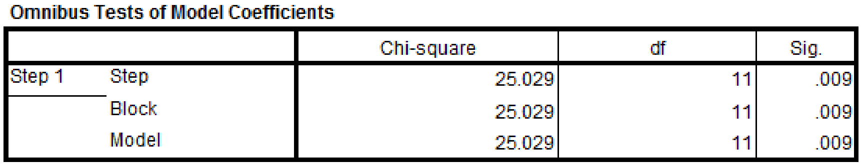
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.115	.225	.261	1	.610	1.122
	C2	-.349	.240	2.112	1	.146	.705
	C3	.210	.237	.783	1	.376	1.233
	C4	-.441	.243	3.294	1	.070	.644
	Sex	.130	.418	.097	1	.755	1.139
	Age1	-1.177	1.106	1.132	1	.287	.308
	Age2	-.139	.618	.051	1	.822	.870
	Age3	-.892	.532	2.809	1	.094	.410
	Length	.003	.011	.054	1	.816	1.003
	Dist	.000	.000	.054	1	.816	1.000
	Island	-.039	.638	.004	1	.952	.962
	Constant	-1.910	.559	11.662	1	.001	.148

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Wildlife (Cat4)

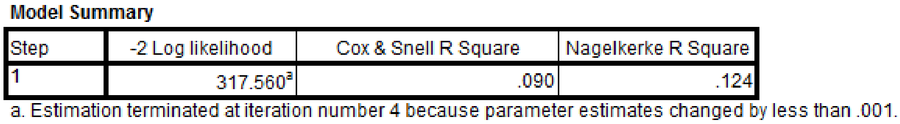
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

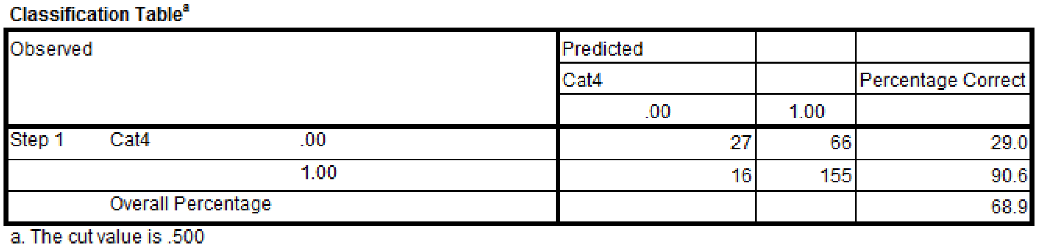
		Chi-square	df	Sig.
Step 1	Step	25.029	11	.009
	Block	25.029	11	.009
	Model	25.029	11	.009



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	317.560[a]	.090	.124

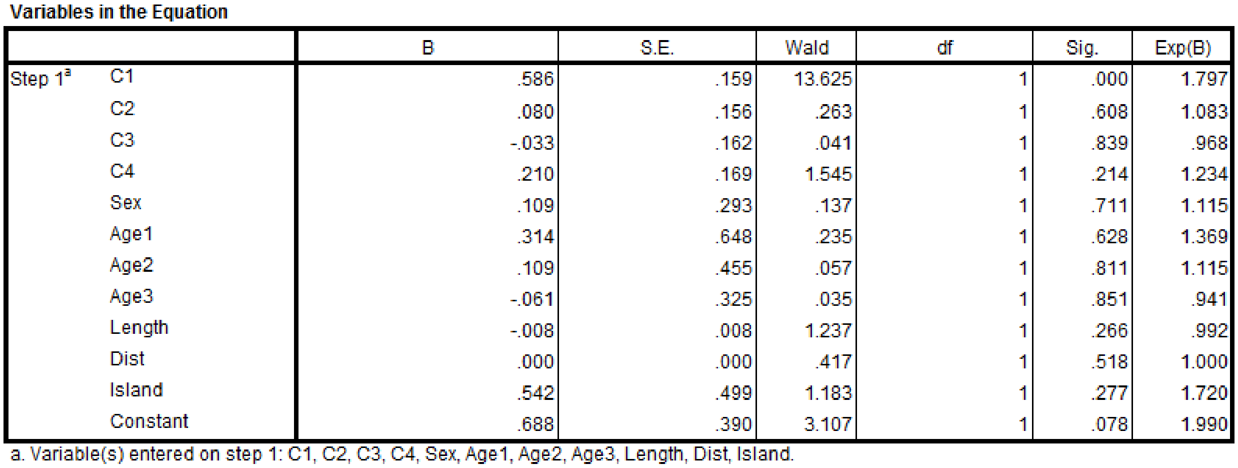
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat4		Percentage Correct
			.00	1.00	
Step 1	Cat4	.00	27	66	29.0
		1.00	16	155	90.6
	Overall Percentage				68.9

a. The cut value is .500



Variables in the Equation

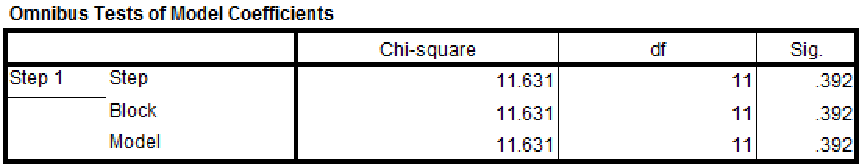
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.586	.159	13.625	1	.000	1.797
	C2	.080	.156	.263	1	.608	1.083
	C3	-.033	.162	.041	1	.839	.968
	C4	.210	.169	1.545	1	.214	1.234
	Sex	.109	.293	.137	1	.711	1.115
	Age1	.314	.648	.235	1	.628	1.369
	Age2	.109	.455	.057	1	.811	1.115
	Age3	-.061	.325	.035	1	.851	.941
	Length	-.008	.008	1.237	1	.266	.992
	Dist	.000	.000	.417	1	.518	1.000
	Island	.542	.499	1.183	1	.277	1.720
	Constant	.688	.390	3.107	1	.078	1.990

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Terrestrial wildlife (Cat5)

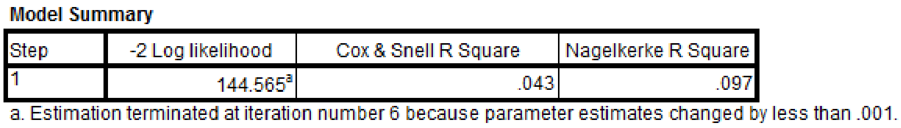
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

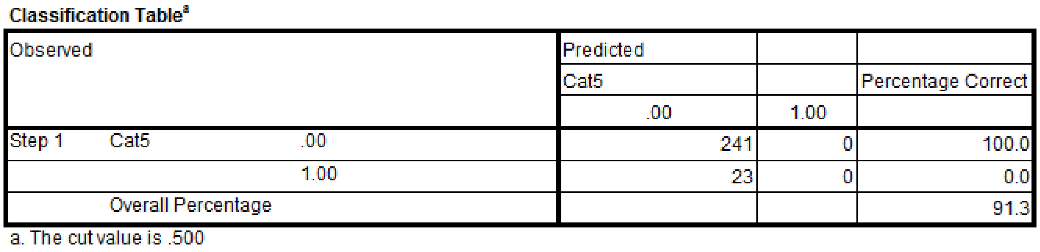
		Chi-square	df	Sig.
Step 1	Step	11.631	11	.392
	Block	11.631	11	.392
	Model	11.631	11	.392



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	144.565[a]	.043	.097

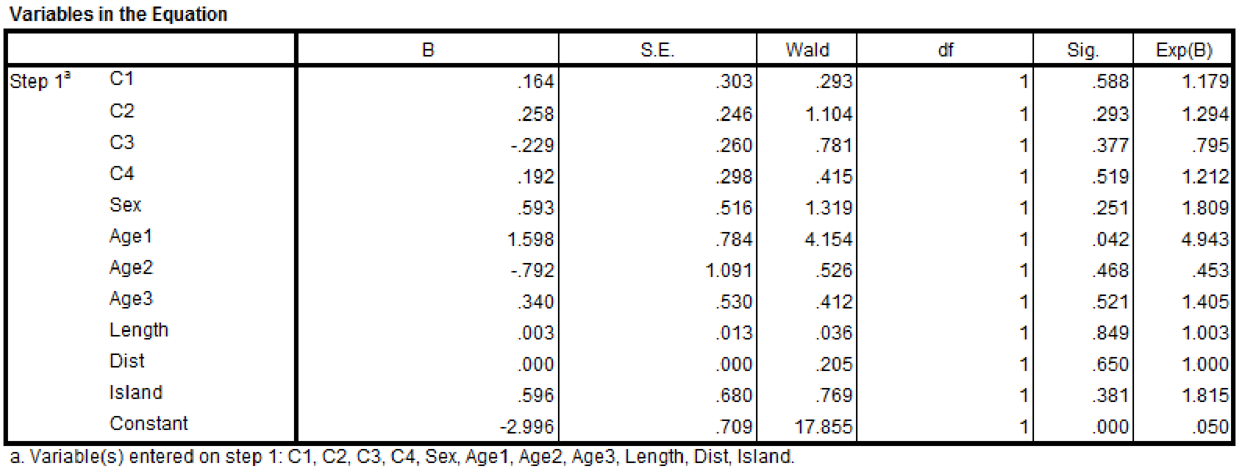
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat5		Percentage Correct
			.00	1.00	
Step 1	Cat5	.00	241	0	100.0
		1.00	23	0	0.0
	Overall Percentage				91.3

a. The cut value is .500



Variables in the Equation

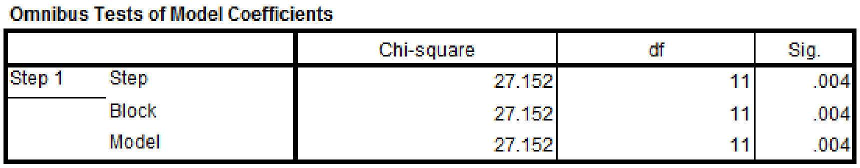
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.164	.303	.293	1	.588	1.179
	C2	.258	.246	1.104	1	.293	1.294
	C3	-.229	.260	.781	1	.377	.795
	C4	.192	.298	.415	1	.519	1.212
	Sex	.593	.516	1.319	1	.251	1.809
	Age1	1.598	.784	4.154	1	.042	4.943
	Age2	-.792	1.091	.526	1	.468	.453
	Age3	.340	.530	.412	1	.521	1.405
	Length	.003	.013	.036	1	.849	1.003
	Dist	.000	.000	.205	1	.650	1.000
	Island	.596	.680	.769	1	.381	1.815
	Constant	-2.996	.709	17.855	1	.000	.050

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Marine wildlife (Cat6)

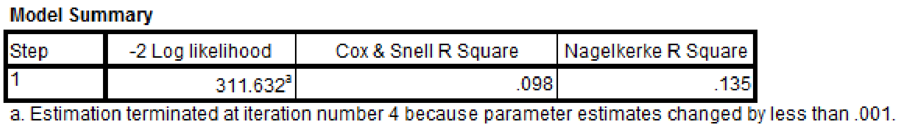
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

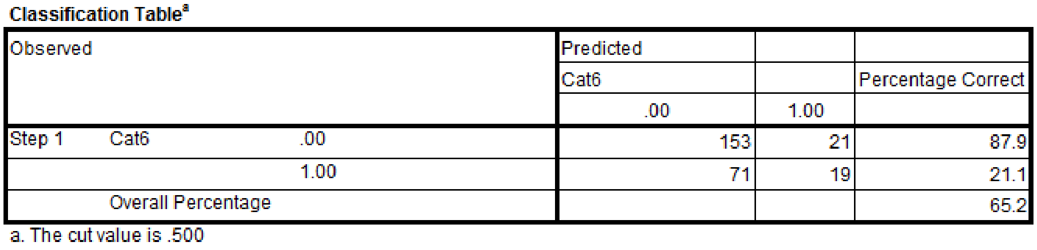
		Chi-square	df	Sig.
Step 1	Step	27.152	11	.004
	Block	27.152	11	.004
	Model	27.152	11	.004



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	311.632[a]	.098	.135

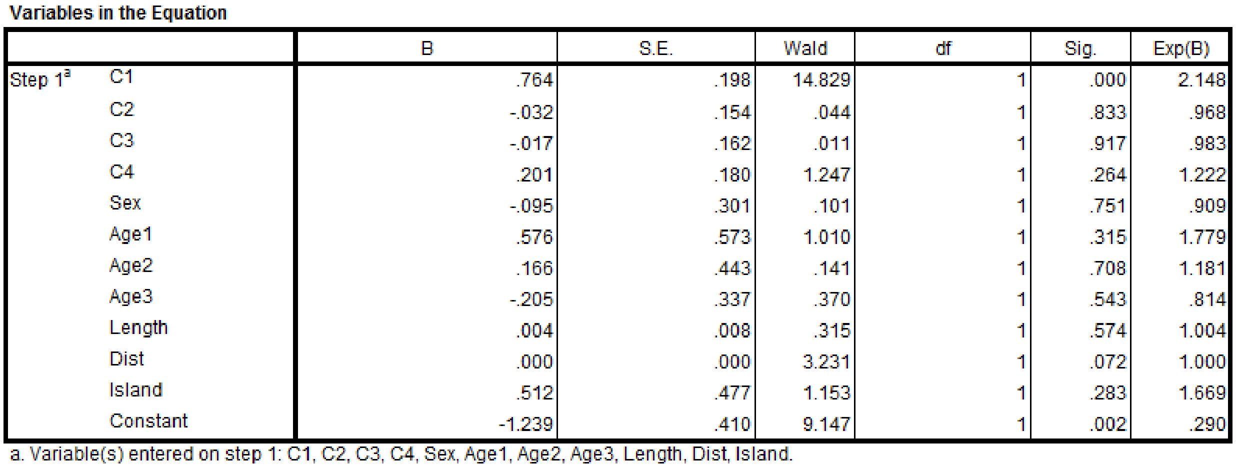
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat6		Percentage Correct
			.00	1.00	
Step 1	Cat6	.00	153	21	87.9
		1.00	71	19	21.1
	Overall Percentage				65.2

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.764	.198	14.829	1	.000	2.148
	C2	-.032	.154	.044	1	.833	.968
	C3	-.017	.162	.011	1	.917	.983
	C4	.201	.180	1.247	1	.264	1.222
	Sex	-.095	.301	.101	1	.751	.909
	Age1	.576	.573	1.010	1	.315	1.779
	Age2	.166	.443	.141	1	.708	1.181
	Age3	-.205	.337	.370	1	.543	.814
	Length	.004	.008	.315	1	.574	1.004
	Dist	.000	.000	3.231	1	.072	1.000
	Island	.512	.477	1.153	1	.283	1.669
	Constant	-1.239	.410	9.147	1	.002	.290

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Domestic animals (Cat7)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	15.481	11	.162
	Block	15.481	11	.162
	Model	15.481	11	.162

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	75.971[a]	.057	.195

a. Estimation terminated at iteration number 8 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat7		Percentage Correct
			.00	1.00	
Step 1	Cat7	.00	253	0	100.0
		1.00	11	0	0.0
	Overall Percentage				95.8

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	1.452	.861	2.845	1	.092	4.270
	C2	-.029	.346	.007	1	.934	.972
	C3	.081	.405	.040	1	.842	1.084
	C4	-.171	.457	.140	1	.708	.843
	Sex	2.230	1.120	3.965	1	.046	9.297
	Age1	-.453	1.327	.117	1	.733	.636
	Age2	-.575	1.158	.246	1	.620	.563
	Age3	-.339	.760	.200	1	.655	.712
	Length	-.016	.021	.629	1	.428	.984
	Dist	.000	.000	.388	1	.533	1.000
	Island	-.658	1.177	.313	1	.576	.518
	Constant	-4.856	1.339	13.161	1	.000	.008

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Marine invertebrates (Cat8)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	22.921	11	.018
	Block	22.921	11	.018
	Model	22.921	11	.018

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	183.661[a]	.083	.153

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat8		Percentage Correct
			.00	1.00	
Step 1	Cat8	.00	227	2	99.1
		1.00	32	3	8.6
	Overall Percentage				87.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.482	.266	3.289	1	.070	1.620
	C2	-.225	.226	.997	1	.318	.798
	C3	.063	.227	.078	1	.780	1.065
	C4	.378	.259	2.118	1	.146	1.459
	Sex	-.190	.424	.201	1	.654	.827
	Age1	1.361	.707	3.710	1	.054	3.901
	Age2	1.159	.548	4.462	1	.035	3.185
	Age3	.224	.503	.198	1	.657	1.251
	Length	.013	.011	1.289	1	.256	1.013
	Dist	.000	.000	5.313	1	.021	1.000
	Island	.540	.725	.553	1	.457	1.716
	Constant	-3.383	.636	28.295	1	.000	.034

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Birds (Cat9)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	12.332	11	.339
	Block	12.332	11	.339
	Model	12.332	11	.339

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	298.993[a]	.046	.066

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat9		Percentage Correct
			.00	1.00	
Step 1	Cat9	.00	189	2	99.0
		1.00	69	4	5.5
	Overall Percentage				73.1

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.377	.187	4.074	1	.044	1.458
	C2	.108	.156	.478	1	.489	1.114
	C3	.166	.170	.957	1	.328	1.181
	C4	-.067	.184	.134	1	.714	.935
	Sex	.085	.309	.076	1	.782	1.089
	Age1	.668	.568	1.381	1	.240	1.949
	Age2	-.416	.513	.656	1	.418	.660
	Age3	.117	.334	.123	1	.726	1.124
	Length	-.004	.008	.265	1	.607	.996
	Dist	.000	.000	.268	1	.605	1.000
	Island	.262	.477	.301	1	.583	1.299
	Constant	-1.069	.411	6.757	1	.009	.343

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Land birds (Cat10)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	18.342	11	.074
	Block	18.342	11	.074
	Model	18.342	11	.074

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	102.376[a]	.067	.183

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Classification Table[a]

Observed			Predicted		
			Cat10		Percentage Correct
			.00	1.00	
Step 1	Cat10	.00	248	0	100.0
		1.00	16	0	0.0
	Overall Percentage				93.9

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.114	.375	.092	1	.762	1.120
	C2	.478	.293	2.657	1	.103	1.613
	C3	-.059	.319	.034	1	.854	.943
	C4	.316	.371	.723	1	.395	1.371
	Sex	.792	.642	1.525	1	.217	2.208
	Age1	2.524	.916	7.586	1	.006	12.474
	Age2	-17.885	6931.566	.000	1	.998	.000
	Age3	.167	.663	.064	1	.801	1.182
	Length	.015	.016	.859	1	.354	1.015
	Dist	.000	.000	.816	1	.366	1.000
	Island	.951	.827	1.320	1	.251	2.587
	Constant	-3.943	.932	17.912	1	.000	.019

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Aquatic birds (Cat11)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	28.629	11	.003
	Block	28.629	11	.003
	Model	28.629	11	.003

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	259.168[a]	.103	.155

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat11		Percentage Correct
			.00	1.00	
Step 1	Cat11	.00	200	2	99.0
		1.00	59	3	4.8
	Overall Percentage				76.9

a. The cut value is .500

Variables in the Equation

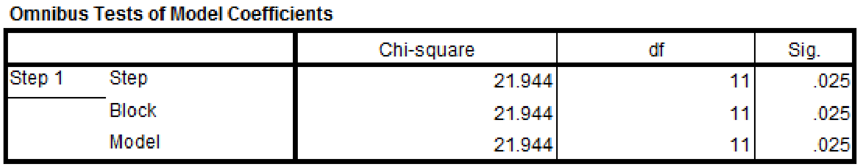
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.397	.212	3.492	1	.062	1.487
	C2	-.104	.172	.364	1	.546	.901
	C3	.051	.179	.081	1	.776	1.052
	C4	.264	.198	1.779	1	.182	1.302
	Sex	.271	.335	.655	1	.418	1.312
	Age1	.541	.637	.723	1	.395	1.718
	Age2	-2.354	1.051	5.015	1	.025	.095
	Age3	-.212	.356	.354	1	.552	.809
	Length	.007	.009	.752	1	.386	1.008
	Dist	.000	.000	5.873	1	.015	1.000
	Island	-.273	.522	.273	1	.601	.761
	Constant	-.974	.441	4.883	1	.027	.378

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Land plants (Cat12)

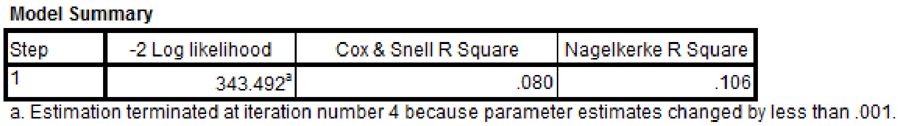
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

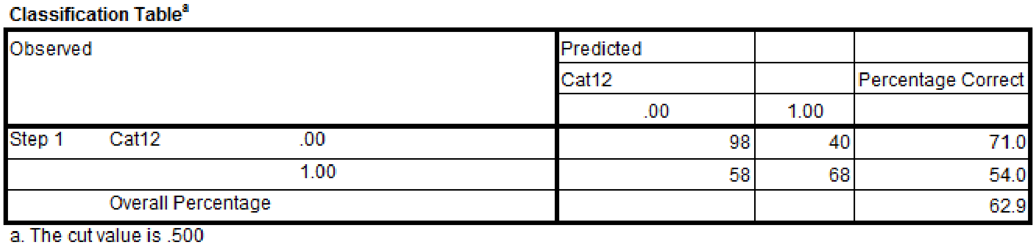
		Chi-square	df	Sig.
Step 1	Step	21.944	11	.025
	Block	21.944	11	.025
	Model	21.944	11	.025



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	343.492[a]	.080	.106

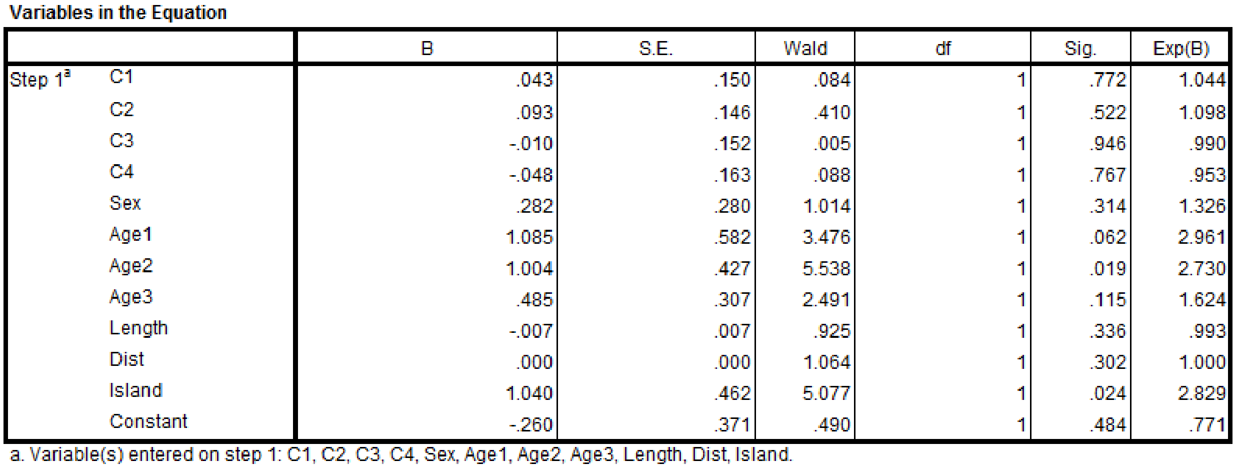
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat12		Percentage Correct
			.00	1.00	
Step 1	Cat12	.00	98	40	71.0
		1.00	58	68	54.0
	Overall Percentage				62.9

a. The cut value is .500



Variables in the Equation

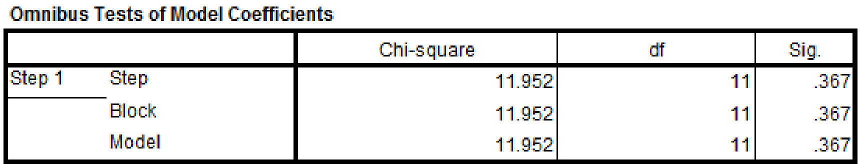
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.043	.150	.084	1	.772	1.044
	C2	.093	.146	.410	1	.522	1.098
	C3	-.010	.152	.005	1	.946	.990
	C4	-.048	.163	.088	1	.767	.953
	Sex	.282	.280	1.014	1	.314	1.326
	Age1	1.085	.582	3.476	1	.062	2.961
	Age2	1.004	.427	5.538	1	.019	2.730
	Age3	.485	.307	2.491	1	.115	1.624
	Length	-.007	.007	.925	1	.336	.993
	Dist	.000	.000	1.064	1	.302	1.000
	Island	1.040	.462	5.077	1	.024	2.829
	Constant	-.260	.371	.490	1	.484	.771

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Boats (Cat13)

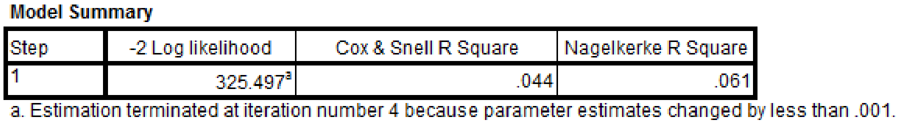
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

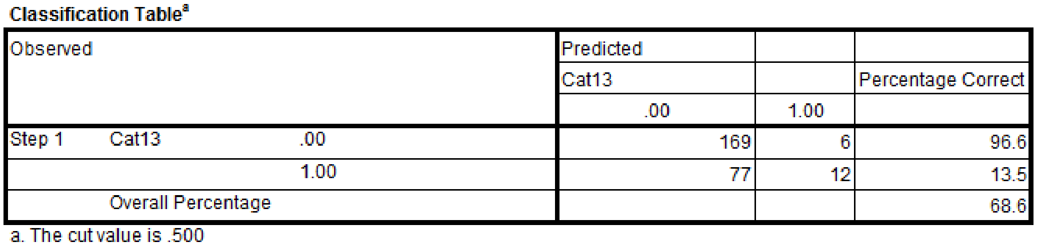
		Chi-square	df	Sig.
Step 1	Step	11.952	11	.367
	Block	11.952	11	.367
	Model	11.952	11	.367



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	325.497[a]	.044	.061

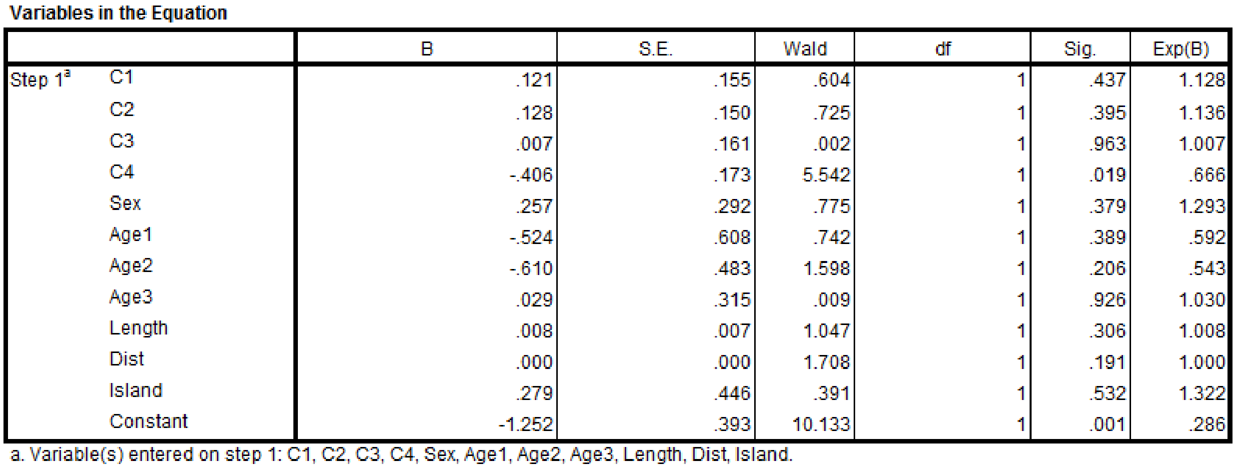
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat13		Percentage Correct
			.00	1.00	
Step 1	Cat13	.00	169	6	96.6
		1.00	77	12	13.5
	Overall Percentage				68.6

a. The cut value is .500



Variables in the Equation

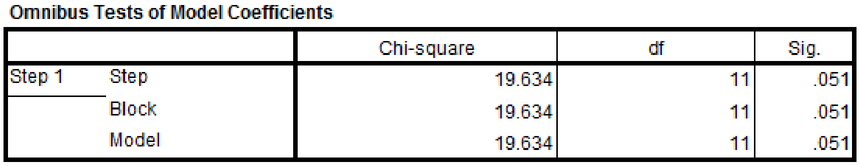
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.121	.155	.604	1	.437	1.128
	C2	.128	.150	.725	1	.395	1.136
	C3	.007	.161	.002	1	.963	1.007
	C4	-.406	.173	5.542	1	.019	.666
	Sex	.257	.292	.775	1	.379	1.293
	Age1	-.524	.608	.742	1	.389	.592
	Age2	-.610	.483	1.598	1	.206	.543
	Age3	.029	.315	.009	1	.926	1.030
	Length	.008	.007	1.047	1	.306	1.008
	Dist	.000	.000	1.708	1	.191	1.000
	Island	.279	.446	.391	1	.532	1.322
	Constant	-1.252	.393	10.133	1	.001	.286

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Large boats (Cat14)

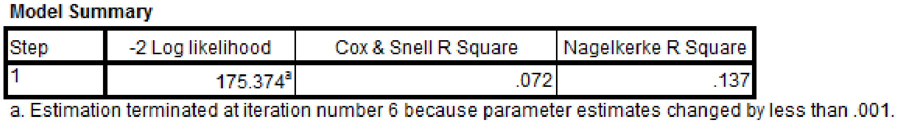
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

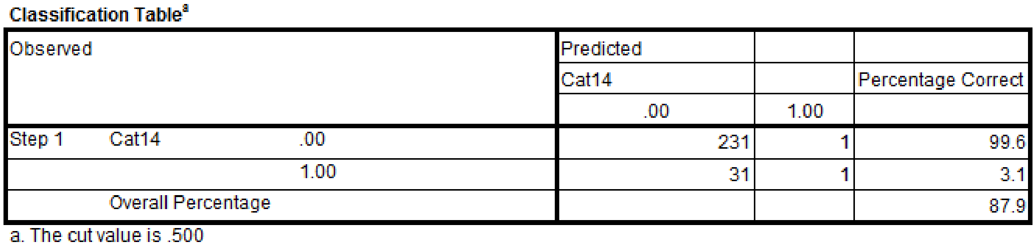
		Chi-square	df	Sig.
Step 1	Step	19.634	11	.051
	Block	19.634	11	.051
	Model	19.634	11	.051



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	175.374[a]	.072	.137

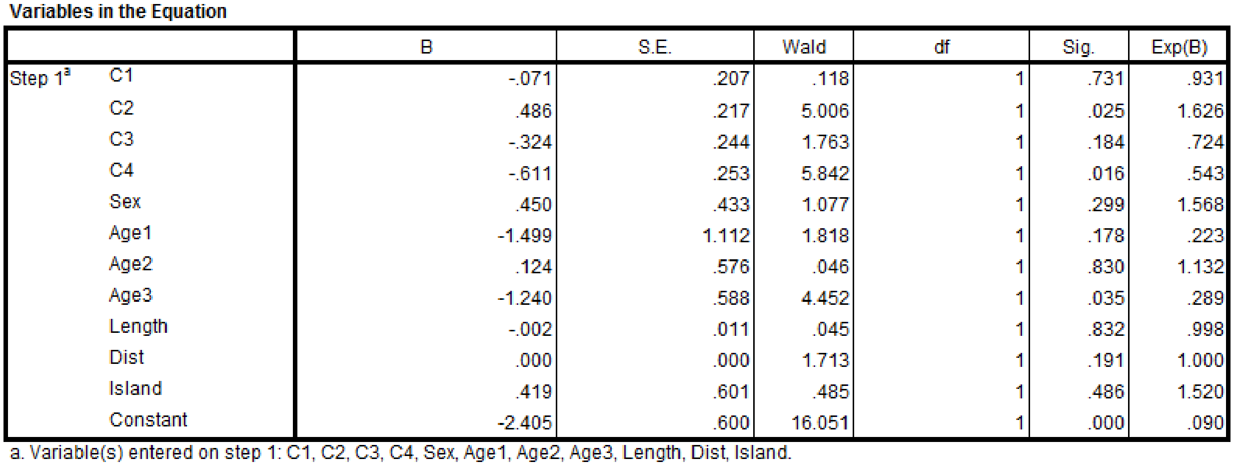
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat14		Percentage Correct
			.00	1.00	
Step 1	Cat14	.00	231	1	99.6
		1.00	31	1	3.1
	Overall Percentage				87.9

a. The cut value is .500



Variables in the Equation

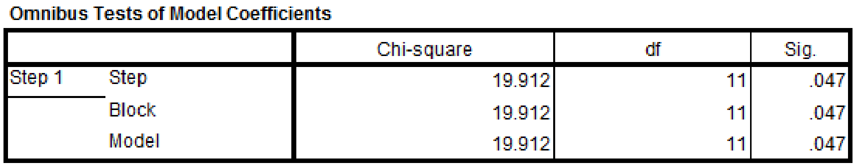
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.071	.207	.118	1	.731	.931
	C2	.486	.217	5.006	1	.025	1.626
	C3	-.324	.244	1.763	1	.184	.724
	C4	-.611	.253	5.842	1	.016	.543
	Sex	.450	.433	1.077	1	.299	1.568
	Age1	-1.499	1.112	1.818	1	.178	.223
	Age2	.124	.576	.046	1	.830	1.132
	Age3	-1.240	.588	4.452	1	.035	.289
	Length	-.002	.011	.045	1	.832	.998
	Dist	.000	.000	1.713	1	.191	1.000
	Island	.419	.601	.485	1	.486	1.520
	Constant	-2.405	.600	16.051	1	.000	.090

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Small boats (Cat15)

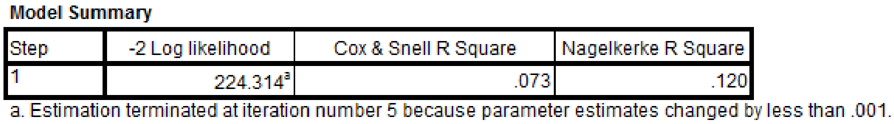
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

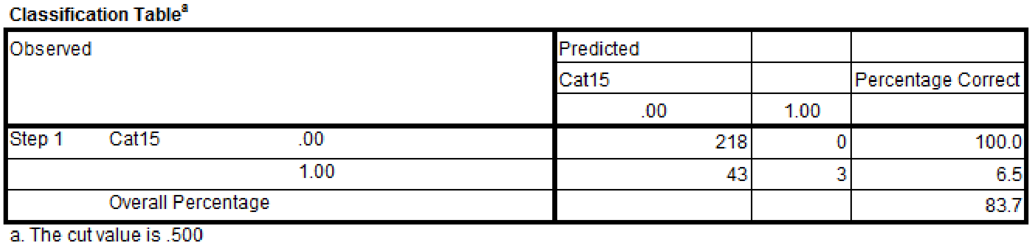
		Chi-square	df	Sig.
Step 1	Step	19.912	11	.047
	Block	19.912	11	.047
	Model	19.912	11	.047



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	224.314[a]	.073	.120

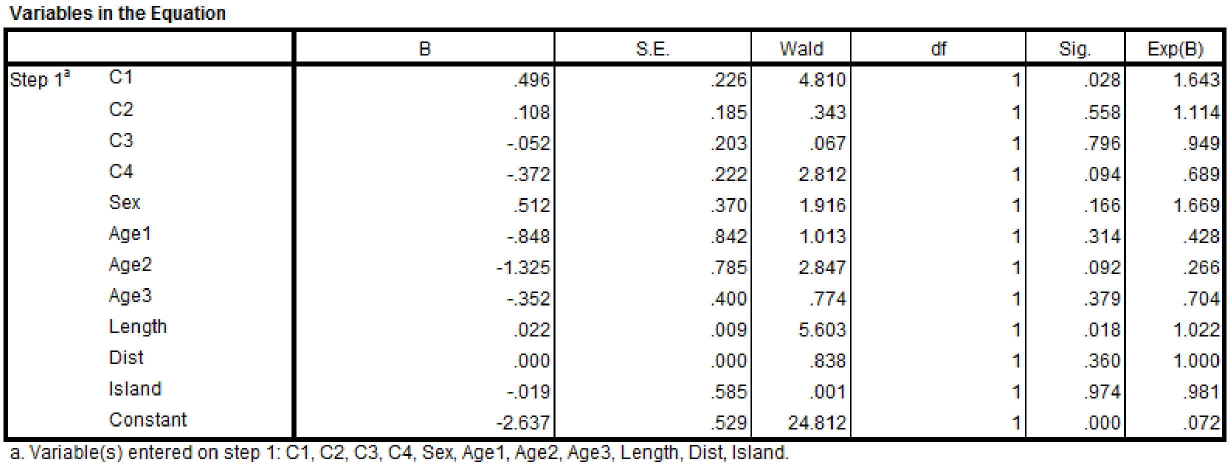
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat15		Percentage Correct
			.00	1.00	
Step 1	Cat15	.00	218	0	100.0
		1.00	43	3	6.5
	Overall Percentage				83.7

a. The cut value is .500



Variables in the Equation

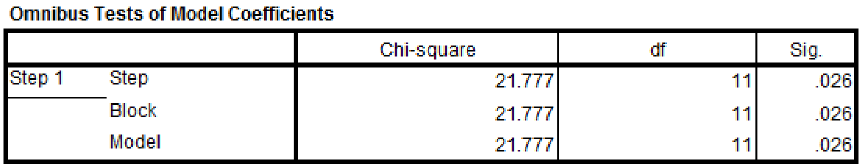
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.496	.226	4.810	1	.028	1.643
	C2	.108	.185	.343	1	.558	1.114
	C3	-.052	.203	.067	1	.796	.949
	C4	-.372	.222	2.812	1	.094	.689
	Sex	.512	.370	1.916	1	.166	1.669
	Age1	-.848	.842	1.013	1	.314	.428
	Age2	-1.325	.785	2.847	1	.092	.266
	Age3	-.352	.400	.774	1	.379	.704
	Length	.022	.009	5.603	1	.018	1.022
	Dist	.000	.000	.838	1	.360	1.000
	Island	-.019	.585	.001	1	.974	.981
	Constant	-2.637	.529	24.812	1	.000	.072

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Marine environment (Cat16)

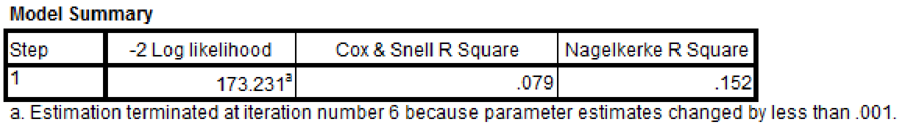
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

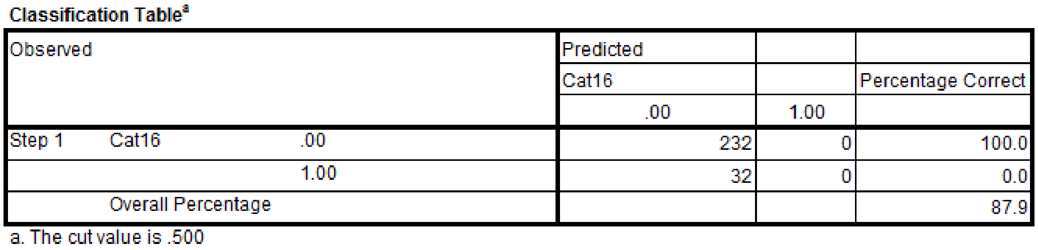
		Chi-square	df	Sig.
Step 1	Step	21.777	11	.026
	Block	21.777	11	.026
	Model	21.777	11	.026



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	173.231[a]	.079	.152

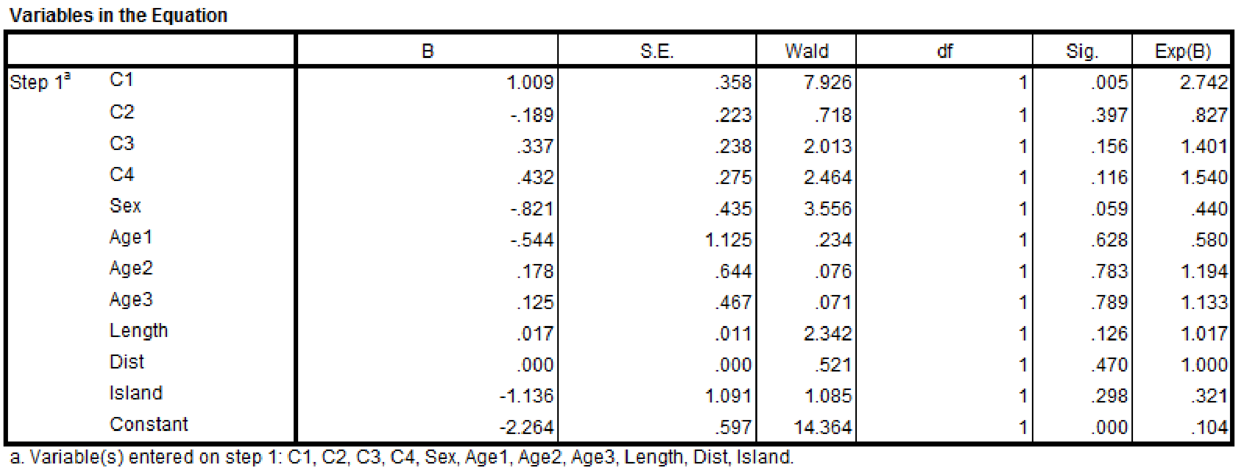
a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat16		Percentage Correct
			.00	1.00	
Step 1	Cat16	.00	232	0	100.0
		1.00	32	0	0.0
	Overall Percentage				87.9

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	1.009	.358	7.926	1	.005	2.742
	C2	-.189	.223	.718	1	.397	.827
	C3	.337	.238	2.013	1	.156	1.401
	C4	.432	.275	2.464	1	.116	1.540
	Sex	-.821	.435	3.556	1	.059	.440
	Age1	-.544	1.125	.234	1	.628	.580
	Age2	.178	.644	.076	1	.783	1.194
	Age3	.125	.467	.071	1	.789	1.133
	Length	.017	.011	2.342	1	.126	1.017
	Dist	.000	.000	.521	1	.470	1.000
	Island	-1.136	1.091	1.085	1	.298	.321
	Constant	-2.264	.597	14.364	1	.000	.104

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

People (Cat17)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	11.812	11	.378
	Block	11.812	11	.378
	Model	11.812	11	.378

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	255.693[a]	.044	.069

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat17		Percentage Correct
			.00	1.00	
Step 1	Cat17	.00	210	0	100.0
		1.00	54	0	0.0
	Overall Percentage				79.5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.118	.175	.455	1	.500	.889
	C2	.192	.175	1.204	1	.272	1.212
	C3	.066	.190	.122	1	.727	1.069
	C4	-.005	.200	.001	1	.978	.995
	Sex	.647	.349	3.435	1	.064	1.910
	Age1	.025	.734	.001	1	.973	1.025
	Age2	.749	.478	2.449	1	.118	2.114
	Age3	.094	.384	.060	1	.806	1.099
	Length	.010	.009	1.304	1	.253	1.010
	Dist	.000	.000	1.331	1	.249	1.000
	Island	.993	.501	3.932	1	.047	2.698
	Constant	-2.563	.505	25.776	1	.000	.077

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Human activity (Cat18)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	18.149	11	.078
	Block	18.149	11	.078
	Model	18.149	11	.078

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	113.275[a]	.066	.169

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Classification Table[a]

Observed			Predicted		
			Cat18		Percentage Correct
			.00	1.00	
Step 1	Cat18	.00	246	0	100.0
		1.00	18	0	0.0
	Overall Percentage				93.2

a. The cut value is .500

Variables in the Equation

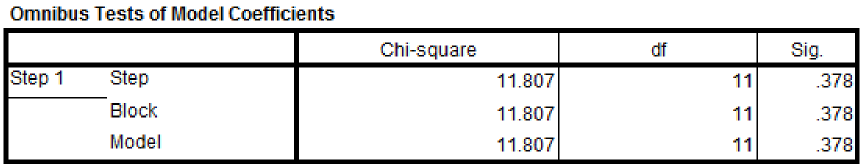
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.003	.311	.000	1	.993	1.003
	C2	.359	.281	1.637	1	.201	1.432
	C3	-.260	.302	.743	1	.389	.771
	C4	.258	.335	.592	1	.442	1.294
	Sex	1.039	.619	2.819	1	.093	2.827
	Age1	1.010	.982	1.059	1	.303	2.747
	Age2	-18.288	6987.068	.000	1	.998	.000
	Age3	.072	.598	.014	1	.905	1.074
	Length	.008	.015	.287	1	.592	1.008
	Dist	.000	.000	.007	1	.936	1.000
	Island	1.711	.696	6.047	1	.014	5.533
	Constant	-3.958	.879	20.253	1	.000	.019

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Recreation (Cat19)

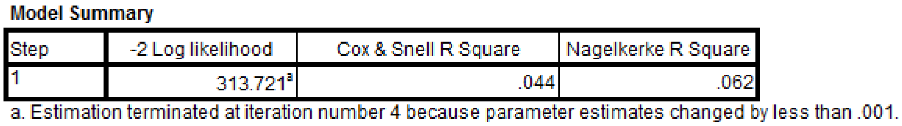
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

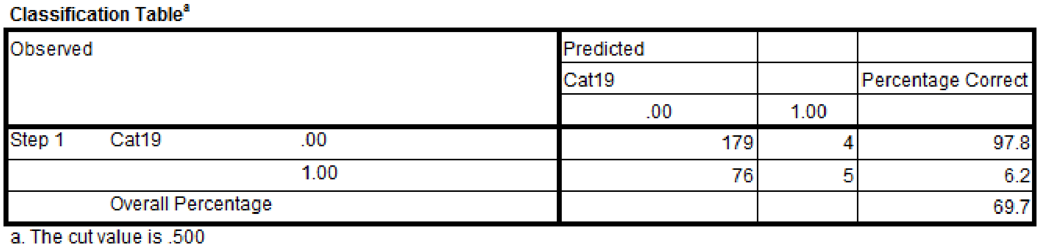
		Chi-square	df	Sig.
Step 1	Step	11.807	11	.378
	Block	11.807	11	.378
	Model	11.807	11	.378



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	313.721[a]	.044	.062

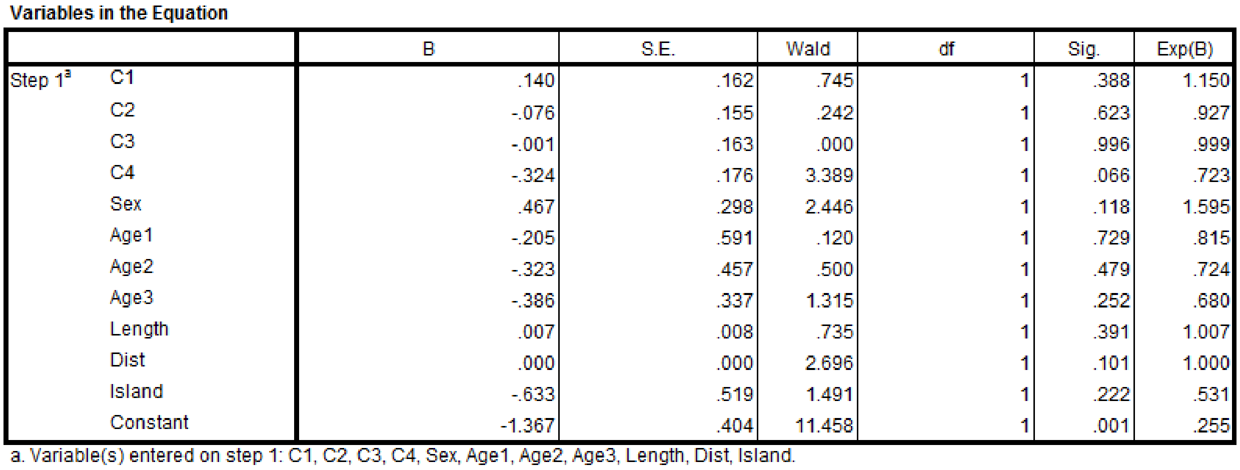
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat19		Percentage Correct
			.00	1.00	
Step 1	Cat19	.00	179	4	97.8
		1.00	76	5	6.2
	Overall Percentage				69.7

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.140	.162	.745	1	.388	1.150
	C2	-.076	.155	.242	1	.623	.927
	C3	-.001	.163	.000	1	.996	.999
	C4	-.324	.176	3.389	1	.066	.723
	Sex	.467	.298	2.446	1	.118	1.595
	Age1	-.205	.591	.120	1	.729	.815
	Age2	-.323	.457	.500	1	.479	.724
	Age3	-.386	.337	1.315	1	.252	.680
	Length	.007	.008	.735	1	.391	1.007
	Dist	.000	.000	2.696	1	.101	1.000
	Island	-.633	.519	1.491	1	.222	.531
	Constant	-1.367	.404	11.458	1	.001	.255

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Land recreation (Cat20)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	18.005	11	.081
	Block	18.005	11	.081
	Model	18.005	11	.081

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	180.929[a]	.066	.125

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat20		Percentage Correct
			.00	1.00	
Step 1	Cat20	.00	231	0	100.0
		1.00	33	0	0.0
	Overall Percentage				87.5

a. The cut value is .500

Variables in the Equation

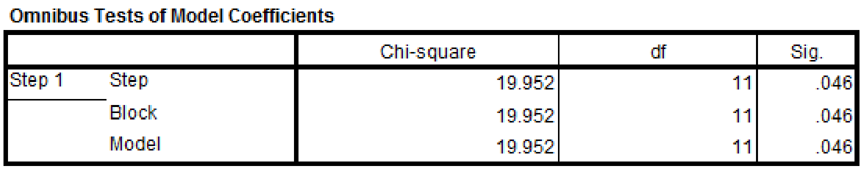
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.277	.276	1.008	1	.315	1.319
	C2	-.263	.224	1.380	1	.240	.769
	C3	.129	.231	.312	1	.576	1.138
	C4	.073	.254	.082	1	.774	1.075
	Sex	.987	.447	4.875	1	.027	2.684
	Age1	.497	.720	.477	1	.490	1.644
	Age2	-1.714	1.068	2.572	1	.109	.180
	Age3	-.063	.446	.020	1	.888	.939
	Length	-.008	.011	.461	1	.497	.992
	Dist	.000	.000	1.004	1	.316	1.000
	Island	-.375	.708	.281	1	.596	.687
	Constant	-2.465	.578	18.203	1	.000	.085

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Ocean recreation (Cat21)

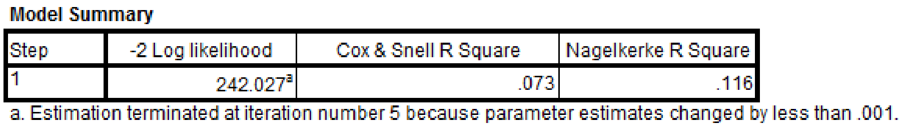
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

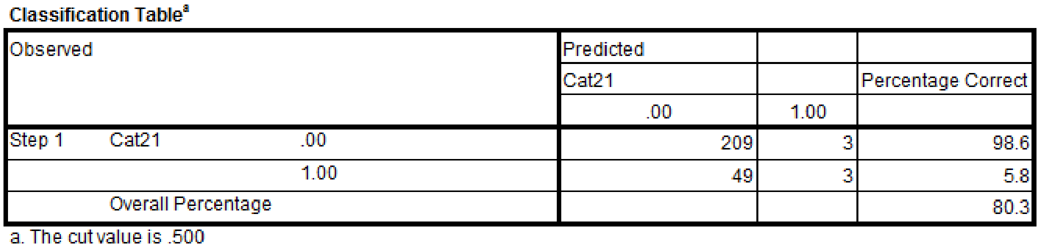
		Chi-square	df	Sig.
Step 1	Step	19.952	11	.046
	Block	19.952	11	.046
	Model	19.952	11	.046



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	242.027[a]	.073	.116

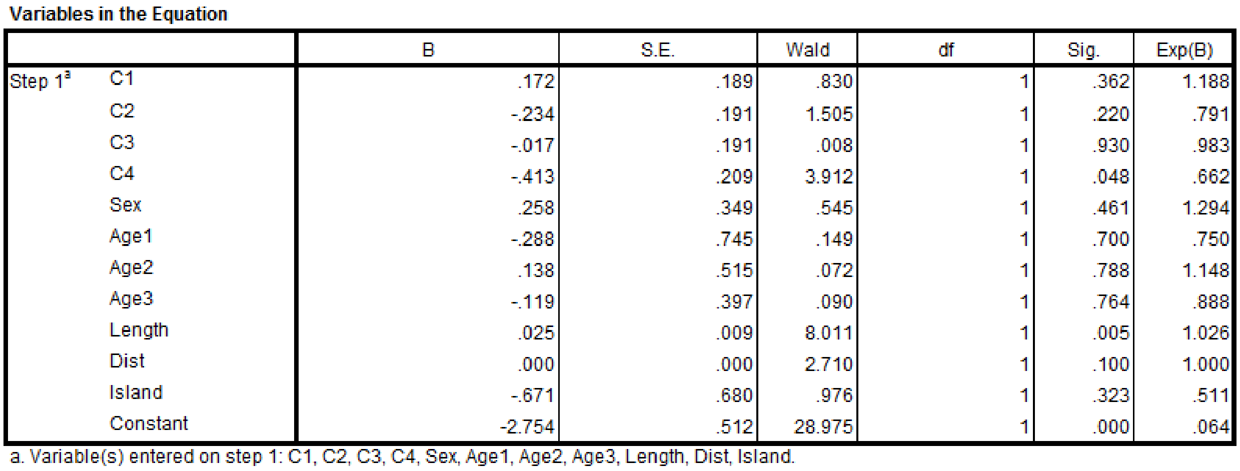
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat21		Percentage Correct
			.00	1.00	
Step 1	Cat21	.00	209	3	98.6
		1.00	49	3	5.8
	Overall Percentage				80.3

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.172	.189	.830	1	.362	1.188
	C2	-.234	.191	1.505	1	.220	.791
	C3	-.017	.191	.008	1	.930	.983
	C4	-.413	.209	3.912	1	.048	.662
	Sex	.258	.349	.545	1	.461	1.294
	Age1	-.288	.745	.149	1	.700	.750
	Age2	.138	.515	.072	1	.788	1.148
	Age3	-.119	.397	.090	1	.764	.888
	Length	.025	.009	8.011	1	.005	1.026
	Dist	.000	.000	2.710	1	.100	1.000
	Island	-.671	.680	.976	1	.323	.511
	Constant	-2.754	.512	28.975	1	.000	.064

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Park structures (Cat22)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	13.991	11	.234
	Block	13.991	11	.234
	Model	13.991	11	.234

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	168.802[a]	.052	.103

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat22		Percentage Correct
			.00	1.00	
Step 1	Cat22	.00	235	0	100.0
		1.00	29	0	0.0
	Overall Percentage				89.0

a. The cut value is .500

Variables in the Equation

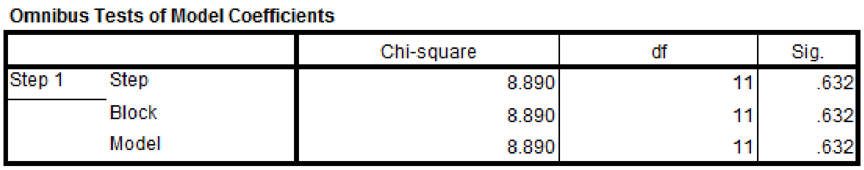
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.080	.229	.124	1	.725	.923
	C2	-.097	.229	.180	1	.671	.907
	C3	.695	.277	6.279	1	.012	2.004
	C4	-.197	.262	.568	1	.451	.821
	Sex	.268	.442	.367	1	.545	1.307
	Age1	.040	.886	.002	1	.964	1.040
	Age2	-1.294	1.079	1.438	1	.231	.274
	Age3	.159	.466	.116	1	.733	1.172
	Length	.014	.011	1.726	1	.189	1.015
	Dist	.000	.000	.619	1	.431	1.000
	Island	.333	.731	.207	1	.649	1.395
	Constant	-3.086	.635	23.584	1	.000	.046

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Development (Cat23)

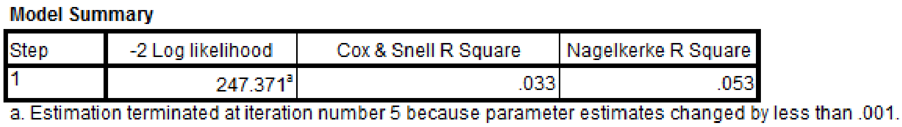
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

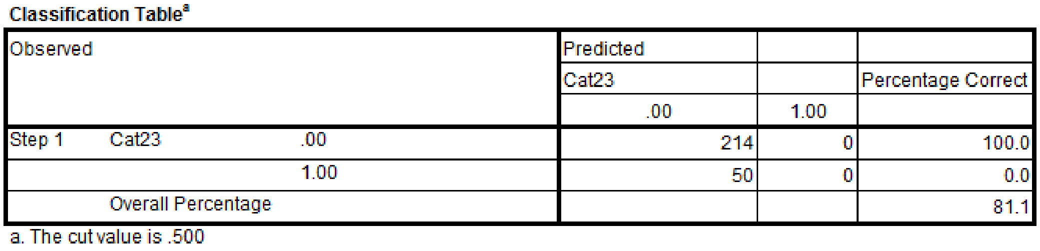
		Chi-square	df	Sig.
Step 1	Step	8.890	11	.632
	Block	8.890	11	.632
	Model	8.890	11	.632



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	247.371[a]	.033	.053

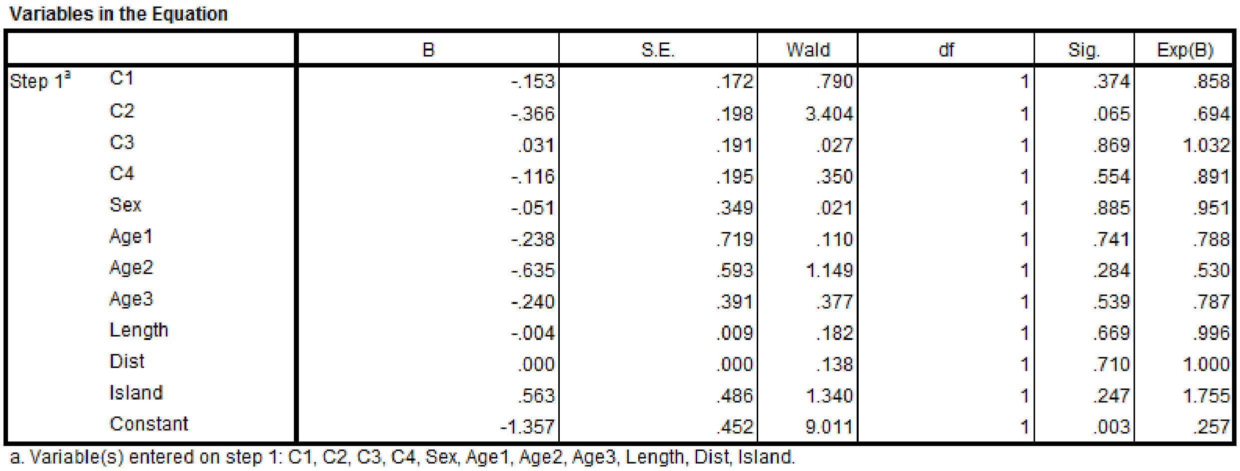
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat23		Percentage Correct
			.00	1.00	
Step 1	Cat23	.00	214	0	100.0
		1.00	50	0	0.0
	Overall Percentage				81.1

a. The cut value is .500



Variables in the Equation

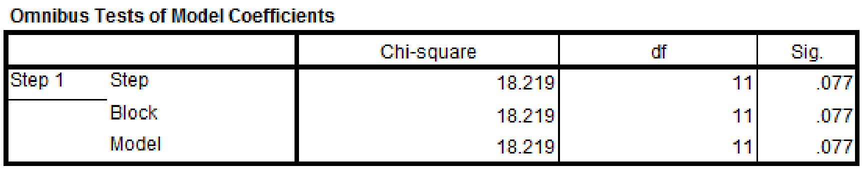
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.153	.172	.790	1	.374	.858
	C2	-.366	.198	3.404	1	.065	.694
	C3	.031	.191	.027	1	.869	1.032
	C4	-.116	.195	.350	1	.554	.891
	Sex	-.051	.349	.021	1	.885	.951
	Age1	-.238	.719	.110	1	.741	.788
	Age2	-.635	.593	1.149	1	.284	.530
	Age3	-.240	.391	.377	1	.539	.787
	Length	-.004	.009	.182	1	.669	.996
	Dist	.000	.000	.138	1	.710	1.000
	Island	.563	.486	1.340	1	.247	1.755
	Constant	-1.357	.452	9.011	1	.003	.257

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Tranquility (Cat24)

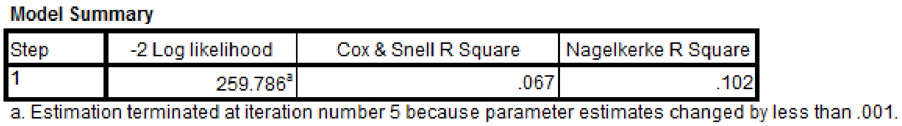
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

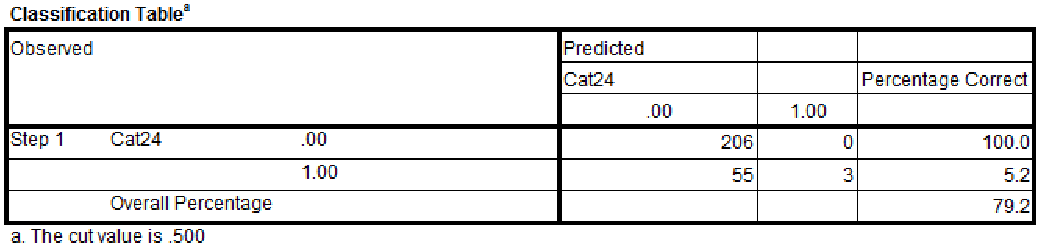
		Chi-square	df	Sig.
Step 1	Step	18.219	11	.077
	Block	18.219	11	.077
	Model	18.219	11	.077



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	259.786[a]	.067	.102

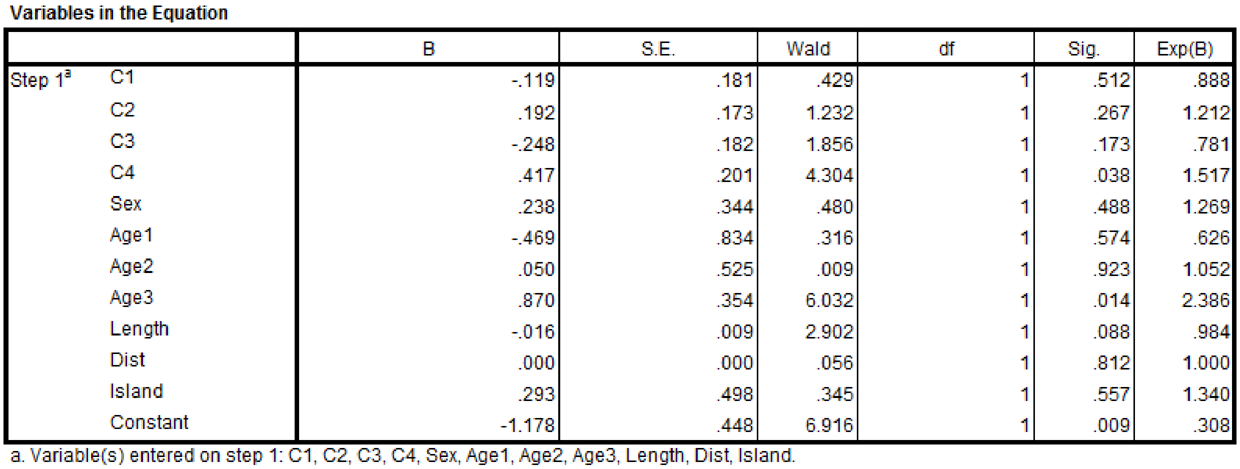
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat24		Percentage Correct
			.00	1.00	
Step 1	Cat24	.00	206	0	100.0
		1.00	55	3	5.2
	Overall Percentage				79.2

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.119	.181	.429	1	.512	.888
	C2	.192	.173	1.232	1	.267	1.212
	C3	-.248	.182	1.856	1	.173	.781
	C4	.417	.201	4.304	1	.038	1.517
	Sex	.238	.344	.480	1	.488	1.269
	Age1	-.469	.834	.316	1	.574	.626
	Age2	.050	.525	.009	1	.923	1.052
	Age3	.870	.354	6.032	1	.014	2.386
	Length	-.016	.009	2.902	1	.088	.984
	Dist	.000	.000	.056	1	.812	1.000
	Island	.293	.498	.345	1	.557	1.340
	Constant	-1.178	.448	6.916	1	.009	.308

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Environmental quality (Cat25)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	12.259	11	.344
	Block	12.259	11	.344
	Model	12.259	11	.344

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	244.002[a]	.045	.073

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat25		Percentage Correct
			.00	1.00	
Step 1	Cat25	.00	214	0	100.0
		1.00	49	1	2.0
	Overall Percentage				81.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.303	.208	2.121	1	.145	1.354
	C2	-.092	.183	.254	1	.614	.912
	C3	.066	.191	.118	1	.731	1.068
	C4	.434	.213	4.142	1	.042	1.544
	Sex	-.696	.359	3.756	1	.053	.499
	Age1	-.123	.727	.029	1	.865	.884
	Age2	-.018	.530	.001	1	.973	.982
	Age3	.333	.386	.745	1	.388	1.395
	Length	-.004	.009	.196	1	.658	.996
	Dist	.000	.000	1.112	1	.292	1.000
	Island	-.447	.679	.434	1	.510	.639
	Constant	-1.316	.460	8.197	1	.004	.268

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Intertidal area (Cat26)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	11.759	11	.382
	Block	11.759	11	.382
	Model	11.759	11	.382

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	162.506[a]	.044	.090

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat26		Percentage Correct
			.00	1.00	
Step 1	Cat26	.00	237	0	100.0
		1.00	27	0	0.0
	Overall Percentage				89.8

a. The cut value is .500

Variables in the Equation

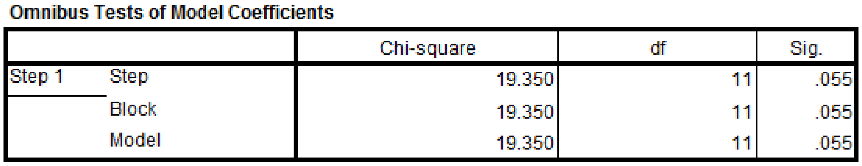
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.083	.259	.104	1	.748	1.087
	C2	.156	.236	.436	1	.509	1.169
	C3	-.129	.247	.271	1	.602	.879
	C4	-.004	.269	.000	1	.988	.996
	Sex	.382	.463	.681	1	.409	1.465
	Age1	1.113	.737	2.282	1	.131	3.042
	Age2	.733	.602	1.485	1	.223	2.082
	Age3	-.568	.602	.891	1	.345	.567
	Length	-.009	.013	.448	1	.503	.991
	Dist	.000	.000	.107	1	.743	1.000
	Island	.909	.597	2.319	1	.128	2.483
	Constant	-2.267	.639	12.598	1	.000	.104

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Beach textures (Cat27)

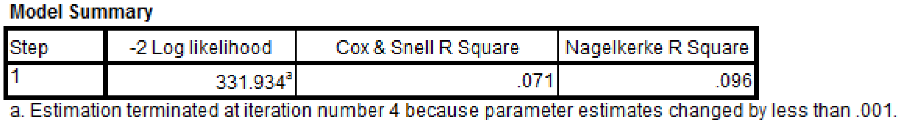
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

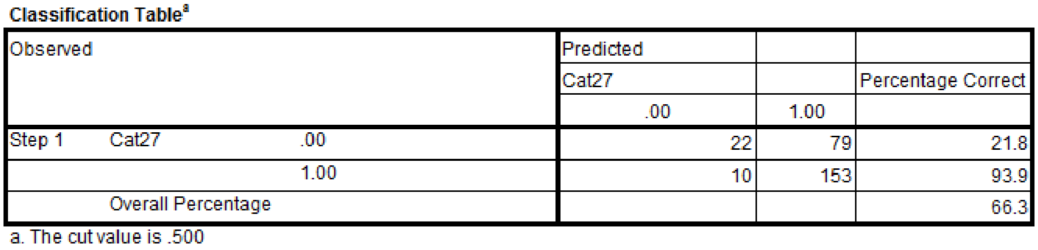
		Chi-square	df	Sig.
Step 1	Step	19.350	11	.055
	Block	19.350	11	.055
	Model	19.350	11	.055



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	331.934[a]	.071	.096

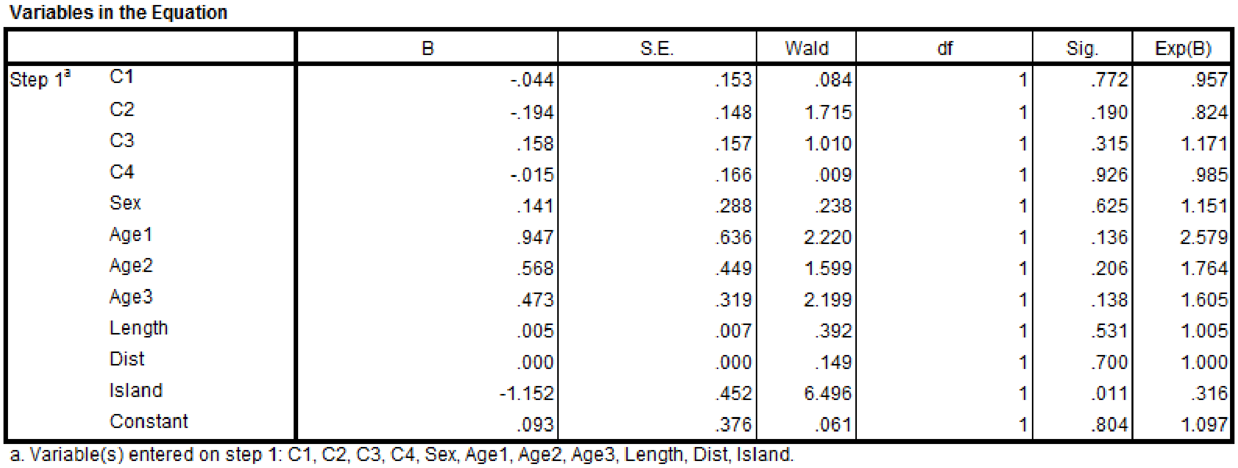
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat27		Percentage Correct
			.00	1.00	
Step 1	Cat27	.00	22	79	21.8
		1.00	10	153	93.9
	Overall Percentage				66.3

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.044	.153	.084	1	.772	.957
	C2	-.194	.148	1.715	1	.190	.824
	C3	.158	.157	1.010	1	.315	1.171
	C4	-.015	.166	.009	1	.926	.985
	Sex	.141	.288	.238	1	.625	1.151
	Age1	.947	.636	2.220	1	.136	2.579
	Age2	.568	.449	1.599	1	.206	1.764
	Age3	.473	.319	2.199	1	.138	1.605
	Length	.005	.007	.392	1	.531	1.005
	Dist	.000	.000	.149	1	.700	1.000
	Island	-1.152	.452	6.496	1	.011	.316
	Constant	.093	.376	.061	1	.804	1.097

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Woody debris (Cat28)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	30.580	11	.001
	Block	30.580	11	.001
	Model	30.580	11	.001

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	164.428[a]	.109	.209

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat28		Percentage Correct
			.00	1.00	
Step 1	Cat28	.00	229	3	98.7
		1.00	29	3	9.4
	Overall Percentage				87.9

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.122	.254	.233	1	.629	1.130
	C2	-.464	.253	3.358	1	.067	.629
	C3	.341	.244	1.964	1	.161	1.407
	C4	-.348	.266	1.707	1	.191	.706
	Sex	1.319	.466	8.009	1	.005	3.739
	Age1	1.704	.746	5.222	1	.022	5.496
	Age2	1.368	.569	5.777	1	.016	3.927
	Age3	-.262	.545	.232	1	.630	.769
	Length	.019	.012	2.697	1	.101	1.020
	Dist	.000	.000	.040	1	.842	1.000
	Island	-1.376	1.125	1.497	1	.221	.253
	Constant	-3.832	.704	29.626	1	.000	.022

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Algae (Cat29)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	24.784	11	.010
	Block	24.784	11	.010
	Model	24.784	11	.010

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	158.008[a]	.090	.179

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat29		Percentage Correct
			.00	1.00	
Step 1	Cat29	.00	232	3	98.7
		1.00	25	4	13.8
	Overall Percentage				89.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.062	.245	.065	1	.799	1.064
	C2	.106	.237	.200	1	.655	1.112
	C3	.008	.257	.001	1	.976	1.008
	C4	.178	.277	.414	1	.520	1.195
	Sex	.433	.471	.842	1	.359	1.541
	Age1	2.158	.717	9.052	1	.003	8.654
	Age2	.906	.626	2.096	1	.148	2.475
	Age3	-.116	.587	.039	1	.843	.890
	Length	.012	.013	.869	1	.351	1.012
	Dist	.001	.000	5.364	1	.021	1.001
	Island	1.618	.679	5.689	1	.017	5.045
	Constant	-4.067	.744	29.887	1	.000	.017

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Dynamics (Cat30)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	8.119	11	.703
	Block	8.119	11	.703
	Model	8.119	11	.703

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	290.971[a]	.030	.045

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat30		Percentage Correct
			.00	1.00	
Step 1	Cat30	.00	197	0	100.0
		1.00	67	0	0.0
	Overall Percentage				74.6

a. The cut value is .500

Variables in the Equation

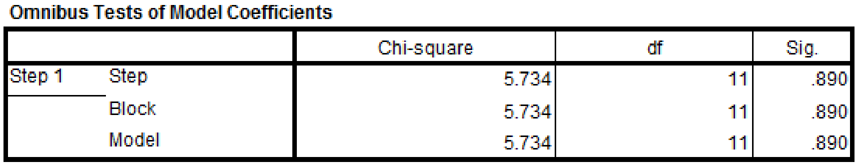
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.043	.167	.066	1	.797	.958
	C2	.019	.161	.013	1	.908	1.019
	C3	.205	.174	1.388	1	.239	1.227
	C4	-.198	.182	1.190	1	.275	.820
	Sex	.128	.312	.168	1	.682	1.136
	Age1	-.407	.645	.398	1	.528	.666
	Age2	-.175	.468	.140	1	.709	.839
	Age3	-.573	.363	2.498	1	.114	.564
	Length	-.009	.008	1.274	1	.259	.991
	Dist	.000	.000	.483	1	.487	1.000
	Island	-.819	.553	2.192	1	.139	.441
	Constant	-.450	.407	1.220	1	.269	.638

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Non-visual senses (Cat31)

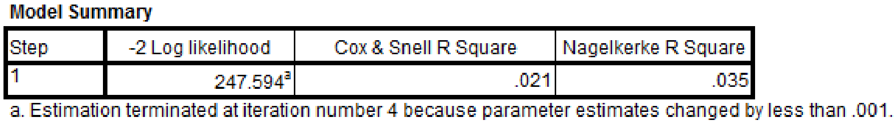
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

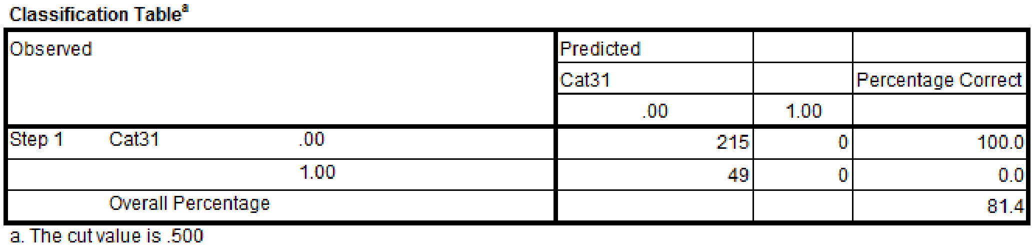
		Chi-square	df	Sig.
Step 1	Step	5.734	11	.890
	Block	5.734	11	.890
	Model	5.734	11	.890



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	247.594[a]	.021	.035

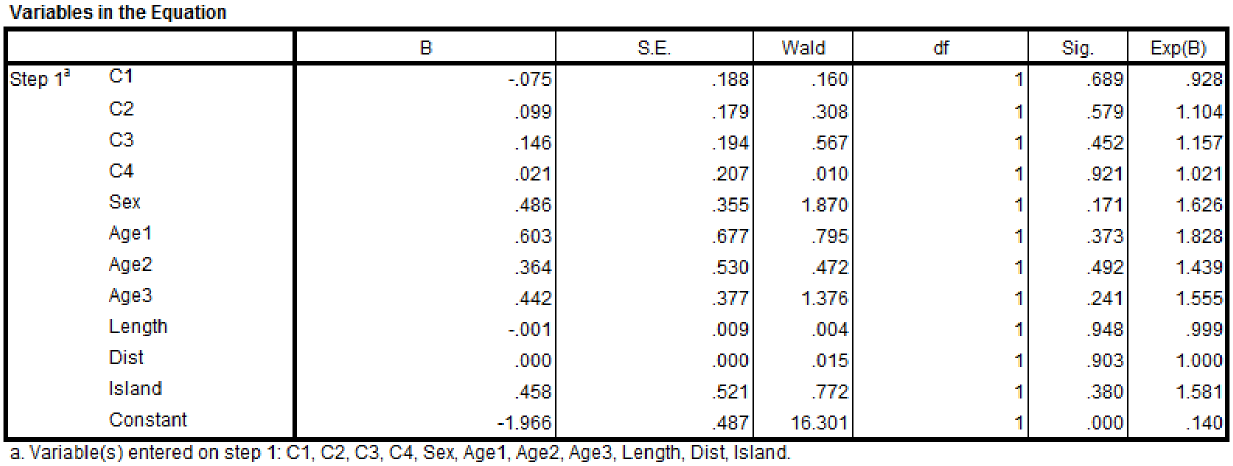
a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Cat31		Percentage Correct
			.00	1.00	
Step 1	Cat31	.00	215	0	100.0
		1.00	49	0	0.0
	Overall Percentage				81.4

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.075	.188	.160	1	.689	.928
	C2	.099	.179	.308	1	.579	1.104
	C3	.146	.194	.567	1	.452	1.157
	C4	.021	.207	.010	1	.921	1.021
	Sex	.486	.355	1.870	1	.171	1.626
	Age1	.603	.677	.795	1	.373	1.828
	Age2	.364	.530	.472	1	.492	1.439
	Age3	.442	.377	1.376	1	.241	1.555
	Length	-.001	.009	.004	1	.948	.999
	Dist	.000	.000	.015	1	.903	1.000
	Island	.458	.521	.772	1	.380	1.581
	Constant	-1.966	.487	16.301	1	.000	.140

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Temperature (Cat32)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	13.353	11	.271
	Block	13.353	11	.271
	Model	13.353	11	.271

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	78.099[a]	.049	.168

a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.

Classification Table[a]

Observed			Predicted		
			Cat32		Percentage Correct
			.00	1.00	
Step 1	Cat32	.00	253	0	100.0
		1.00	11	0	0.0
	Overall Percentage				95.8

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.576	.356	2.611	1	.106	.562
	C2	.218	.348	.395	1	.530	1.244
	C3	.067	.379	.032	1	.859	1.070
	C4	-.184	.395	.217	1	.641	.832
	Sex	.674	.709	.903	1	.342	1.961
	Age1	.203	1.248	.026	1	.871	1.225
	Age2	-.393	1.147	.118	1	.732	.675
	Age3	-.264	.769	.118	1	.731	.768
	Length	-.046	.021	4.720	1	.030	.955
	Dist	.000	.000	.885	1	.347	1.000
	Island	-18.874	7034.462	.000	1	.998	.000
	Constant	-1.616	.845	3.656	1	.056	.199

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Tourism (Cat33)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	4.249	11	.962
	Block	4.249	11	.962
	Model	4.249	11	.962

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	137.405[a]	.016	.038

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Cat33		Percentage Correct
			.00	1.00	
Step 1	Cat33	.00	244	0	100.0
		1.00	20	0	0.0
	Overall Percentage				92.4

a. The cut value is .500

Variables in the Equation

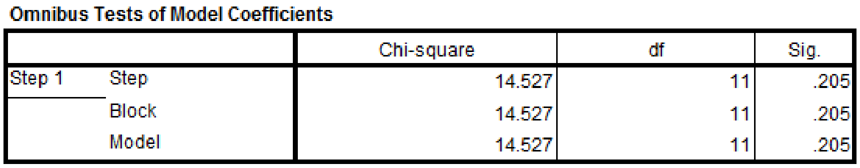
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.036	.260	.019	1	.890	.965
	C2	.130	.258	.255	1	.614	1.139
	C3	.050	.291	.030	1	.862	1.052
	C4	-.346	.299	1.338	1	.247	.707
	Sex	.514	.513	1.005	1	.316	1.673
	Age1	.179	.902	.039	1	.842	1.196
	Age2	-.223	.822	.074	1	.786	.800
	Age3	-.454	.610	.553	1	.457	.635
	Length	.005	.013	.154	1	.695	1.005
	Dist	.000	.000	.807	1	.369	1.000
	Island	.410	.752	.297	1	.586	1.507
	Constant	-3.209	.727	19.488	1	.000	.040

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagine oneself in the image (Pic1)

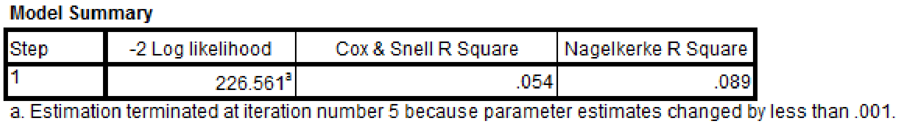
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

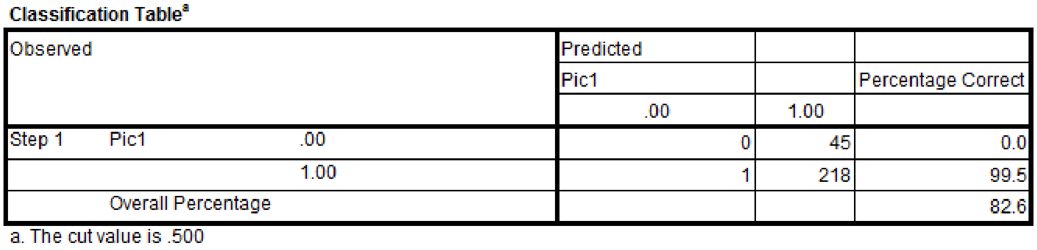
		Chi-square	df	Sig.
Step 1	Step	14.527	11	.205
	Block	14.527	11	.205
	Model	14.527	11	.205



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	226.561[a]	.054	.089

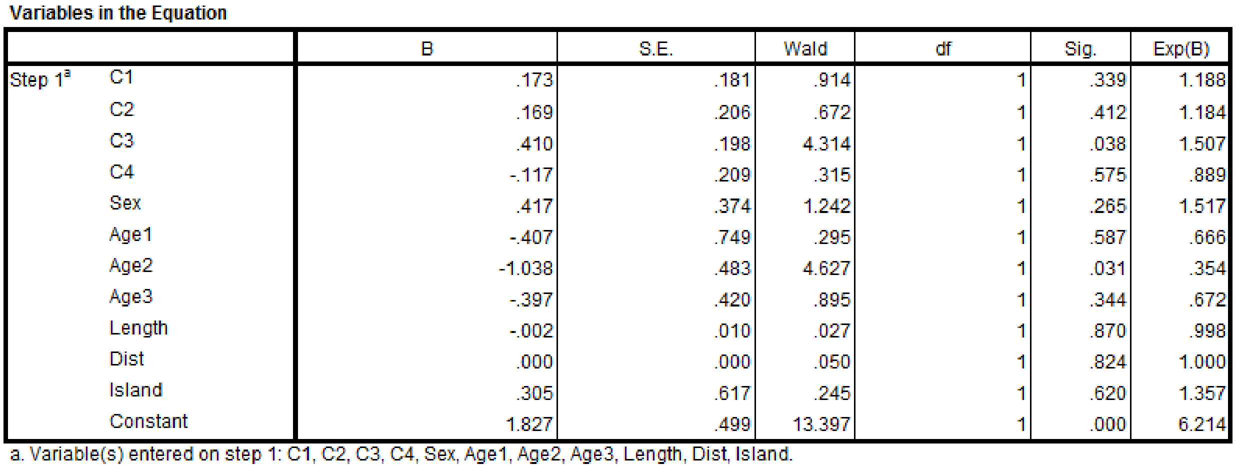
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Pic1		Percentage Correct
			.00	1.00	
Step 1	Pic1	.00	0	45	0.0
		1.00	1	218	99.5
	Overall Percentage				82.6

a. The cut value is .500



Variables in the Equation

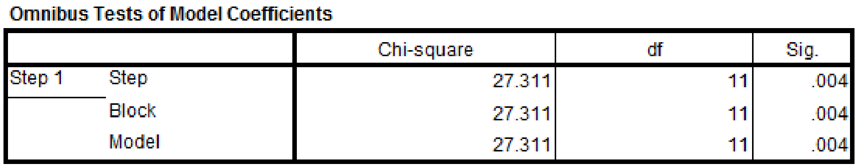
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.173	.181	.914	1	.339	1.188
	C2	.169	.206	.672	1	.412	1.184
	C3	.410	.198	4.314	1	.038	1.507
	C4	-.117	.209	.315	1	.575	.889
	Sex	.417	.374	1.242	1	.265	1.517
	Age1	-.407	.749	.295	1	.587	.666
	Age2	-1.038	.483	4.627	1	.031	.354
	Age3	-.397	.420	.895	1	.344	.672
	Length	-.002	.010	.027	1	.870	.998
	Dist	.000	.000	.050	1	.824	1.000
	Island	.305	.617	.245	1	.620	1.357
	Constant	1.827	.499	13.397	1	.000	6.214

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagine oneself on private property (Pic2)

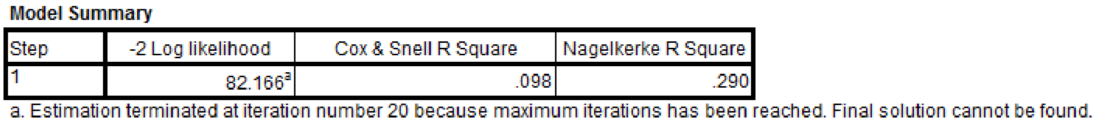
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

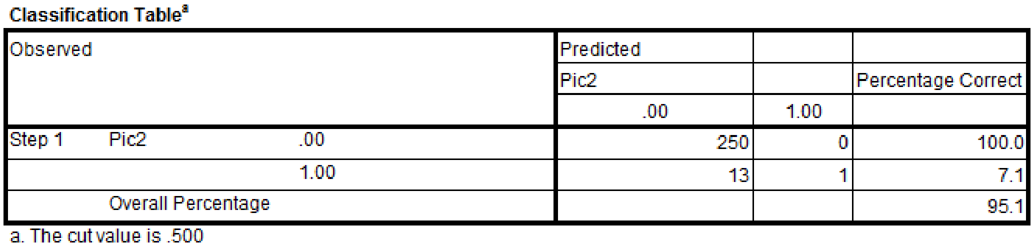
		Chi-square	df	Sig.
Step 1	Step	27.311	11	.004
	Block	27.311	11	.004
	Model	27.311	11	.004



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	82.166[a]	.098	.290

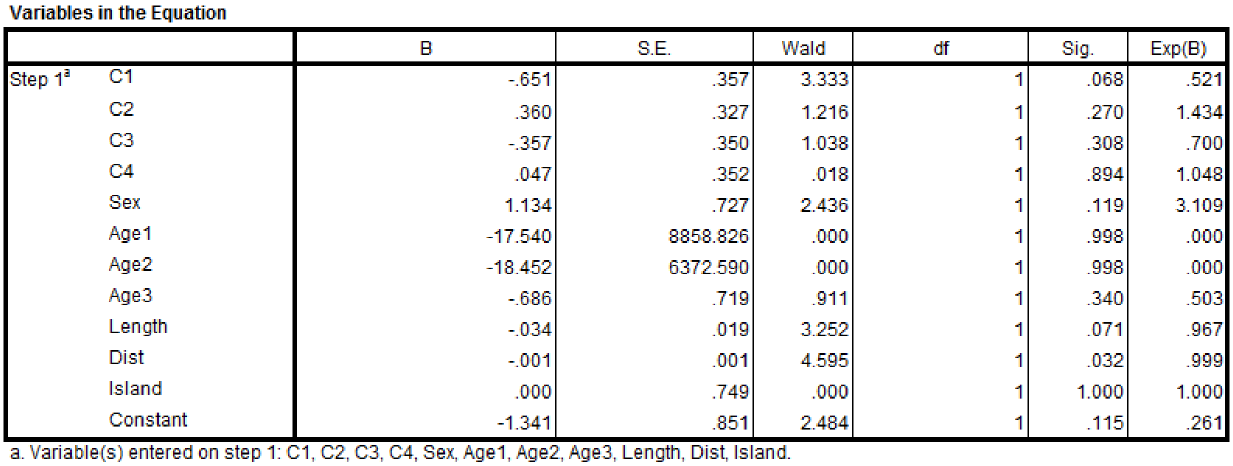
a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.



Classification Table[a]

Observed			Predicted		
			Pic2		Percentage Correct
			.00	1.00	
Step 1	Pic2	.00	250	0	100.0
		1.00	13	1	7.1
	Overall Percentage				95.1

a. The cut value is .500



Variables in the Equation

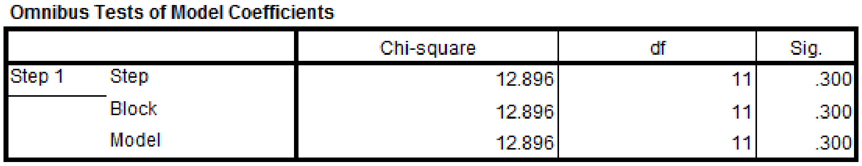
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.651	.357	3.333	1	.068	.521
	C2	.360	.327	1.216	1	.270	1.434
	C3	-.357	.350	1.038	1	.308	.700
	C4	.047	.352	.018	1	.894	1.048
	Sex	1.134	.727	2.436	1	.119	3.109
	Age1	-17.540	8858.826	.000	1	.998	.000
	Age2	-18.452	6372.590	.000	1	.998	.000
	Age3	-.686	.719	.911	1	.340	.503
	Length	-.034	.019	3.252	1	.071	.967
	Dist	-.001	.001	4.595	1	.032	.999
	Island	.000	.749	.000	1	1.000	1.000
	Constant	-1.341	.851	2.484	1	.115	.261

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagine oneself on a boat (Pic3)

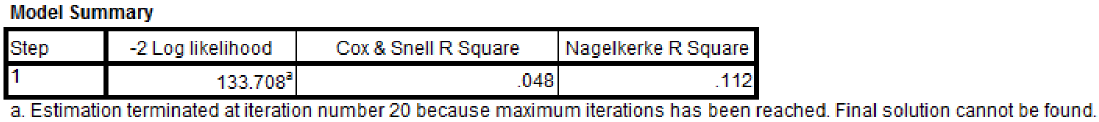
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

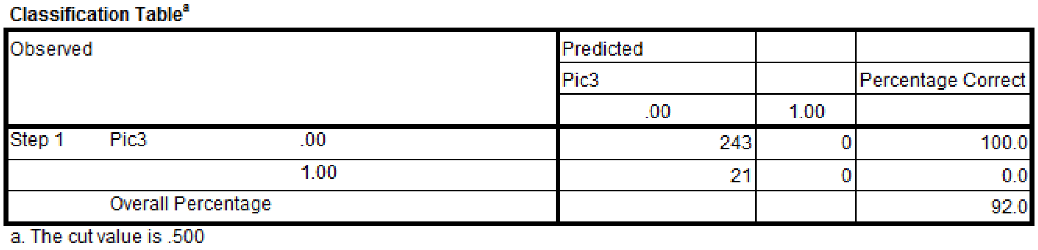
		Chi-square	df	Sig.
Step 1	Step	12.896	11	.300
	Block	12.896	11	.300
	Model	12.896	11	.300



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	133.708[a]	.048	.112

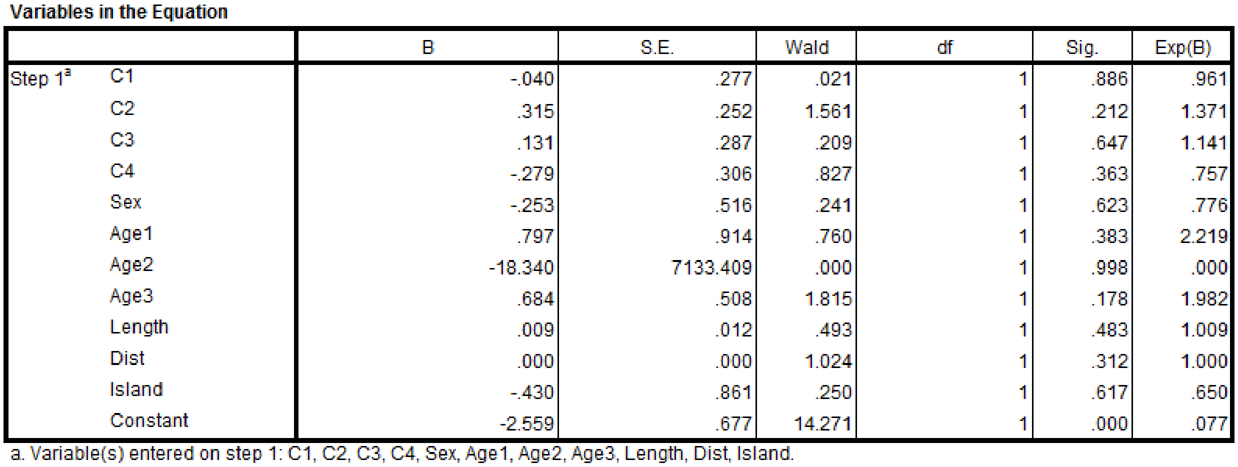
a. Estimation terminated at iteration number 20 because maximum iterations has been reached. Final solution cannot be found.



Classification Table[a]

Observed			Predicted		
			Pic3		Percentage Correct
			.00	1.00	
Step 1	Pic3	.00	243	0	100.0
		1.00	21	0	0.0
	Overall Percentage				92.0

a. The cut value is .500



Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	-.040	.277	.021	1	.886	.961
	C2	.315	.252	1.561	1	.212	1.371
	C3	.131	.287	.209	1	.647	1.141
	C4	-.279	.306	.827	1	.363	.757
	Sex	-.253	.516	.241	1	.623	.776
	Age1	.797	.914	.760	1	.383	2.219
	Age2	-18.340	7133.409	.000	1	.998	.000
	Age3	.684	.508	1.815	1	.178	1.982
	Length	.009	.012	.493	1	.483	1.009
	Dist	.000	.000	1.024	1	.312	1.000
	Island	-.430	.861	.250	1	.617	.650
	Constant	-2.559	.677	14.271	1	.000	.077

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagining perspective as looking toward ocean (Pic4)

Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)

Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	23.805	11	.014
	Block	23.805	11	.014
	Model	23.805	11	.014

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	339.612[a]	.086	.115

a. Estimation terminated at iteration number 4 because parameter estimates changed by less than .001.

Classification Table[a]

Observed			Predicted		
			Pic4		Percentage Correct
			.00	1.00	
Step 1	Pic4	.00	110	35	75.9
		1.00	56	63	52.9
	Overall Percentage				65.5

a. The cut value is .500

Variables in the Equation

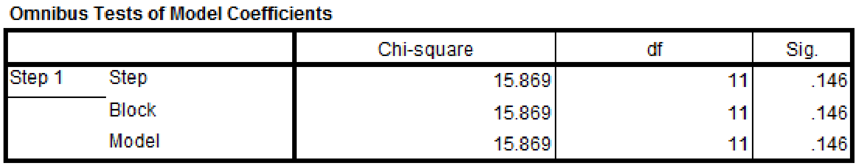
		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.139	.154	.819	1	.365	1.149
	C2	-.076	.146	.273	1	.602	.927
	C3	.228	.155	2.178	1	.140	1.256
	C4	-.117	.165	.505	1	.477	.889
	Sex	.776	.282	7.545	1	.006	2.172
	Age1	1.168	.606	3.718	1	.054	3.214
	Age2	.133	.425	.098	1	.755	1.142
	Age3	.282	.310	.829	1	.362	1.326
	Length	.003	.007	.163	1	.687	1.003
	Dist	.000	.000	.936	1	.333	1.000
	Island	-.566	.472	1.438	1	.231	.568
	Constant	-.955	.380	6.319	1	.012	.385

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Imagining a specific real-world place (Real)

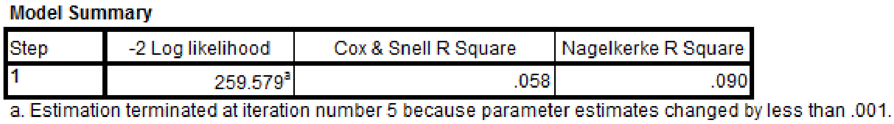
Coastal concerns variables (C)

- Ecological concerns (C1)
- Private opportunities concerns (C2)
- Public space concerns (C3)
- Boating impacts concerns (C4)



Omnibus Tests of Model Coefficients

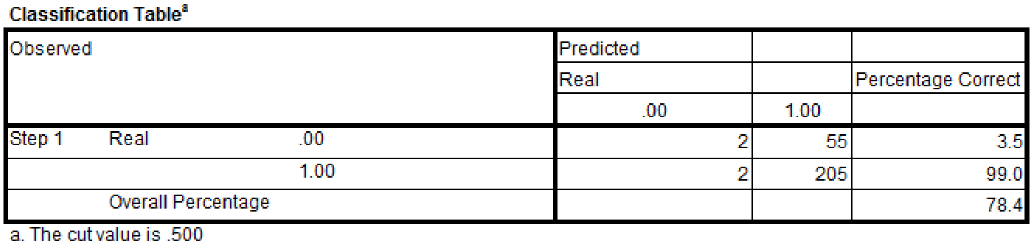
		Chi-square	df	Sig.
Step 1	Step	15.869	11	.146
	Block	15.869	11	.146
	Model	15.869	11	.146



Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	259.579[a]	.058	.090

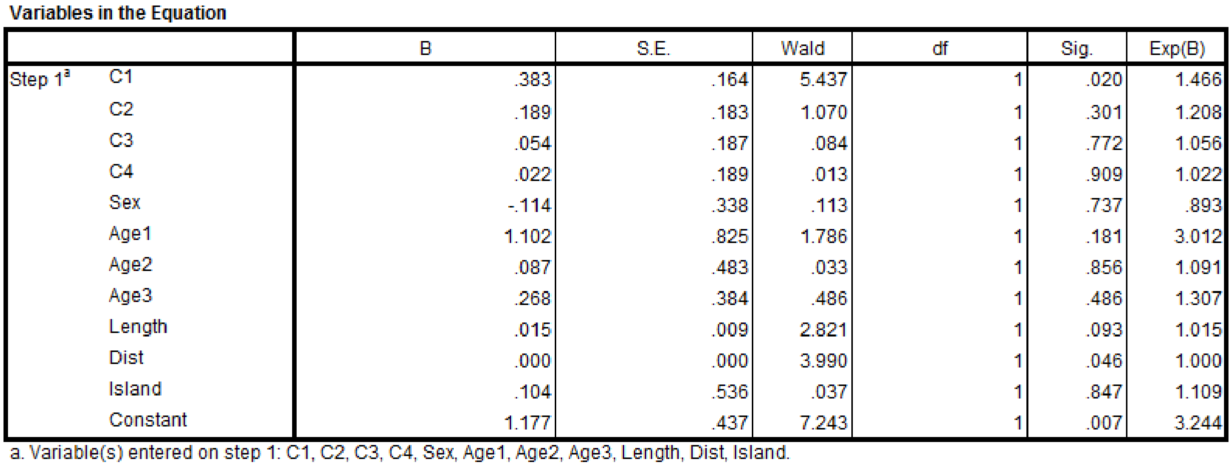
a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.



Classification Table[a]

Observed			Predicted		
			Real		Percentage Correct
			.00	1.00	
Step 1	Real	.00	2	55	3.5
		1.00	2	205	99.0
	Overall Percentage				78.4

a. The cut value is .500

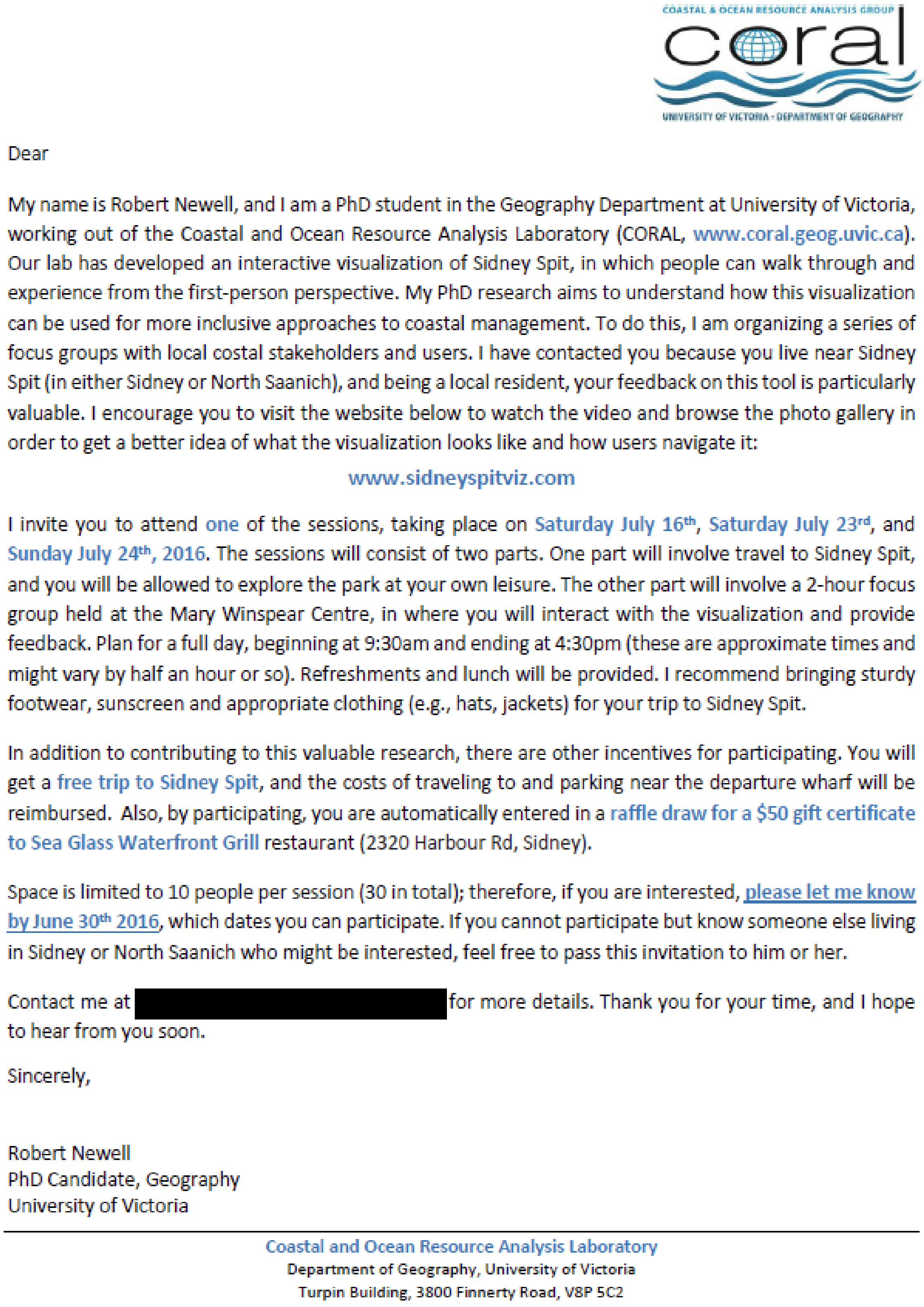


Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	C1	.383	.164	5.437	1	.020	1.466
	C2	.189	.183	1.070	1	.301	1.208
	C3	.054	.187	.084	1	.772	1.056
	C4	.022	.189	.013	1	.909	1.022
	Sex	-.114	.338	.113	1	.737	.893
	Age1	1.102	.825	1.786	1	.181	3.012
	Age2	.087	.483	.033	1	.856	1.091
	Age3	.268	.384	.486	1	.486	1.307
	Length	.015	.009	2.821	1	.093	1.015
	Dist	.000	.000	3.990	1	.046	1.000
	Island	.104	.536	.037	1	.847	1.109
	Constant	1.177	.437	7.243	1	.007	3.244

a. Variable(s) entered on step 1: C1, C2, C3, C4, Sex, Age1, Age2, Age3, Length, Dist, Island.

Appendix H. Invitation to focus group



COASTAL & OCEAN RESOURCE ANALYSIS GROUP
coral
UNIVERSITY OF VICTORIA - DEPARTMENT OF GEOGRAPHY

Dear

My name is Robert Newell, and I am a PhD student in the Geography Department at University of Victoria, working out of the Coastal and Ocean Resource Analysis Laboratory (CORAL, www.coral.geog.uvic.ca). Our lab has developed an interactive visualization of Sidney Spit, in which people can walk through and experience from the first-person perspective. My PhD research aims to understand how this visualization can be used for more inclusive approaches to coastal management. To do this, I am organizing a series of focus groups with local costal stakeholders and users. I have contacted you because you live near Sidney Spit (in either Sidney or North Saanich), and being a local resident, your feedback on this tool is particularly valuable. I encourage you to visit the website below to watch the video and browse the photo gallery in order to get a better idea of what the visualization looks like and how users navigate it:

www.sidneyspitviz.com

I invite you to attend one of the sessions, taking place on Saturday July 16th, Saturday July 23rd, and Sunday July 24th, 2016. The sessions will consist of two parts. One part will involve travel to Sidney Spit, and you will be allowed to explore the park at your own leisure. The other part will involve a 2-hour focus group held at the Mary Winspear Centre, in where you will interact with the visualization and provide feedback. Plan for a full day, beginning at 9:30am and ending at 4:30pm (these are approximate times and might vary by half an hour or so). Refreshments and lunch will be provided. I recommend bringing sturdy footwear, sunscreen and appropriate clothing (e.g., hats, jackets) for your trip to Sidney Spit.

In addition to contributing to this valuable research, there are other incentives for participating. You will get a free trip to Sidney Spit, and the costs of traveling to and parking near the departure wharf will be reimbursed. Also, by participating, you are automatically entered in a raffle draw for a $50 gift certificate to Sea Glass Waterfront Grill restaurant (2320 Harbour Rd, Sidney).

Space is limited to 10 people per session (30 in total); therefore, if you are interested, please let me know by June 30th 2016, which dates you can participate. If you cannot participate but know someone else living in Sidney or North Saanich who might be interested, feel free to pass this invitation to him or her.

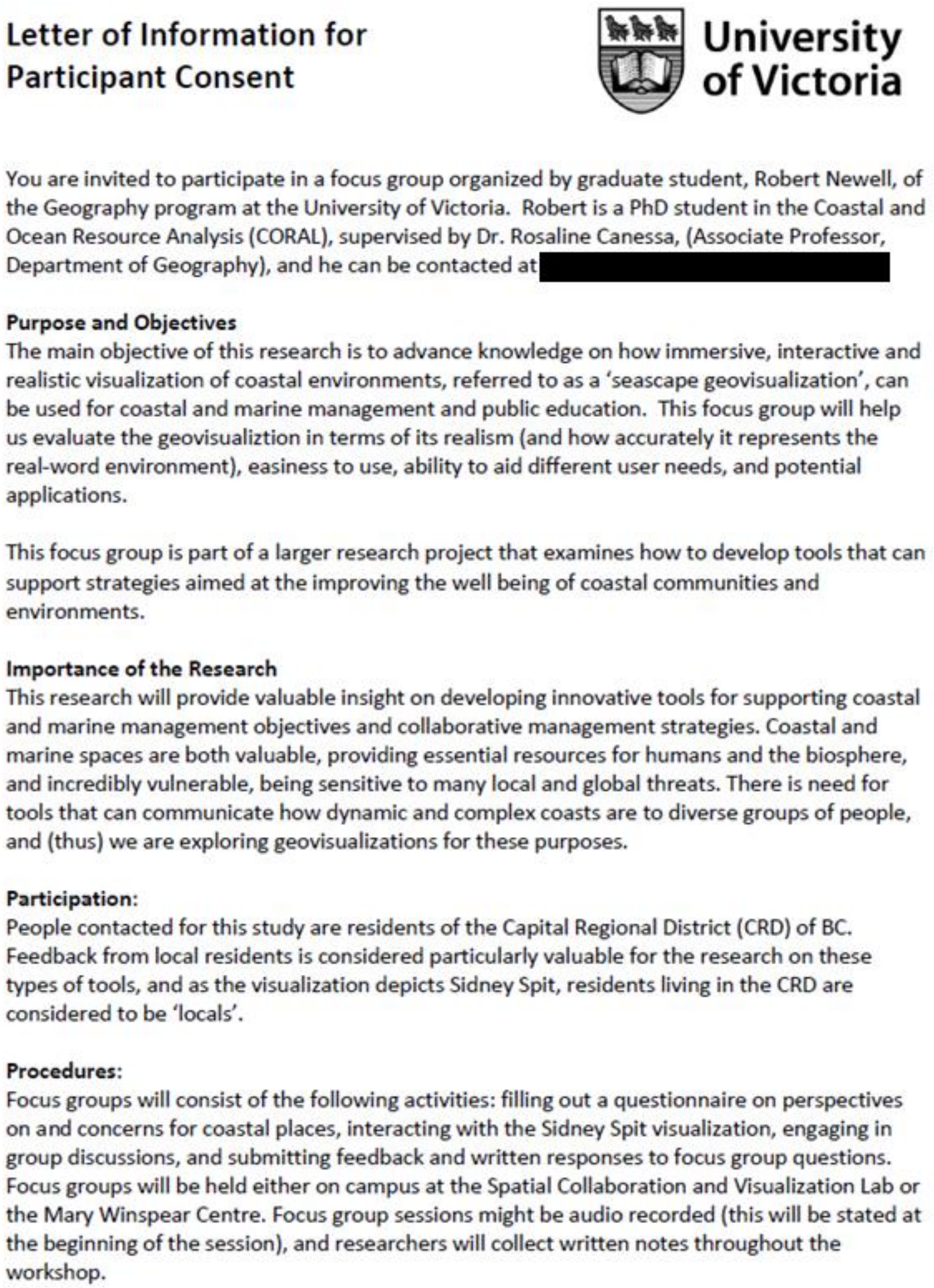
Contact me at [redacted] for more details. Thank you for your time, and I hope to hear from you soon.

Sincerely,

Robert Newell
PhD Candidate, Geography
University of Victoria

Coastal and Ocean Resource Analysis Laboratory
Department of Geography, University of Victoria
Turpin Building, 3800 Finnerty Road, V8P 5C2

Appendix I. Letter of information for participant consent (focus group)



Letter of Information for Participant Consent

University of Victoria

You are invited to participate in a focus group organized by graduate student, Robert Newell, of the Geography program at the University of Victoria. Robert is a PhD student in the Coastal and Ocean Resource Analysis (CORAL), supervised by Dr. Rosaline Canessa, (Associate Professor, Department of Geography), and he can be contacted at [redacted]

Purpose and Objectives

The main objective of this research is to advance knowledge on how immersive, interactive and realistic visualization of coastal environments, referred to as a 'seascape geovisualization', can be used for coastal and marine management and public education. This focus group will help us evaluate the geovisualiztion in terms of its realism (and how accurately it represents the real-word environment), easiness to use, ability to aid different user needs, and potential applications.

This focus group is part of a larger research project that examines how to develop tools that can support strategies aimed at the improving the well being of coastal communities and environments.

Importance of the Research

This research will provide valuable insight on developing innovative tools for supporting coastal and marine management objectives and collaborative management strategies. Coastal and marine spaces are both valuable, providing essential resources for humans and the biosphere, and incredibly vulnerable, being sensitive to many local and global threats. There is need for tools that can communicate how dynamic and complex coasts are to diverse groups of people, and (thus) we are exploring geovisualizations for these purposes.

Participation:

People contacted for this study are residents of the Capital Regional District (CRD) of BC. Feedback from local residents is considered particularly valuable for the research on these types of tools, and as the visualization depicts Sidney Spit, residents living in the CRD are considered to be 'locals'.

Procedures:

Focus groups will consist of the following activities: filling out a questionnaire on perspectives on and concerns for coastal places, interacting with the Sidney Spit visualization, engaging in group discussions, and submitting feedback and written responses to focus group questions. Focus groups will be held either on campus at the Spatial Collaboration and Visualization Lab or the Mary Winspear Centre. Focus group sessions might be audio recorded (this will be stated at the beginning of the session), and researchers will collect written notes throughout the workshop.

Inconvenience:
Depending on where the focus group is held, the session will take 2 hours (off campus) or 4 hours (on campus at the Spatial Collaboration and Visualization Lab), not including the time it takes to travel to the focus group location. An additional 5 hours will be factored into focus group sessions that involve a trip to Sidney Spit, summing to a total of 7 hours. These groups will leave from Beacon Pier on the Alpine II ferry, be permitted 2 hours to freely explore the Spit, and then return to the Sidney Spit dock to board the next available ferry.

Compensation:
Transportation and parking costs will be covered for participants in focus groups to ensure that they are not participating at their own expense. For groups travelling to Sidney Spit, ferry fares will be covered.

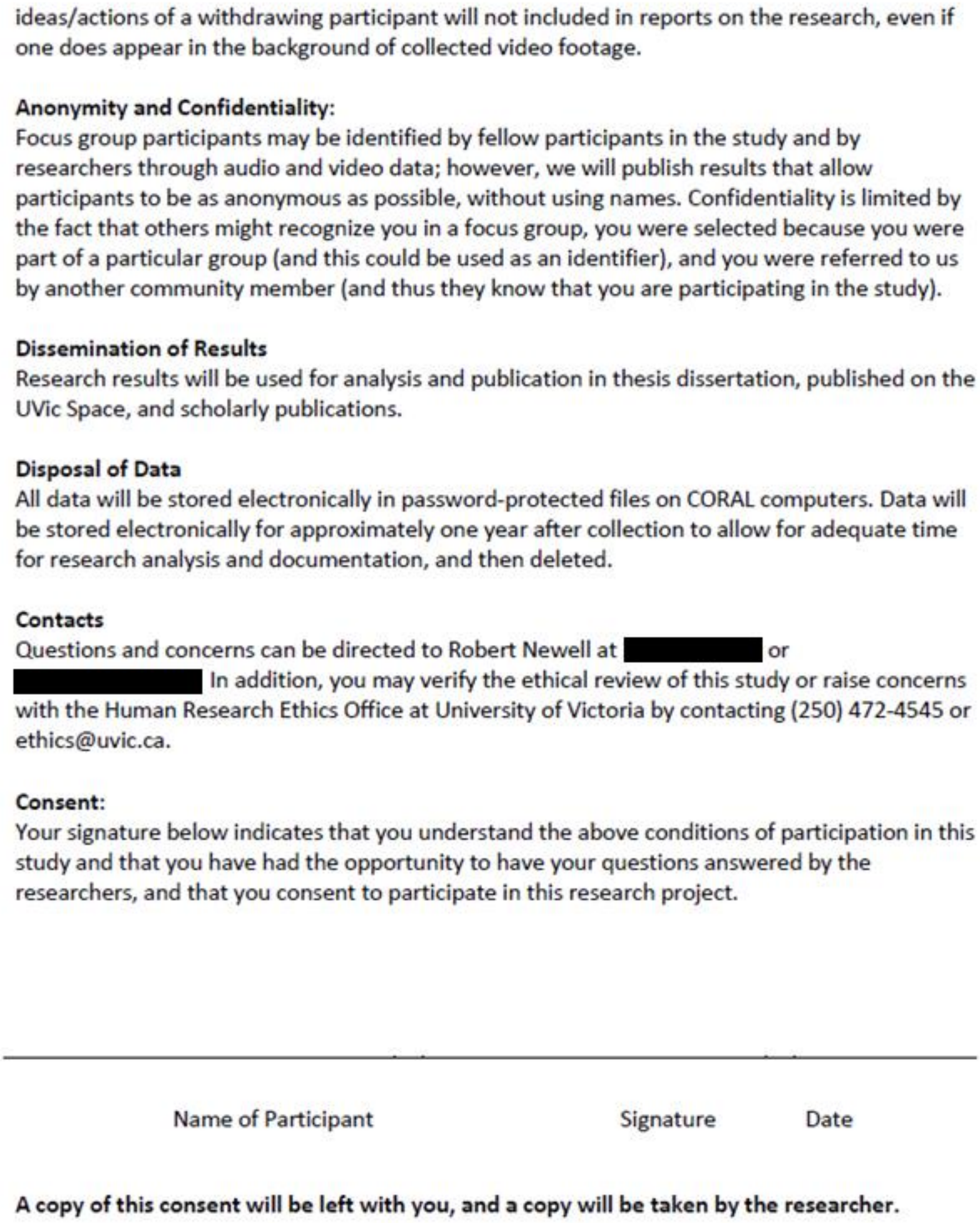
Benefits:
The participant will get to virtually explore Sidney Spit and get a better understanding of the area and coastal environments, in general. In addition, participants will be able to provide feedback on how to use and improve the geovisualization, which could lead to newer versions of the tool that will include their needs and interests.

Risks:
Some of the focus groups involved specific coastal user types and people in political positions, and some questions look at how geovisualizations can be used for collaborative coastal management. Because the focus groups will be guided by a semi-structured interview format, it is possible sensitive information regarding personal working relationships and tensions between governing and/or user groups could be revealed in the interview. Any sensitive information regarding personal/professional conflicts can be indicated by participants as 'off the record', and this will not be included in the research analysis and documentation.

Some physical risks are present for groups traveling to Sidney Spit, during the travel to and exploration of the park. These are typical risks associated with being in an outdoor setting such, as exposure to weather and possible tripping. In addition, there are certain physical risks with the boat ride out to the Spit, such as falling into water.

Withdrawal of Participation:
Participation in this project must be entirely voluntary. You may withdraw at any time without explanation or consequence. You can request your responses/input to be removed from the research. In addition, video data collected involving the participant will be deleted if it does not impact another participants' contribution.

In the circumstance that a withdrawing participant or a part of the participant is visible in the frame of a video that features the actions or discussion another participant, we will attempt to crop out the person before storing video data on UVic computers. There is a possibility that we might not be able to remove all visible traces of a withdrawing participant; however, we would like to stress that video footage will only be used for analysis by the researchers and



ideas/actions of a withdrawing participant will not included in reports on the research, even if one does appear in the background of collected video footage.

Anonymity and Confidentiality:
Focus group participants may be identified by fellow participants in the study and by researchers through audio and video data; however, we will publish results that allow participants to be as anonymous as possible, without using names. Confidentiality is limited by the fact that others might recognize you in a focus group, you were selected because you were part of a particular group (and this could be used as an identifier), and you were referred to us by another community member (and thus they know that you are participating in the study).

Dissemination of Results
Research results will be used for analysis and publication in thesis dissertation, published on the UVic Space, and scholarly publications.

Disposal of Data
All data will be stored electronically in password-protected files on CORAL computers. Data will be stored electronically for approximately one year after collection to allow for adequate time for research analysis and documentation, and then deleted.

Contacts
Questions and concerns can be directed to Robert Newell at [redacted] or [redacted] In addition, you may verify the ethical review of this study or raise concerns with the Human Research Ethics Office at University of Victoria by contacting (250) 472-4545 or ethics@uvic.ca.

Consent:
Your signature below indicates that you understand the above conditions of participation in this study and that you have had the opportunity to have your questions answered by the researchers, and that you consent to participate in this research project.

Name of Participant   Signature   Date

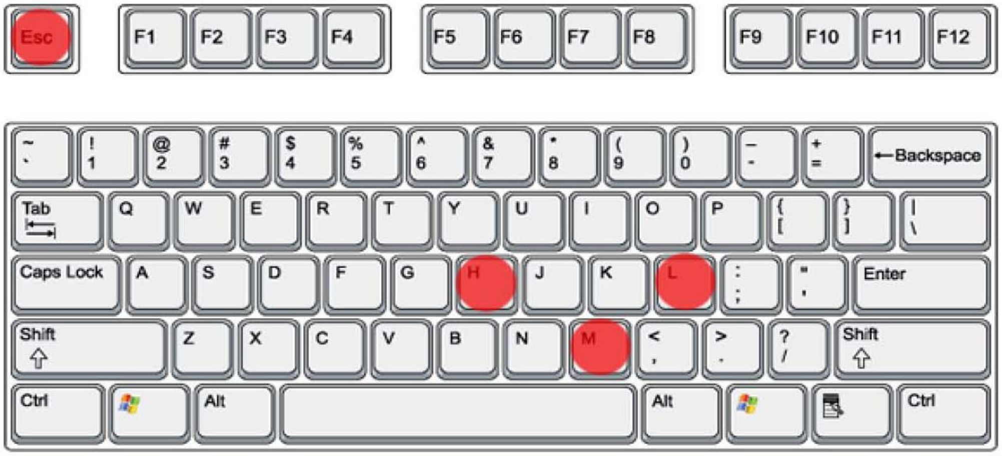
A copy of this consent will be left with you, and a copy will be taken by the researcher.

Appendix J. Geovisualization user manual

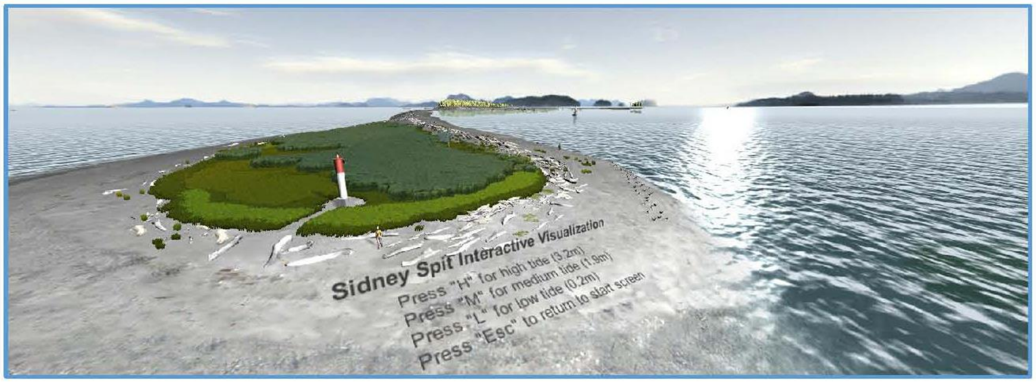
Sidney Spit Visualization – *User's Guide*

TITLE SCREEN AND TIDES

KEYS USED



DESCRIPTION OF ACTIONS



Sidney Spit Interactive Visualization
Press "H" for high tide (3.2m)
Press "M" for medium tide (1.9m)
Press "L" for low tide (0.2m)
Press "Esc" to return to start screen

When you begin the visualization, you will see instructions that explain which keys control the tides. Click one of the keys to start the visualization at a particular water level. You can select a different water level while in visualization; however, this will restart the visualization with the new level present.

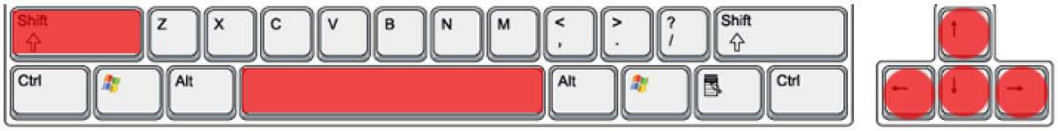
- **Press "H"** to start the visualization at high tide (3.2m)
- **Press "M"** to start the visualization at medium tide (1.9m)
- **Press "L"** to start the visualization at low tide (0.2m)
- **Press "Esc"** to return to the title screen

NAVIGATION

KEYS USED

DESCRIPTION OF ACTIONS

The keys designated for navigation were selected to allow for relatively intuitive first-person movement. The arrows keys serve as the primary controls for navigation. Your walking speed in the visualization is approximately 10 km/hour.

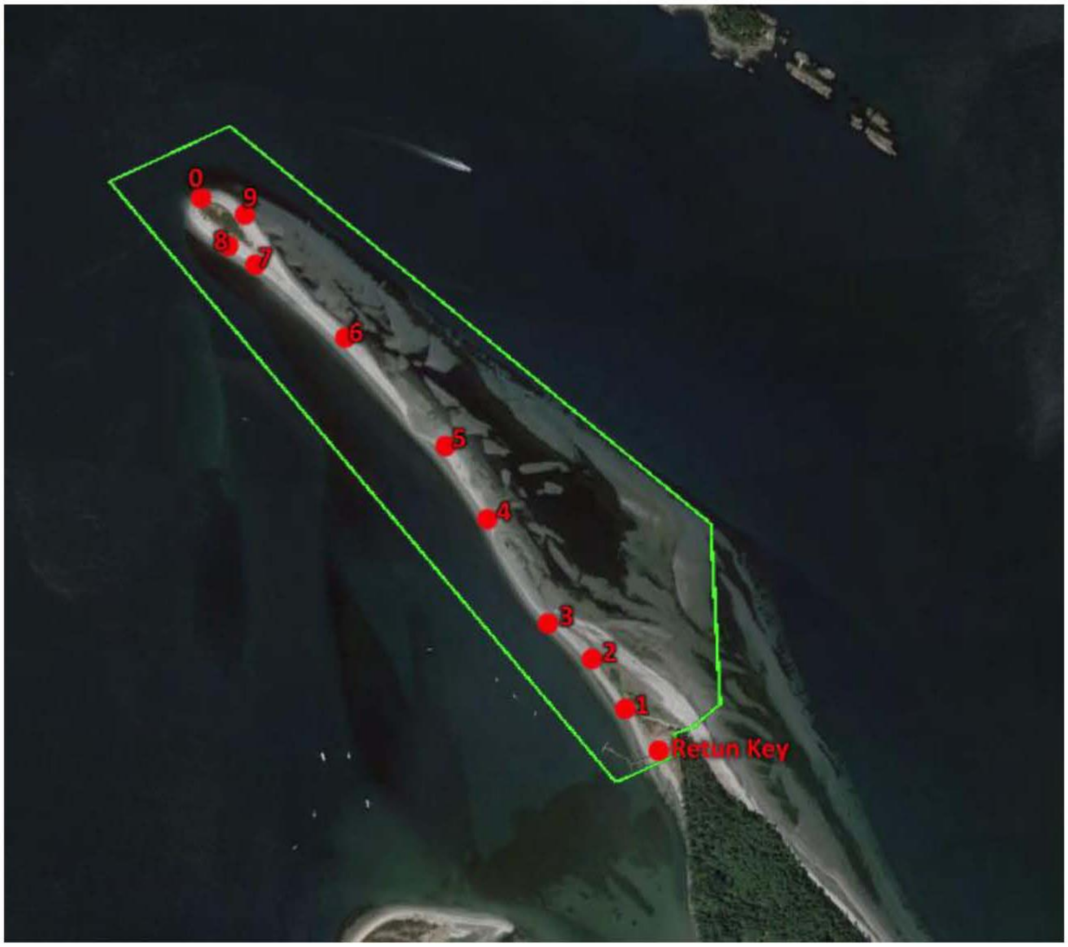


- **Press "Up Arrow"** key to walk forward
- **Press "Back Arrow"** key to walk backward
- **Press "Left Arrow"** key to rotate left
- **Press "Right Arrow"** key to rotate right
- **Press "Space bar"** to jump
- **Hold "Shift"** while moving forward to "run" (i.e., move twice as fast)

Sidney Spit Visualization – *User's Guide*

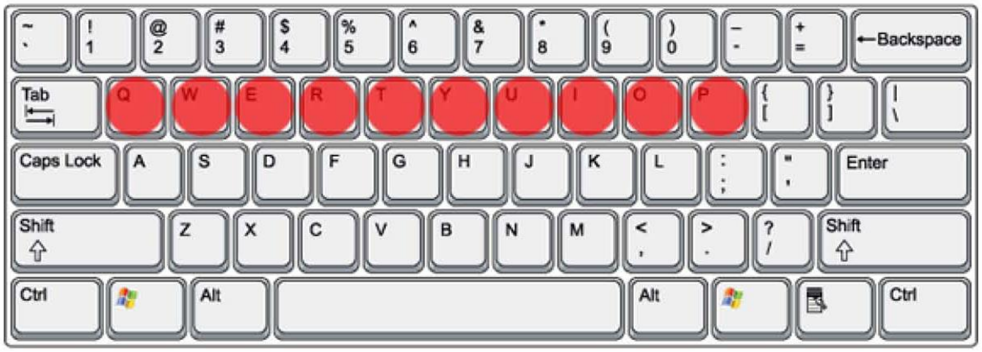
While in the visualization, you can explore an area of approximately 85 hectares (210 acres), consisting of the land and marine space between the Sidney Spit dock and (about) 130 metres past the end of the spit. This navigable area is surrounded by invisible boundaries that you cannot cross. These boundaries are identified on the map below with green lines.

You will enter the visualization at the Sidney Spit dock. For convenience sake, "teleportation points" have been placed along the spit. If you press any of the number keys, you will be teleported to a location. The map below shows these teleportation point locations and their corresponding number keys. Click the "return/enter" key to return back to the dock.



FENCING SCENARIOS

KEYS USED



DESCRIPTIONS OF SCENARIOS AND ACTIONS

Fencing scenarios show different fencing options for protecting an area of the spit after Scotch broom has been removed. Following the removal of the broom, plants such as contorted-pod evening-primrose, silky beach pea, yellow sand verbena and dune grasses are expected to populate the area.

There are two configurations of fencing – one that spans only the west side of the vegetation area and one that completely encompasses a smaller critical restoration area at the north end of the vegetation area. In addition, there are three different types of fencing materials – wood, metal mesh, and rope.

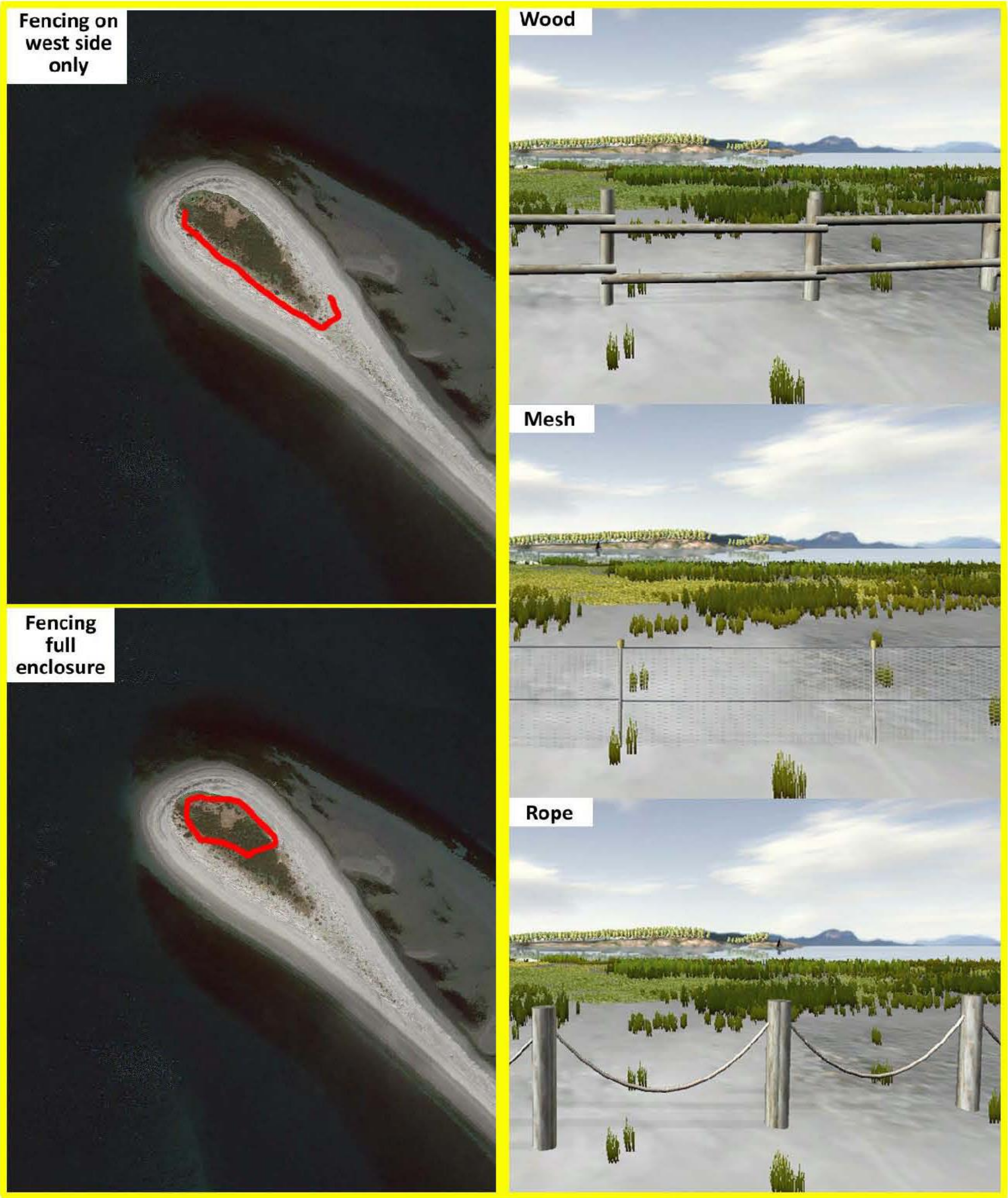
Altogether, this creates six different fencing scenarios:

- West side only, fenced using wooden materials
- West side only, fenced using metal mesh
- West side only, fenced using rope

- Complete enclosure, fenced using wooden materials
- Complete enclosure, fenced using metal mesh
- Complete enclosure, fenced using rope

***Tip*: The fencing scenarios are near teleportation points "7", "8", "9", and "0". You may wish to teleport to these points while exploring the scenarios.**

The maps on the left side of the image below show the locations of the different fencing configurations. The pictures on the right side of the image below show the different fencing material types.



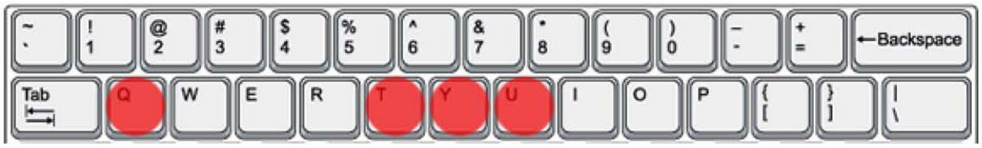
Controls for "west side only" fencing scenarios

To bring up the "west side only" fencing scenarios, use the keys below:

- **Press "W"** for west side only fenced using wooden materials
- **Press "E"** for west side only fenced using metal mesh
- **Press "R"** for west side only fenced using rope
- **Press "Q"** to return to original state with Scotch broom present

Controls for "full enclosure" fencing scenarios

To bring up the "full enclosure" fencing scenarios, use the keys below:



- **Press "T"** for complete enclosure fenced using wooden materials
- **Press "Y"** for complete enclosure fenced using metal mesh
- **Press "U"** for complete enclosure fenced using rope
- **Press "Q"** to return to original state with Scotch broom present

With each fencing scenario, the user can place signs in different positions around the fence. These signs serve to tell park visitors to stay out of the vegetation area.

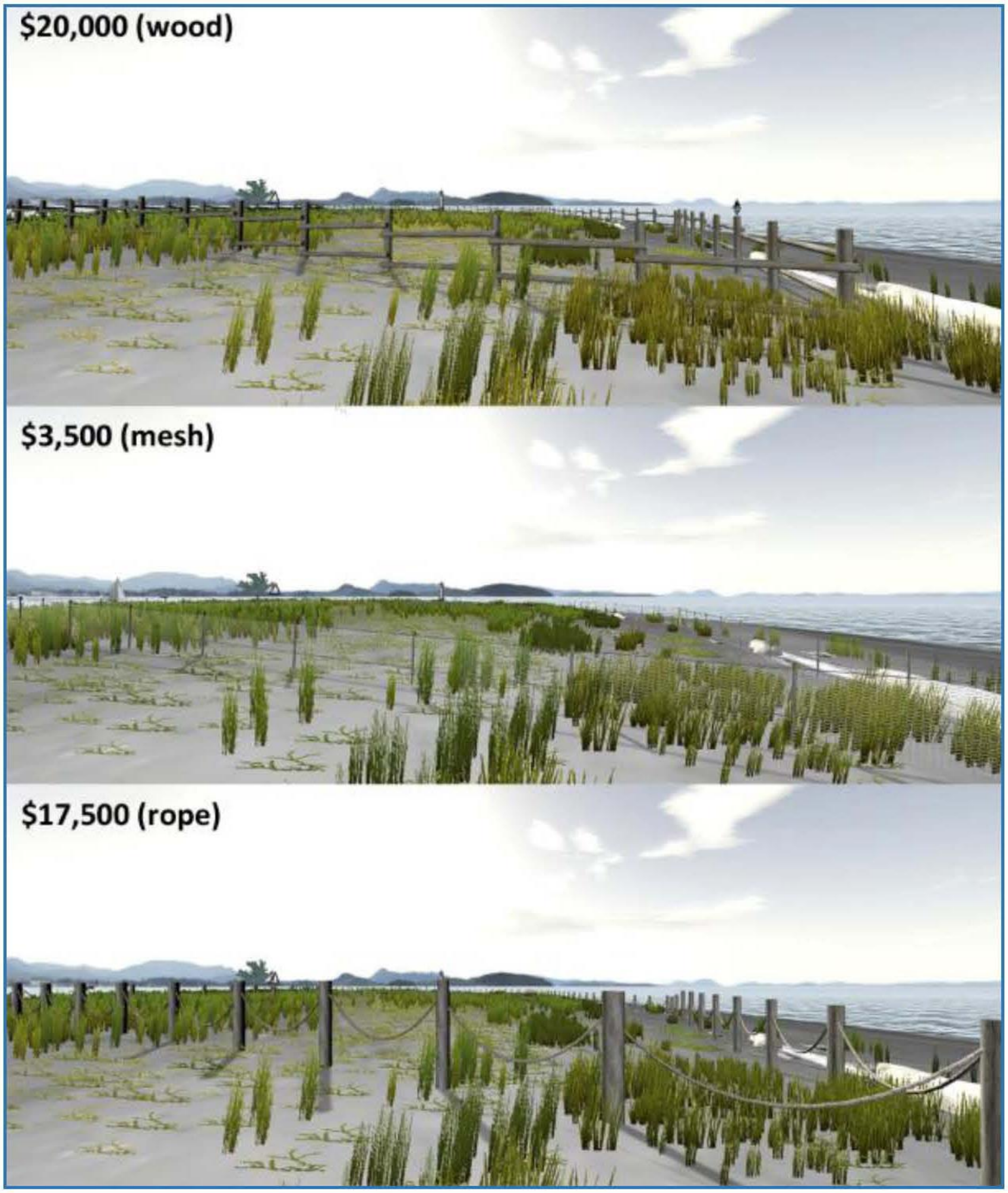
There are three potential locations for signs for both the "west side only" and "full enclosure" scenarios. Signs can be moved to these potential locations using the **"I", "O", and "P" keys**. The maps below show the potential locations for each sign and the key commands for placing the signs at the different locations.

West side only

Full enclosure

It is important to note that different scenarios can come with different costs. These costs will not differ dramatically depending on whether "west side only" or "full enclosure" configurations, as both configurations require similar fence lengths (212 metres and 222 metres, respectively). However, costs will differ more significantly depending on the materials used to build the fences.

Below are VERY ROUGH estimates for difference in pricing for each fencing type. The estimates take into account both materials and labour.



$20,000 (wood)

$3,500 (mesh)

$17,500 (rope)

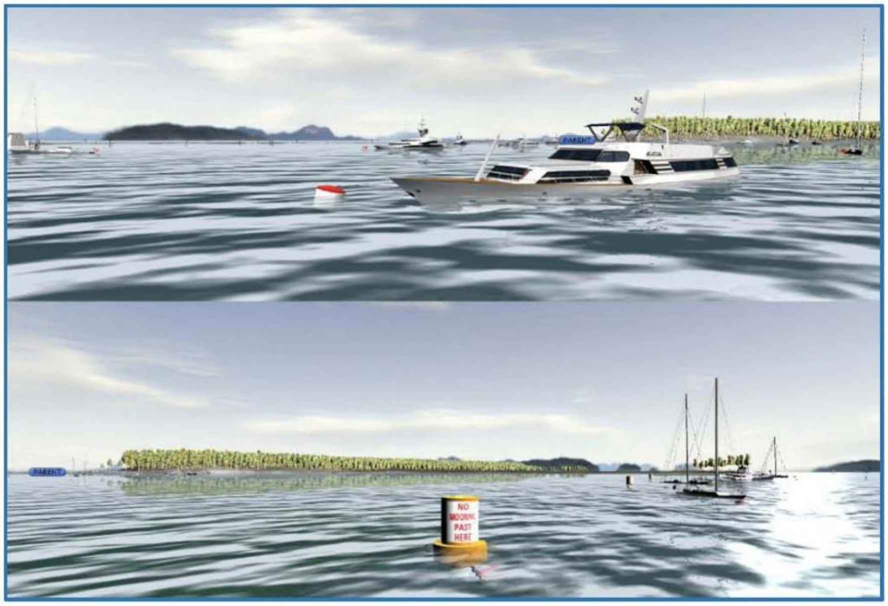
MOORING BUOY SCENARIOS

KEYS USED

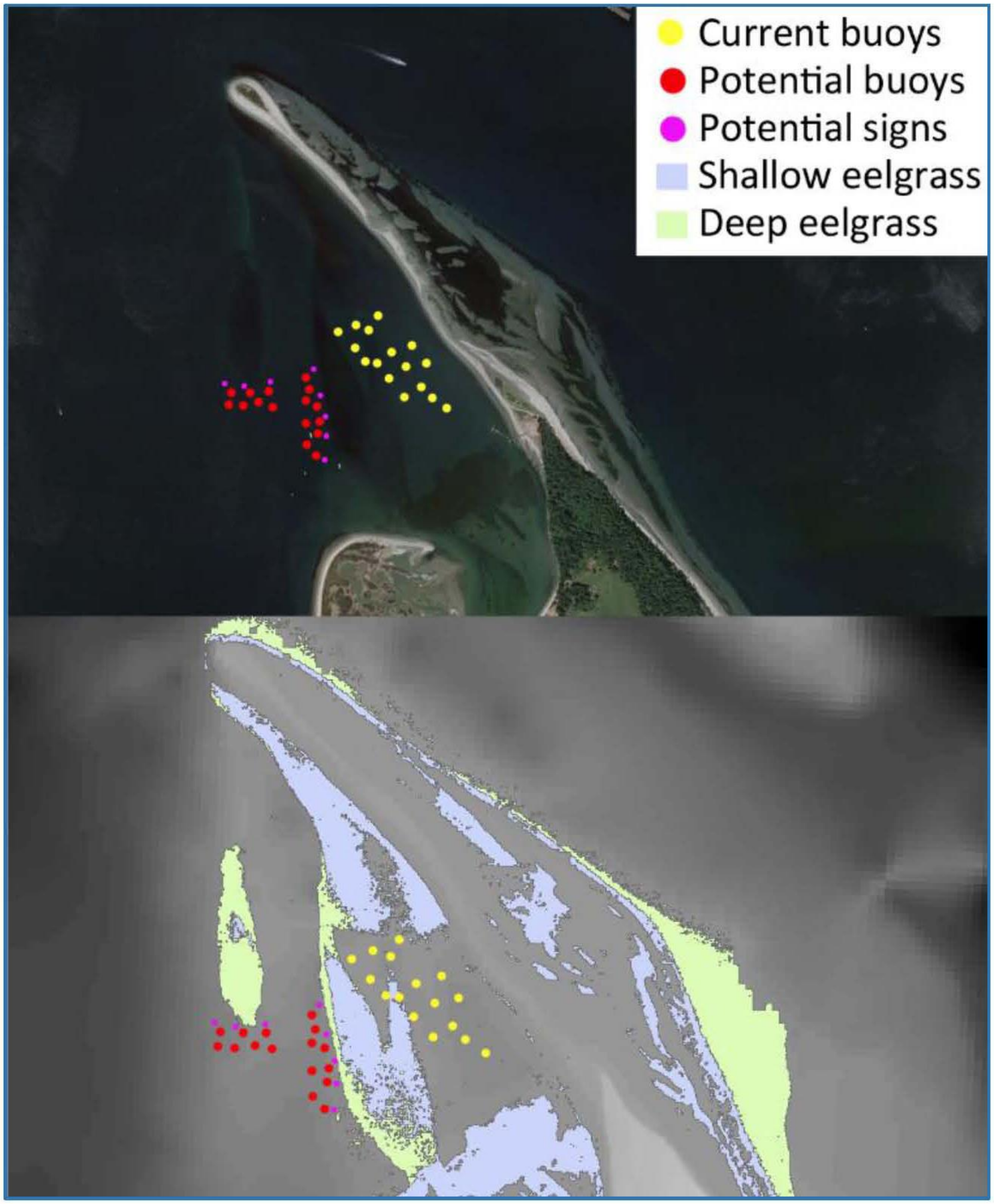
DESCRIPTIONS OF SCENARIOS AND ACTIONS

Mooring buoy scenarios consist of mooring buoys clustered in two different locations – the current location of the buoys and a potential relocation of the buoys. The relocation scenario would position the buoys outside of the eelgrass meadows around the spit, keeping boats from entering the meadows area and potentially damaging eelgrass with anchors.

Each mooring buoy scenario involves 16 buoys. The relocation scenario also includes floating signs that ask boaters not to moor past the signs.



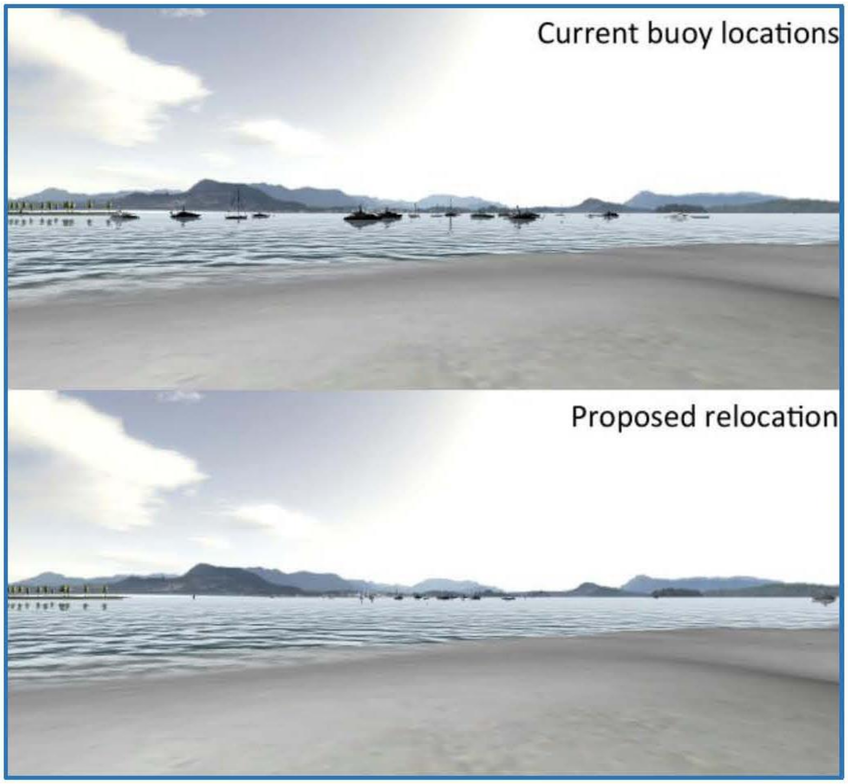
Below are maps displaying the current locations of the mooring buoys, the proposed relocation scenario, the proposed locations for floating signs, and locations of eelgrass meadows.



Mooring buoy scenarios can be experienced in two ways. The first is by viewing the position of the boats from land. Toggle the scenarios while on the spit (or in the waters around the spit) by using the keys below:

- **Press "A"** for the "current buoy locations" scenario, featuring the current mooring buoy locations
- **Press "S"** for the "proposed relocation" scenario, featuring the proposed relocation of mooring buoys

***Tip*: The boats in the different mooring buoy scenarios can be viewed well from teleportation points "1", "2", "3", and "4". You may wish to teleport to these points while exploring the scenarios. The images below show how the two scenarios appear when at teleportation point "3".**

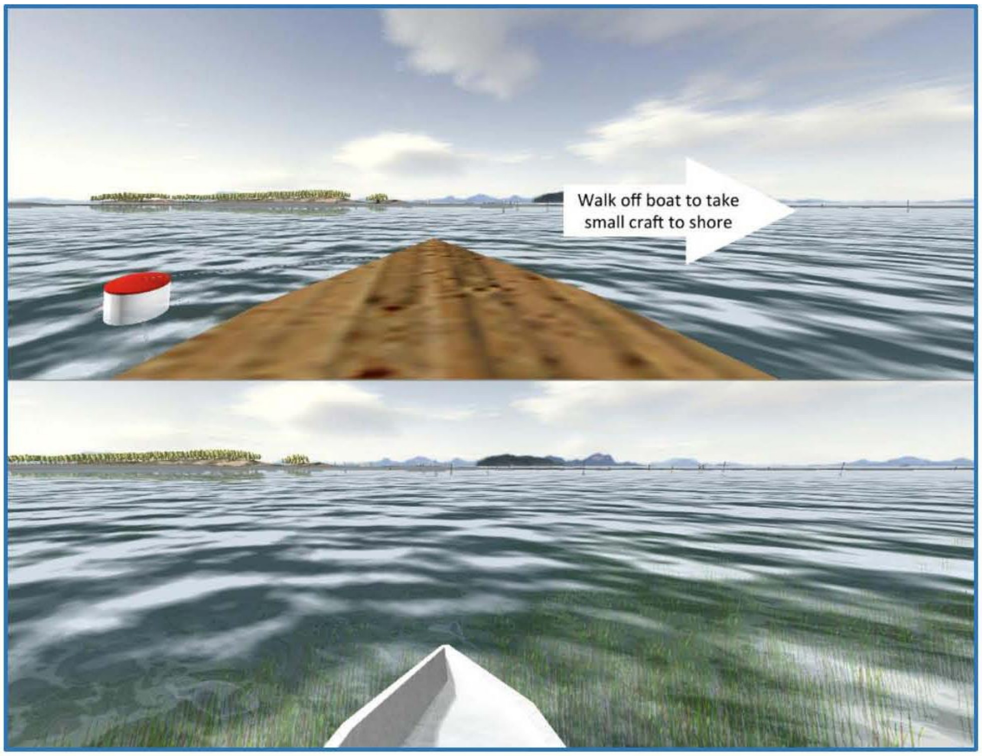


The second way of experiencing mooring buoy scenarios is through teleporting to and boarding one of the boats. This is done using the keys below:

- **Press "D"** to toggle the current buoy locations scenario, while also boarding one of the boats
- **Press "F"** to toggle the proposed relocation scenario, while also boarding one of the boats

The boats that you can board in each of the scenarios are identified in the map below using white arrows. The boat in the current buoy locations scenario is approximately 200 metres from shore of Sidney Spit, and the boat in the proposed relocation scenario is approximately 500 metres from shore.

When the user of the visualization is on a boat, he/she can take a small craft to get to shore. To do this, the user needs to walk off the starboard (i.e., right-hand) side of the boat.



The small craft travels about 7 knots (13 km/hour). The travel time to shore for the current buoy locations scenario is approximately 55 seconds, and the travel time to shore for the proposed relocation scenario is just under 2 minutes and 20 seconds. Once the user reaches the shore, he/she is back on the spit in a location near teleportation point "4".

While traveling to shore, the user may look around using the keyboard and mouse; however, it is best not to teleport or toggle scenarios during this time.

Other considerations around the mooring buoy scenarios include the following.

- The current buoy locations scenario features a mooring buoy system that is anchored by concrete blocks, as this is the system currently in place at Sidney Spit (these blocks can been seen in the visualization). The proposed relocation scenario will likely employ helical anchors that "screw" into the sea floor and take up less sea floor space.
- The boats in the proposed relocation scenario are (on average) 27% closer to one another.
- The proposed relocation scenario will require 25% more chain.

DOG SCENARIOS

KEYS USED

DESCRIPTIONS OF SCENARIOS AND ACTIONS

Dog scenarios concern the regulations around pets brought to the island by their owners. Current regulations require dogs to be on-leash at all times during the park; however, the regulations are not always followed (whether deliberately or due to lack of knowledge) and owners often let dogs off-leash. The concern held by the park managers is that off-leash dogs can disturb the wildlife that use the park.

Three dog scenarios are implemented in the visualization:

1. The park as it currently is, meaning dogs are supposed to be on-leash at all times but some people do not follow this regulation
2. People are prohibited from bringing dogs to the park
3. The park managers increase enforcement and signage to strength the regulations

The scenarios can be toggled by using the keys below:

- **Press "Z"** to toggle the first scenario
- **Press "X"** to toggle the second scenario
- **Press "C"** to toggle the third scenario

There are two dogs in the park. The dog owners and dogs can be reached quickly by teleporting to points "2" and "7", as seen in the map below.

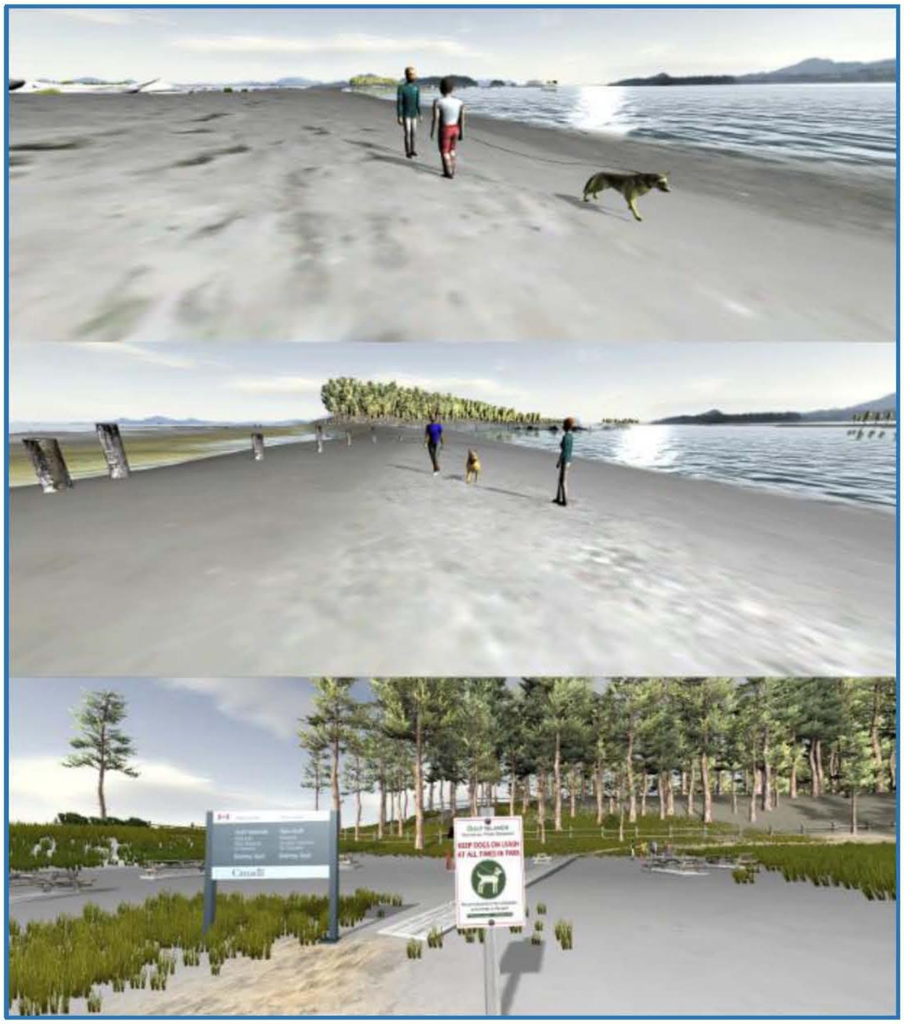
In the first scenario, one dog (i.e., "Dog 1") is on-leash and the owner is walking this dog along the spit. The other dog (i.e., "Dog 2") is off-leash and running away from the owner, up the spit. The off-leash dog disturbs a flock of birds toward the north end of the spit (the location of the birds is shown on the map below).

In the second scenario, the dog owners are still present in the park; however, dogs are no longer with these people.

In the third scenario, two Parks Canada staff are on the island to enforce the on-leash regulation. One staff member can be found talking to the owner of Dog 2, reminding him to keep his dog on a leash while in the park. The other staff member can be found near Dog 1, and she reminds people of the regulation while they walk by her. The staff member near Dog 1 also thanks the owner of the dog for using a leash, when the owner and dog walk by her.

In addition to increasing Parks Canada presence, a sign is posted by the Sidney Spit dock, reminding people of the on-leash regulation.

It is important to recognize that the third scenario has associated costs, as it requires mounting a new sign and time spent by staff members. The staff time can be particularly costly. Even when employing summer co-op students paid at a rate of $13/hour, this can cost $195/day with 2 students working 7.5 hour days.



Appendix K. Focus group feedback forms

Before we begin…

Prior to today, have you visited Sidney Spit before? (circle one)

Yes

No

When was your last visit? (circle one)

Within the last week

Within the last month

Within the last year

Over a year ago

How many times have you been to Sidney Spit? (circle one)

Once before

2 to 5 times

Over 5 times

Survey ID___

Sidney Spit Visualization Feedback Form

SECTION 1. *REPRESENTATION OF PLACE*

1. **On the scale below, rate how well the visualization represents a real-world place:**

   Not at all - 1 2 3 4 5 6 7 8 9 10 - ***Extremely well***

2. **What aspects of the visualization contribute to its realism and sense of place?**

3. **What aspects detract from its realism and sense of place? Are there key elements ‘missing’ or ‘misrepresented’?**

Sidney Spit Visualization Feedback Form

SECTION 2. *FENCING SCENARIOS*

1. Which of the two fencing configurations do you feel should be implemented?

West side only Full enclosure

Please explain your selection above:

2. Rank the fencing materials – *wood, mesh, rope* - in order of preference:

1st preference______________________________

2nd preference______________________________

3rd preference______________________________

Please explain your selection above:

Sidney Spit Visualization Feedback Form

3. Where do you think is the best placements for the signs for…

…the "west side only" scenario: I O P

…the "full enclosure" scenario: I O P

Please explain your selections above:

4. Do you find the visualization to be a useful tool for evaluating potential fencing scenarios?

Not useful at all - 1 2 3 4 5 6 7 8 9 10 - ***Very useful***

Please comment on its strengths and/or its weaknesses.

Sidney Spit Visualization Feedback Form

SECTION 3. *MOORING SCENARIOS*

1. Which of the mooring buoy scenarios do you prefer when experiencing…

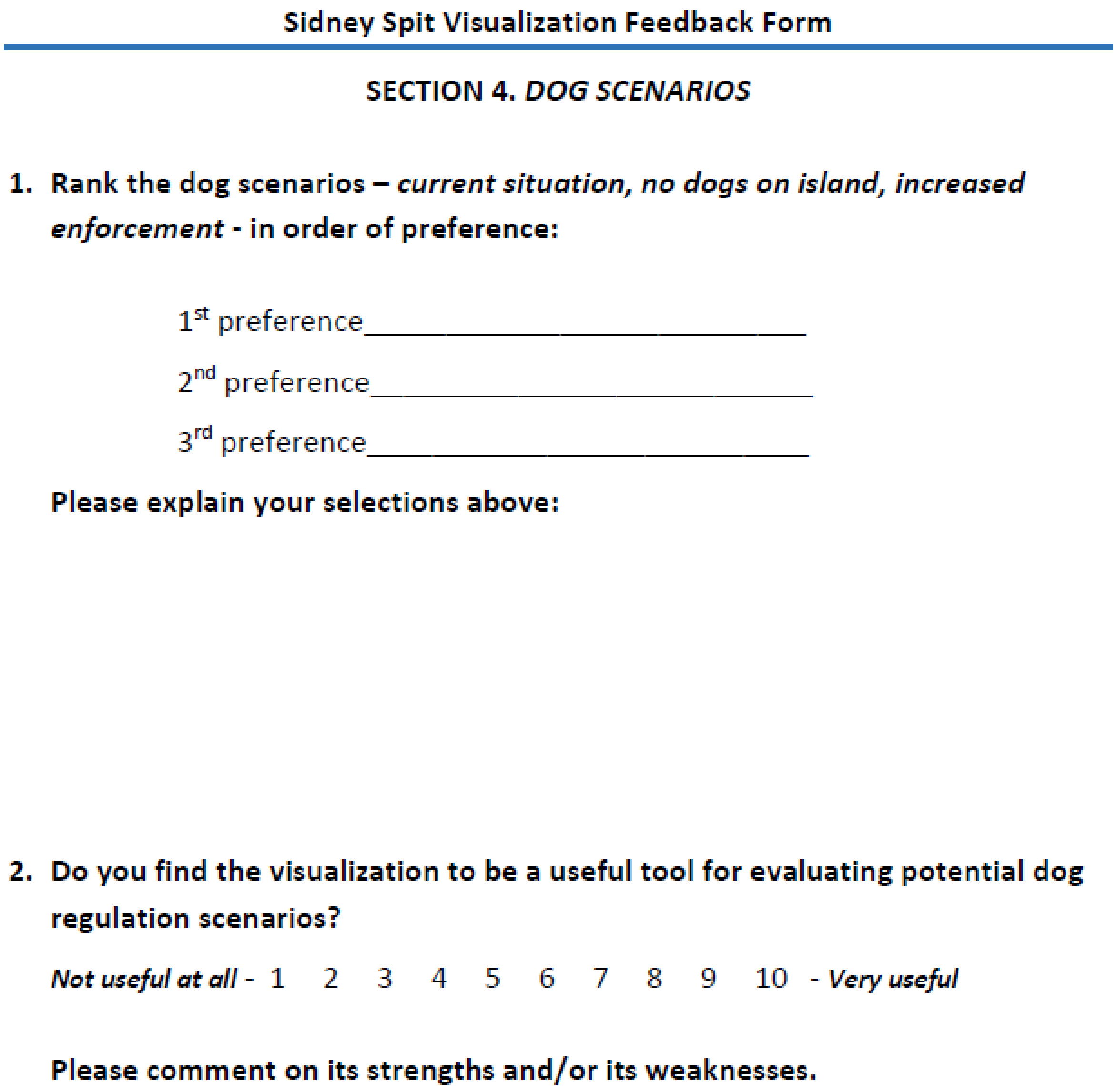
…from land:	current location	proposed relocation
…from the boat:	current location	proposed relocation

Please explain your selections above:

2. Do you find the visualization to be a useful tool for evaluating potential mooring buoy scenarios?

Not useful at all - 1 2 3 4 5 6 7 8 9 10 - *Very useful*

Please comment on its strengths and/or its weaknesses.



Sidney Spit Visualization Feedback Form

SECTION 4. *DOG SCENARIOS*

1. **Rank the dog scenarios – *current situation, no dogs on island, increased enforcement* - in order of preference:**

1st preference______________________________

2nd preference______________________________

3rd preference______________________________

Please explain your selections above:

2. **Do you find the visualization to be a useful tool for evaluating potential dog regulation scenarios?**

Not useful at all - 1 2 3 4 5 6 7 8 9 10 - *Very useful*

Please comment on its strengths and/or its weaknesses.

Note: The third dog management scenario is described as ‘increased enforcement’; however, this scenario was designed and presented to the focus groups as efforts for increasing awareness around dog regulations. Therefore, this scenario is referred to as ‘increased awareness’ when discussing this aspect of the research in the dissertation (i.e., in Chapter 6).

Sidney Spit Visualization Feedback Form

SECTION 5. *User friendliness*

1. **On the scale below, rate the user-friendliness of the visualization:**

   Difficult to use - 1 2 3 4 5 6 7 8 9 10 - ***Easy to use***

2. **Which features of the visualization were easy to use and worked well?**

3. **What could be improved or added to make for a better user experience?**

4. **How essential were the supporting materials when using the visualization to evaluate scenarios, such as the maps and cost estimates in the user guide?**

Sidney Spit Visualization Feedback Form

SECTION 6. *APPLICATIONS*

1. **What other scenarios or applications do you think the visualization could be used for and who would use benefit from these?**

2. **Thinking of this as a communication tool, does the visualization provide any new understandings or perspectives on coastal environments?**