Exploring Ecological and Social Forms of Connectivity in Kespukwitk, Nova Scotia

by

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Dalhousie University is located in Mi'kma'ki,
the ancestral and unceded territory of the Mi'kmaq.
We are all Treaty people.

DEDICATION PAGE

To my niece Lydia Jean Griffin, born sleeping July 30th, 2021 – in loving memory.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Connectivity is an essential component of conservation efforts. Ambiguity surrounding the term makes distinguishing between multiple forms difficult, posing challenges to implementation. This research aims to address two key gap—the limited social science research focusing on connectivity; and the ambiguity associated with applying both ecological and social conceptualizations of connectivity—through an explorative, mixed-methods approach incorporating qualitative and spatial methodologies, in southwestern Nova Scotia, Canada. The findings indicate that a plurality of forms of connectivity are considered both conceptually and spatially, including ecological and social forms, such as ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human) connectivity, consistent with Hodgetts' taxonomy (2018). Considering such forms of connectivity and their inter-relationships between types can support connectivity conservation planning that considers ecological, social, economic, and cultural realms. Distinguishing between "plural" types of connectivity was found to illuminate the relationships between types, and thus served to illuminate approaches to viewing connectivity as an indivisible whole, and thus "a multiple".

The study uses Hodgetts (2018) taxonomy of connectivity types to examine how connectivity is discussed and conceptualized by those working on the ground within the conservation community. By engaging with experts and other key local knowledge holders through in-depth, semi-structured interviews within the study region of Nova Scotia (Mi'kmaq district of Kespukwitk), both social and ecological forms of connectivity and how they are delineated through spatial prioritization of focal areas for connectivity were examined. When thematically analyzed through inductive-deductive hybrid coding, all six core types of connectivity proposed in Hodgetts' taxonomy were found to be frequently discussed by participants, representing those also proposed on Hodgetts' taxonomy (2018). These include ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human) connectivity. Various nuanced examples of each were found, including aquatic, cultural, human, social (well-being) connectivity, and interconnectedness. All of the above-mentioned forms of connectivity were also found to be prevalent in participants' mapping of key focal areas for connectivity in the region, to varying extents, with ecological-functional, spatial-structural, and social (economic) connectivity being the most prevalent.

This research demonstrates the utility of a social science research approach to understanding underlying meanings associated with connectivity, the findings of which indicate a diverse sub-set of connectivity types, many of which are social in nature. This supports the broader tenant that social elements are of equal importance to conservation work, alongside ecological and biophysical considerations, with social forms of connectivity being key for both the conceptualization of connectivity and the spatial delineation of areas for connectivity. I found utility in examining the "plural" forms of connectivity, including the relationships between such forms, which may be most useful in practice, while conceptions of connectivity as "a multiple" may represent an ideal to strive for. I propose that we cannot move towards a true conception of an indivisible, holistic view of connectivity as "a multiple" without learning from and giving priority to Indigenous worldviews.

LIST OF ABBREVIATIONS AND SYMBOLS USED

ACPF – Atlantic Coastal Plain Flora

ATV – All-terrain vehicle

CCEA – Canadian Council on Ecological Areas

CBD – International Convention on Biological Diversity

CCSG – Connectivity Conservation Specialist Group

CFCI – Colin Stewart Forest Forum Steering Committee

CICS – Canadian Intergovernmental Conference Secretariat

CMM – Confederacy of Mainland Mi'kmaq

CMS – Convention on Migratory Species

ECCC – Environment and Climate Change Canada

ECP – Eastern Canadian Premiers

GIS – Geographic Information Science

IUCN – International Union for Conservation of Nature

NEG – New England Governors

NS – Nova Scotia

NWOOA – Nova Scotia Woodlot Owners & Operators Association

SES – Social-Ecological System

SNBR – Southwest Nova Biosphere Reserve

SNBRA – Southwest Nova Biosphere Reserve Association

SWNS – Southwest Nova Scotia

UINR – Unama'ki Institute of Natural Resources

WCPA – World Commission on Protected Areas

WWF-Canada – Worldwide Fund for Nature – Canada

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CHAPTER 1: INTRODUCTION

1.1 Problem Statement: Biodiversity Crisis

The loss of biodiversity globally has been referred to as a biodiversity crisis (Anderson & Jenkins, 2006; Polasky, 2008; Rudnick et al., 2012; Steffen et al., 2019). Biodiversity loss is continuing to occur at unprecedented rates; this is attributed to intensifying human pressures, habitat fragmentation, and climate change impacts (Diaz, Settele & Brondizio, 2019; Hilty et al., 2020; Opdam & Wascher, 2004; Western, Waithaka & Kamanga, 2015). Habitat connectivity has been proposed as a potential path forward from this crisis that would support the adaptation of both species and humans to climate change, while addressing key drivers of biodiversity loss such as habitat fragmentation and conversion (Anderson & Jenkins, 2006; Cumming & Allen, 2017; Diaz et al., 2019; Hilty et al., 2020; Opdam & Wascher, 2004).

The ecological aspects of connectivity conservation have been subject to considerable research, such as approaches used to model ecological connectivity (for an overview of connectivity metrics, see Keeley et al., 2021; and for guidelines on ecological connectivity, see Hilty et al., 2020). However, potential advancements in connectivity conservation research will not progress if planning does not effectively include human dimensions (Rudnick et al., 2012). Translating what is known about the science and management of connectivity into policy and practice is a considerable challenge (Keeley et al., 2018; Lemieux et al, 2021d). Natural sciences, such as ecological connectivity analyses, are necessary for effective corridor planning, but social processes may be just as important for implementation success (Keeley et al., 2018; Parrott et al., 2019). Connectivity across a landscape is impacted by social characteristics and patterns as well as biophysical attributes (Egerer & Anderson, 2020). Yet, the integration of social science remains a major gap within the field of biodiversity conservation (Baldwin & Beazley, 2019; Bennett et al., 2017; Heller & Zavaleta, 2009; Newing, 2011), especially for implementing connectivity (Keeley et al., 2018; Lemieux et al., 2021b; Wyborn, 2011), and in terms of consideration of both biophysical and social forms of connectivity (Egerer et al., 2020). Therefore, the integration of social science in

connectivity research has been identified as a gap, as social science research remains lacking in comparison to natural science research on connectivity.

1.2 Social Science Approach to Connectivity

Social elements are a critical consideration within conservation planning, as conservation involves social processes, many of which directly or indirectly impact natural ecosystems (Baldwin & Beazley, 2019; Beeco & Brown, 2013; Cooke et al., 2012; Pasquini, Twyman, & Wainwright, 2010). Environmental problems highlight the need for humanity to alter our relationship with the natural world (Artelle et al., 2018), as such problems are social in nature (Adams & Sandbrook, 2013). Thus, connectivity conservation is dependent on an understanding of social, economic, cultural, and political factors that influence connectivity (Lockwood, 2010; Worboys et al., 2010). Diverse local social context is critical to consider within research (Jones et al., 2016), with the social science of conservation contributing to a more nuanced understanding of social systems in relation to environmental issues (Berkes, 2004). For implementation of connectivity measures, innovative approaches are needed that incorporate human contexts, such as diverse patterns of resource use, jurisdictions, cultures and geographies in which corridors must function (Hilty et al., 2006; 2020).

Identifying key avenues for social science connectivity research can be done by building upon past research on the social dimensions of connectivity. Previous research on the social dimensions of connectivity has focused on adaptive governance related to connectivity conservation (Wyborn, 2015b, 2015c), social and institutional connectivity (Wyborn, 2011), the perspectives of practitioners (Burgh, 2017; Wyborn, 2015a), the integration of social factors into spatial connectivity planning (Sage, 2019), and challenges associated with implementation of a corridor pilot project (Parrott et al., 2019). Thus, previous research has delineated key social dimensions of connectivity from a variety of directions, but limited research examines the conceptualization of connectivity (except, see Hodgetts, 2018).

There is a considerable gap in research when it comes to examining the ways in which connectivity is conceptualized within practice (Hodgetts, 2018). Understanding the various forms of connectivity from the perspective of those involved in conservation

offers a chance to expand upon the limited literature focusing on the meaning of connectivity (for example, Bormpoudakis & Tzanopoulos, 2019; Hodgetts, 2018; Wyborn, 2011). Recent research has examined ecological and social connectivity in urban contexts by mapping community garden nodes within a network in order to examine levels of socio-ecological connectivity (Egerer et al., 2020; Egerer & Anderson, 2020). Hodgetts (2018) expands upon social forms of connectivity to include a diverse sub-set of types delineated in a taxonomy of connectivity, which is a conceptual framework portraying both ecological and social forms of connectivity. This taxonomy of connectivity (Hodgetts, 2018) delineates six core types of connectivity: ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human) connectivity. Bormpoudakis and Tzanopoulos (2019) interviewed practitioners and reviewed strategies relating to connectivity and green infrastructure, finding that practitioners' diverse conceptualizations of connectivity reflect Hodgetts (2018) depiction of a plurality of types of connectivity (Bormpoudakis& Tzanopoulos, 2019). My research expands upon this past work through an exploration of the meaning of connectivity in a relatively rural and undisturbed landscape, by engaging with conservation experts and other local knowledge holders, with the subsequent application of Hodgetts' taxonomy to discern key forms of connectivity relevant to connectivity conservation in Kespukwitk, Nova Scotia.

Differentiating forms of social science research applied to conservation is critical to understanding the underlying purpose of such research. This research is social research *for* conservation, rather than social research *on* conservation, as defined by Sandbrook and colleagues (2013). Social research *for* conservation shares the goal with conservation science to improve and contribute to the conservation of biodiversity by understanding human society and motivations to people either harming or promoting conservation of biodiversity (Sandbrook et al., 2013). Contrasting this, social research *on* conservation does not share the same goals as biodiversity conservation but rather studies conservation as social phenomena itself (Sandbrook et al., 2013). While the broader goal of this project is to contribute to conservation efforts, it aims to do so through an understanding of the perspectives and knowledge from a key group identified as directly relevant to

connectivity conservation: conservation experts and others with local conservation knowledge.

1.3 Research Questions and Objectives

The purpose of this qualitative research is to explore the meaning of connectivity, in particular the social elements relating to connectivity conservation, through a place-based approach focused on the local conservation context in Kespukwitk, Nova Scotia. Research examining the conceptualization and prioritization of ecological and social forms of connectivity by experts and other local knowledge holders is important and has not yet been completed within Kespukwitk. Social connectivity has been the focus of recent work highlighted in the literature but has not yet been examined within the context of the present study, which aims to discern the nuanced conceptions, perceptions, and spatial delineations of both ecological and social forms of connectivity. Overall, I aim to contribute to the broader discussion surrounding social connectivity in the literature and to contribute to a better understanding of connectivity conservation in the Kespukwitk region.

To achieve this aim, a series of in-depth interviews with a mapping component were completed with experts and other local knowledge holders, examining the meaning of connectivity, social dimensions relating to connectivity, and rationale for delineating focal areas for connectivity in Kespukwitk. The meanings of connectivity and their application in practice were examined through two approaches: conceptual-textual expressions (chapter 2), and spatial delineations of focal areas (chapter 3). In both, I applied Hodgetts' (2018) taxonomy of connectivity as a way to interpret how experts and other local knowledge holders conceptualize and ascribe meaning to connectivity in practice. Research questions and objectives for each approach are detailed in the following sections.

1.3.1 Meanings of Connectivity in Kespukwitk: Pluralities or "a Multiple"? (Chapter 2)

Research question: How is connectivity conceptualized by experts and other local knowledge holders in Kespukwitk?

I answer this through the following objectives:

(1) Explore perceptions of ecological and social forms of connectivity through interviews with experts and other local knowledge holders relevant to connectivity conservation in the region;
(2) Identify and describe forms of connectivity through an inductive-deductive hybrid thematic coding approach;
(3) Explore the prevalence of and relationships between types and nuanced examples of connectivity by examining theme prevalence and thematic overlap; and
(4) Explore conceptions of connectivity as "a multiple" versus "plural" types.

1.3.2 Spatial Delineations of Ecological and Social Forms of Connectivity (Chapter 3)

Research question: How are ecological and social forms of connectivity applied spatially when delineating focal areas for connectivity in Kespukwitk?

To answer this question, I pursue the following objectives:

(1) Explore key rationale and characteristics for identifying focal areas for connectivity in Kespukwitk through interviews with conservation experts and local knowledge holders;
(2) Digitally delineate (in ArcGIS Pro) the spatial areas indicated by participants on a map of the region;
(3) Thematically code the stated reasons for prioritizing key areas in terms of Hodgetts' connectivity taxonomy;
(4) Identify potential priority areas through spatial overlay analyses to explore overlap (a) between types of connectivity, (b) within types, (c) within categories (ecological and social);
(5) Explore relationships between types of connectivity through thematic overlap analyses; and
(6) Consider instances that represent "pluralities" versus "a multiple".

1.4 Methods

The study was designed based on a qualitative approach to conservation research (Drury et al., 2011; Moser & Korstjens, 2017; Newing, 2011; Rust et al., 2017), with the

aim of deeply exploring the meanings of connectivity. In order to answer the research questions depicted above, I used an explorative, mixed-methods approach incorporating qualitative textual and spatial methodologies. Approval for the study as ethical conduct of research with human participants was obtained from Dalhousie University's Social Sciences Research Ethics Board (file # 2020-5174). This involved semi-structured, map-based interviews with conservation experts and other local knowledge holders in Kespukwitk, Nova Scotia. Qualitative interviews were chosen given their ability to explore a topic in-depth and because such approaches allow for the determination of themes from the participant's perspective (Drury et al., 2011; Gray, 2009; Newing, 2011). The textual data analysis included an inductive-deductive hybrid approach to qualitative data analysis, as well as the quantification of findings including counts of coding references.

The spatial component of this study involved a qualitative GIS approach to participatory mapping (Dunn, 2007; Muenchow, Schäfer & Krüger, 2019), through an expert-based (Karimi et al., 2017) participatory mapping approach (Brown, 2012), in which participants were engaged with maps through a question relating to key focal areas in the study region (Whitehead et al., 2014). The spatial portion of data analysis included a separate thematic analysis of text solely related to the spatial component of interviews as well as the digitization of participant-discussed polygons representing focal areas for connectivity, and subsequent quantification through area-based percentages.

1.5 Defining 'Connectivity'

The terms that depict 'connectivity' and 'corridors' are numerous. While such terms all refer to a form of 'connectivity', confusion can easily arise when communicating 'connectivity' within conservation science and to the broader public. The concept of connectivity was described in the past as a "loose amalgamation of related topics with little synthesis between them" (Crooks & Sanjayan, 2006, p.2). Multiple interpretations of the term connectivity are contributing to the conflicting perspectives on the effectiveness of connectivity conservation across disciplines, such as science, policy, and practice (Wyborn, 2015b; Hodgetts, 2018). Distinguishing a set of clearly defined terms is a priority within connectivity conservation, as there are various sub-definitions

for connectivity within the literature (Hilty et al., 2020). It is essential to create a common language that promotes better cooperation, sharing of experiences, and ultimately more effective conservation (Hilty et al., 2020).

Examining definitions from the literature is a key step in understanding conceptions of connectivity in practice. However, within the literature, connectivity is inconsistently defined (Calabrese & Fagan, 2004) and is considered a broad and all-encompassing term (Burgh, 2017), which results in multiple interpretations of what is meant by 'connectivity' (Wyborn, 2015b). Therefore, connectivity may be a 'panchreston', similar to the term fragmentation (Bunnell, 1999; Lindenmayer & Fischer, 2007). A panchreston is a term that encompasses many discrete concepts and is often applied too broadly, resulting in a loss of meaning for practical use (Allan et al., 2021; Bunnell, 1999; Lindenmayer & Fischer, 2007). This lack of clarity and specificity may lead to conflicting perspectives on its effectiveness and application (Wyborn, 2015b), rendering such debates unproductive (Lindenmayer & Fischer, 2007).

The most recent and influential definitions of connectivity are those for 'ecological connectivity,' broadly defined as the unimpeded flow that supports life on Earth (CMS, 2020; Hilty et al., 2020). Ecological definitions are characterized by two distinct types of connectivity: functional and structural (Taylor et al., 2010), referred to as ecological-functional and spatial-structural by Hodgetts (2018). Functional connectivity involves organisms' responses to the landscape, while structural connectivity involves the physical arrangement of landscape features (Bennett, 1999; Hilty et al., 2020; Taylor et al., 2010). Functional connectivity focuses on the movement and flow of organisms through a landscape (Calabrese & Fagan, 2004; Kindlemann and Burel, 2008; Rudnick et al., 2012; Taylor et al., 2010). Structural connectivity involves the physical layout of landscape features and is influenced by the number and length of gaps, presence of a network or multiple pathways, and presence of nodes or patches of habitat associated with the link (Bennett, 1999; Hilty et al., 2020; Taylor et al., 2010).

Other key terms depict the area encompassing a connectivity role, such as a corridor or ecological corridor. Corridor is a term that is widely used to describe connectivity areas but as a term it carries many different connotations and can lead to confusion (Lockwood, 2010). The ecological definition of the term corridor is an area of

land intended to facilitate movement for a wildlife species between two or more habitat patches (Beier, Majka & Spencer, 2008; Hilty et al., 2006). Work by Hilty and colleagues (2020) use 'ecological corridor' to depict an area that is geographically defined and is governed and managed with the goal of maintaining and/or restoring ecological connectivity. Connectivity corridors are also referred to as bio-links, landscape linkages, greenways, shelterbelts, wildlife corridors, ecological networks (Wyborn, 2011), linkages, safe passages, ecological connectivity areas, ecological connectivity zones, and permeability areas (Hilty et al., 2020).

Terms with definitions that incorporate a social component include connectivity conservation (Wyborn, 2015a), social connectivity (Borgström, 2019; Borgatti et al., 2009; Egerer & Anderson, 2020; Kondolf & Pinto, 2017; Wyborn, 2011), and connectivity area (Lausche et al., 2013), as well as Hodgetts' depiction of four social forms of connectivity—emotional-affective, economic, equity, and more-than-human (2018; described in the next section). Connectivity conservation refers to a conservation philosophy built around the concept of ecological connectivity that represents a broader narrative of connecting both landscapes and communities through collaborative approaches (Wyborn, 2015a). Social connectivity serves to address the historic dualism that portrays the separation of humans from nature (Wyborn, 2011). Social connectivity is also discussed as how actors within a social network are connected (Borgström, 2019; Borgatti et al., 2009; Egerer & Anderson, 2020), as well as the communication and movement of people, goods, ideas and culture (Kondolf & Pinto, 2017). The term 'connectivity area' describes areas between protected areas that involve diverse uses, values, and actors in the management of the landscape (Lausche et al., 2013). These terms represent various adaptations from the original ecological-based definitions of connectivity that incorporate social-features as well, while Hodgetts' (2018) extends this through a set of social forms of connectivity which are part of a taxonomy of connectivity.

1.6 Hodgetts' Taxonomy Of Connectivity

Hodgetts' taxonomy of connectivity involves a conceptual framework that describes both ecological and social forms of connectivity (2018). These forms of

connectivity are depicted to exist as "plural" types, with problems arising from this conception, in which "different types of connectivity are considered as being separate: as sharing coincidental terminology, but pertaining to different things" (Hodgetts, 2018, p.83). Hodgetts proposes that connectivity should instead be thought of as "a multiple" because "multiplicity" addresses how these realities overlap and interact with each other in an indivisible way (Hodgetts, 2018; Law, 2004), thus representing the concept of "more than one – but less than many" (Mol, 2002, p.55, as cited in Hodgetts, 2018, p.83). *Figure 1* represents my interpretation of the difference Hodgetts discusses between viewing connectivity as a "plurality" of types and "a multiple" whole.

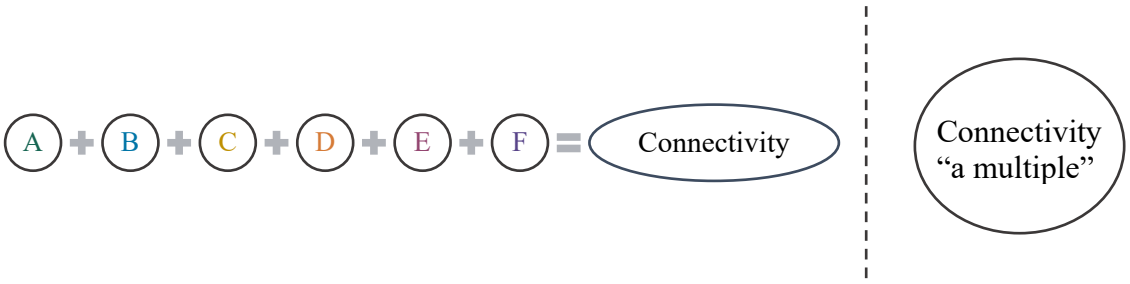


Figure 1.1 Connectivity depicted as a summation of discrete, separate "plural" types that may be considered within a connectivity planning process beside connectivity as "a multiple", an indivisible whole, to be considered at the outset and throughout. *Note that the letters "A, B, C, D, E, F" refer to corresponding types of connectivity depicted below. This figure is based on my interpretation of Hodgetts' (2018) depiction of "plural" types versus connectivity as "a multiple".*

Hodgetts' taxonomy (2018) provides details and examples of a diverse set of core types of connectivity, including (A) ecological-functional connectivity, which refers to species movement throughout the landscape; (B) spatial-structural connectivity, the habitat being connected; (C) emotional-affective connectivity, the emotional connection between people and nature; (D) social (economic) connectivity, the connection between society and nature, such as through a social-ecological systems (SES) lens; (E) social (equity) connectivity, addressing the inequalities within conservation; and (F) social (more-than-human), the connections between all actors, not limited to humans (for more

detailed descriptions see *Table 2.1* in Chapter 2). Hodgetts describes social (more-than-human) connectivity to be based on more-than-human geographies, which include the encounters and relations between humans and non-humans (Isaacs, 2020). Hodgetts depicts more-than-human connectivity as being "most aligned with (and indeed draws directly on) the notion of "multiplicity", describing more-than-human to emphasize "the types, forms, and intensities of diverse and heterogenous connections that exist within and between humans and all manner of non-humans" (2018, p.87).

Hodgetts (2018) also makes the point that while the various types of connectivity mentioned above are evident in theory and conceptual realms, applications in planning and practice remain primarily focused on ecological forms of connectivity. In this study, Hodgetts' framework is applied, *a posteriori*, to assess local knowledge holders' and experts' responses to questions raised in semi-structured, map-based interviews about connectivity conservation and its application within Kespukwitk, Nova Scotia.

1.7 Social-Cultural Considerations

Social and cultural dimensions are depicted in various ways within the literature, leading to potential inconsistencies and confusion. Within the literature pertaining to Hodgetts' taxonomy of connectivity (2018), the focus is primarily on ecological and social forms of connectivity, with 'cultural' elements being considered within broader social categories. For example, cultural elements are mentioned briefly through a discussion of cultural geography, as it pertains to emotional-affective and more than human connectivity (Hodgetts, 2018). This extends to some extent to the literature, as progress has been made in characterizing social-ecological complexity, but at times cultural interactions with ecosystems are poorly understood (Poe, Norman & Levin, 2014). Within the literature social and cultural dimensions are often used interchangeably (e.g., Gavin et al., 2015).

Some authors, however, do distinguish between social and cultural dimensions. Within the field of social science conservation research, social often refers to structures and norms (Roberts, 2002) of a community or group, while cultural refers to the traditions and religions associated with a community or group (Garavito-Bermúdez, 2020). Culture as a concept is manifested in worldviews, languages and sources of

knowledge (Gavin et al., 2015), with cultural dimensions including meanings, values, identify, knowledge and practice, livelihoods, governance and access, and biophysical interactions (Poe et al., 2014).

Social and cultural dimensions are also frequently referred to as 'sociocultural' or 'social-cultural' within the literature. For example, "social-cultural" is used to discuss features of the learning environment and biocultural learning frameworks (Garavito-Bermúdez, 2020), as well as "sociocultural" in references sociocultural evolution (Lorimer, 2017), sociocultural practices of local communities (Kittinger, 2013), and sociocultural attributes relating to opportunities and constraints for potential land uses (Brown, 2005). While I acknowledge that the appropriate term is 'sociocultural' or 'social-cultural' when referring to both social (norms, structures, groups, communities) and cultural (practices, traditions, and religions of such communities), when discussing Hodgetts' taxonomy (2018) I will use the term social to refer to relevant social and cultural dimensions in order to be consistent with the terminology used within the framework.

1.8 Provincial, National and International Mandates for Connectivity

While limited in quantity, notable plans and mandates exist for connectivity relevant to the Kespukwitk region. The southwestern region of Nova Scotia closely aligns with the area known by the Mi'kmaq, the Indigenous people of the region, as "Kespukwitk", which I will use throughout. This region was selected as a study region because of its biodiversity values and cultural heritage, as recognized through formal designations. The region is designated as the Southwest Nova Biosphere Reserve (SNBR) under the UNESCO Biosphere Reserve Programme, on the basis of its considerable biodiversity and cultural value (Drysdale, 2008). The region has recently been named as one of Canada's eleven priority places under the Pan-Canadian Approach to Transforming Species at Risk Conservation in Canada (ECCC, 2019). Current initiatives include a collaborative partnership to advance Target 1 in Nova Scotia, under the Target 1 Challenge of the Pathway (Spaces) Program, Canada Nature Fund (ECCC, 2019). There are explorations around establishing Indigenous Protected and Conserved Areas, led by the Confederacy of Mainland Mi'kmaq (CMM) through the Unama'ki Institute of

Natural Resources (UINR) and partners. A current initiative within the region is the Kespukwitk (Mersey) Corridor Project (2021), which aims to blend the mapping of ecological and cultural values and connectivity. This initiative attests to the timeliness of my research, through which I aim to support it and other on-the-ground initiatives through a contribution to the discussion surrounding the meaning of connectivity, by helping to reduce ambiguity and advance common understanding of the concept, and thus potentially enhancing the effectiveness of collaborations.

Provincial and ecoregional mandates for connectivity depict its importance at a broader scale, encompassing the Kespukwitk study region. For example, Nova Scotia's parks and protected areas plan depicts "re-connection" as a key criterion for selecting sites for new protected areas through "areas that provide important natural connections for plants and animals" and indicates that the process of land selection should reflect "social values" (Province of Nova Scotia, 2013, p.9). Currently, there are no municipal or provincial policies in place related to connectivity (Noseworthy, 2020), but the New England Governors and Eastern Canadian Premiers have acknowledged the importance and value of restoring connectivity through Resolution 40-3 – Resolution on Ecological Connectivity, Adaptation to Climate Change, and Biodiversity Conservation (Canadian Intergovernmental Conference Secretariat [CICS], 2016). A brief excerpt from this resolution states that:

> The New England Governors and Eastern Canadian Premiers advise agencies within their jurisdictions to support land protection and planning efforts that maintain and improve connectivity, and to promote the sustainable management of public and private lands and aquatic systems that further these objectives … (CICS, 2016, p.2).

The resolution highlights the critical need for protecting and restoring connectivity within the region as a strategy "for boosting the resilience of the region's native ecosystems and biodiversity, as well as its economy and human communities" (CICS, 2016, p.2).

The critical need for connectivity is highlighted by national and international mandates. Nationally, Parks Canada listed a commitment to "advance biodiversity through connectivity of protected places and alternative approaches to protected areas" as part of the commitments to work towards achieving targets depicted under the

International Convention on Biological Diversity (CBD), Aichi Target 11, and Canada Target 1 (Parks Canada Agency, 2017, p.7). International mandates for connectivity include the World Commission on Protected Areas (WCPA), a commission of the International Union for Conservation of Nature (IUCN), which denotes connectivity conservation as "one key response to the destruction and fragmentation of natural habitats by humans" (Worboys et al., 2016, p.3). The WCPA presents guidelines for areas of connectivity conservation, which provide a basis for evaluating the connectivity conservation implementation progress that is part of Target 11 of the CBD's 2011-2020 Strategic plan (CBD, 2011). A new guidance document on ecological corridors has also been released (Hilty et al. 2020), which is an output of the WCPA's Connectivity Conservation Specialist Group (CCSG). A recent document by the Canadian Council on Ecological Areas (CCEA) focuses on implementing connectivity conservation and the need to protect and restore connectivity within Canada's terrestrial ecosystems (Lemieux et al., 2021a; Lemieux, Jacob & Gray, 2021b), as well as government and policy dimensions relating to connectivity conservation in Canada (Lemieux et al., 2021b). There are several mandates at a variety of scales relevant to connectivity conservation, as well as recent work focused on implementation in Canada (Lemieux et al., 2021a; b). This research aims to complement this recent work and current mandates focused on connectivity by exploring the meaning of connectivity in practice, thus contributing to broader discussions, in particular those surrounding social and multiple forms of connectivity.

1.9 Study Area: Kespukwitk, Nova Scotia

The Kespukwitk region is recognized as a biodiversity hotspot within the province because of its rich diversity of species, various rare and endemic species, and unique climate and geological history (Farrows & Nussey, 2013; SNBR, 2010). The region supports the majority of the province's unique herbaceous plants, including Atlantic Coastal Plain Flora (ACPF), which can be found in and around lakes and rivers, and in fens, bogs, saltmarshes, and estuaries (Environment Canada & Parks Canada Agency, 2010). The Kespukwitk region contains 75% of Nova Scotia's species at risk (Farrows & Nussey, 2013; SNBR, 2010). The area has a relatively high degree of

naturalness and is internationally recognized for its ecological value at an ecoregional scale (Trombulak et al., 2012). Previous studies have identified the forests that occur within the region as important for ecosystem protection and connectivity within Nova Scotia and the greater Northern Appalachian-Acadian Ecoregion (Anderson et al., 2016; Beazley et al., 2005; Farrow & Nussey, 2013; Reining et al., 2006; Trombulak et al., 2008).

Of general interest is the history of diverse forms of landscape conservation, human settlement and land use within the Kespukwitk region (Southwest Nova Biosphere Reserve [SNBR], 2017). The region is culturally diverse and was first occupied by the Mi'kmaq (SNBR, 2017) prior to colonization by the Europeans. With colonization came a transition in the landscape from being heavily forested to being open over large areas, which is especially evident along the coastline (Trombulak, et al., 2008). As a result of this long history of human occupancy, the area is culturally diverse (Trombulak et al., 2008) and contains many National Historic sites, such as Kejimkujik National Park and National Historic Site (SNBR, 2017), as well as Provincially protected Wilderness Areas, such as the Tobeatic, Tidney River, Medway Lakes and others (https://novascotia.ca/parksandprotectedareas/plan/interactive-map/).
The primary economic influences include fishery, forestry, tourism and agricultural industries (Farrow & Nussey, 2013; SNBR, 2017). These economic resource uses and other land uses, such as roads and waterfront developments, contribute to on-going threats of landscape changes in the region (Farrow & Nussey, 2013; Trombulak et al., 2012; Woolmer et al., 2008). Thus, the area hosts a diversity of social-ecological interactions within areas of relatively intact nature as well as more human-dominated areas.

1.9.1 Connectivity Research In Kespukwitk

There is a need for connectivity within Nova Scotia and more specifically, within the ecologically important Kespukwitk region. Across Nova Scotia, connectivity is lacking within the protected area system; the provincial protected area system consists of a scattering of protected 'islands' in a sea of human-altered and fragmented landscapes (Colin Stewart Forest Forum Steering Committee [CFCI], 2009, p.20). The province lacks climate refugia and, thus, there is a particular need for connectivity to facilitate

species movement and adaptation to climate change (Worldwide Fund for Wildlife-Canada [WWF-Canada], 2017). Retaining ecological connectivity is of particular importance in Kespukwitk, as the area is still in a relatively natural state but faces increasing development pressures (Farrows & Nussey, 2013).

Previous research has focused on connectivity and conservation at a variety of scales relevant to Kespukwitk. Research on connectivity at ecoregional (Reining et al., 2006; Anderson et al., 2014; 2016) and provincial scales (Beazley et al., 2005) has identified Kespukwitk as supporting 'irreplaceable' ecological values. There is preliminary research in Kespukwitk on ecological connectivity (Inglis, 2007) and the ecological impact of fragmentation from forest roads (Robinson et al., 2010). More recent work by Cunningham and colleagues (2020) looked at forest connectivity across Nova Scotia using a variety of spatial analyses. However, how social and ecological forms of connectivity are conceptualized and spatially delineated has not yet been examined in the region. This research is important in the region, given the diversity of social-ecological interactions and the biodiversity and cultural values contained within the region. Thus, the area presents an interesting microcosm of relatively intact natural lands and more fragmented human-dominated landscapes, and thus a potentially effective case study for exploring ecological and social forms of connectivity.

1.10 De-Limitations and Limitations

A variety of de-limitations and limitations were assigned or encountered at the outset of the project, many of which may limit the generalizability and applicability of the present study. Some of these are deliberate de-limitations related to the scope and focus of the study. For example, this study is limited to the setting of Kespukwitk, and many examples are grounded in local context and thus, the findings may not be generalizable to other contexts. The effect of local context is also an advantage, as it allows the application of theory to a place-based study and results in a variety of grounded examples relevant to connectivity conservation in the region, addressing a gap identified by Hodgetts (2018).

This study uses a purposive sampling approach to recruit local knowledge holders and other experts with relevant knowledge relating to conservation and/or connectivity in

the study region. Therefore, there are limitations in the perspectives included through the targeted sampling approach. This resulted in the exclusion of other diverse perspectives related to the meaning of connectivity, such as those of local rightsholders and stakeholders, landowners and land users, including forestry and other key natural resource-based industries. Indigenous participation also was not specifically targeted due to ethical research considerations (for an overview, see Bull et al., 2019) related to time and other capacity-related constraints, thus limiting representation of their perspectives. Therefore, the findings are not generalizable to the broader population but rather are tied to the local context associated with the study area and study population.

I also focused more on social dimensions relating to connectivity, including social connectivity itself, which likely impacted the prevalence of social forms of connectivity within the findings. Therefore, the results should be interpreted with this in mind, as the prevalence of ecological and social forms of connectivity within conceptual-theoretical realms and spatial delineations may have been impacted by this.

An unanticipated limitation which impacted the present study in a variety of ways was the in-stream switch to remove delivery of the project as a result of the onset of the COVID-19 global pandemic within Nova Scotia in early 2020. The original project was planned for in-person delivery in summer 2020 but was adapted to a remote format as a result of the onset of the pandemic and associated public health restrictions. Thus, the data collection and methods were shifted to a remote format, which was not part of the original study design. This adaptation to remote format meant that some of the topics and components of the project may not have been as well suited for remote interviews, such as the base map and its use in the interviews. The remote format of interviews may have limited participant engagement, in particular with the spatial question and map-based delineation of focal areas for connectivity. Information on the base map was limited to ecological considerations, as no pre-existing research on social connectivity existed within the study area, thereby potentially introducing bias in the results. The boundaries of the study area represented on the base maps may have influenced the spatial extent of the focal areas mapped. These de-limitations and limitations should be considered when interpreting the results of the present study.

1.11 Thesis Structure

This is thesis is organized into four chapters, with the first being this Introduction. Chapters 2 and 3 present the methods and results associated with the conceptual-textual and applied-spatial approaches, respectively. They are followed by an integrative discussion-conclusion chapter (Chapter 4). Chapter 2 is presented as a stand-alone manuscript intended for publication and thus some information from Chapter 1 will be repeated when appropriate. It outlines Hodgetts' taxonomy (2018) and how I apply it as a framework to conceptually analyze textual data from the interview transcripts. Chapter 3 is not meant to be stand-alone and serves to explore the spatial application of connectivity through the delineation of focal areas for ecological and social forms of connectivity, also using Hodgetts' taxonomy, and thus only includes material relevant to the spatial approach. Chapter 4 concludes the thesis with an integrative discussion and high level conclusions relating to the work as a whole and its implications and contributions.

1.12 Chapter Summary

This chapter introduced the purpose, context, and need for this research in Kespukwitk to explore how people interpret and ascribe meaning to both ecological and social forms of connectivity, in both conceptual and spatial realms. As previously discussed, connectivity is a key part of conservation approaches, in terms of ecosystem functioning, wildlife movement, and climate change adaptation. This also extends to human realms, as connectivity has been stated to facilitate human adaptation to climate change and collaboration. Connectivity has multiple meanings, depending on the context, site, species, and scale of focus. This includes social forms of connectivity, although these are less developed within the literature. Several mandates and recent reports highlight the importance of connectivity conservation in Nova Scotia and across Canada. Social conceptions of connectivity relevant to connectivity planning and practice have received minimal attention in the past. This research extends past research focused on the meaning of ecological and social forms of connectivity, through a place-based, contextually-embedded approach, with an in-depth exploration of the meaning of connectivity as a concept and its application in practice.

CHAPTER 2: MEANINGS OF CONNECTIVITY IN KESPUKWITK: PLURALITIES OR "A MULTIPLE"?

This chapter is intended as a stand-alone paper to be submitted for potential publication in the target journal, *Ecology and Society*. Co-authors are Alysha Griffin, Karen F. Beazley and Kate Sherren. AG conceptualized and designed the research, secured ethical approval [REB #: 2020-5174], conducted interviews, analysed the data, and led the writing of the paper; KFB supervised the work, providing guidance and assistance on all aspects, including contributions and edits within the writing process; KS provided feedback and guidance throughout the process, including feedback on written work.

2.2 Introduction

Ecological connectivity within a conservation context involves the unimpeded flow of species and natural processes that sustain life on Earth (e.g., CMS, 2020; Hilty et al., 2020, Hilty et al., 2010; Worboys et al., 2016). It is widely considered essential within conservation initiatives to address the combined impacts of habitat fragmentation and climate change on species and ecosystems (Beier et al., 2011; Hilty et al., 2020; Worboys et al., 2016). Within connectivity research, the focus remains on ecological considerations, and yet social processes are crucial to effective implementation of connectivity conservation initiatives (Parrott et al., 2019; Keeley et al., 2018). Given the complexity of socio-ecological systems, social and institutional context are critical considerations (Lambert, 2013; Lockwood, 2010; Wyborn; 2011). Conservation is inherently about people, and the human dimensions of connectivity are complex, involving a variety of individuals and groups with diverse values and perspectives (Lambert, 2013; Wyborn, 2011). Without considering the 'underlying causes' of fragmentation, such as socioeconomic processes (Anderson & Jenkins, 2006), connectivity initiatives may remain an aspiration (Wyborn, 2011). Few studies have explored the perspectives, needs, challenges and successes of practitioners working to operationalise connectivity in landscapes and waterscapes (but see Keeley et al., 2019 and Lemieux et al., 2021a). Therefore, integrating social research approaches alongside

key ecological considerations can serve to better facilitate the understanding and implementation of connectivity conservation.

Connectivity is conceptualized in multiple ways and has overlapping meanings depending on scale, site, species or landscape-based definitions (Bormpoudakis & Tzanopoulos, 2019; Burgh, 2017; Calabrese & Fagan, 2004; Hodgetts, 2018; Wyborn, 2015b). There is a danger in such ambiguity, however, as this may create a barrier to implementation by inhibiting common understanding and collective action (Allan et al., 2021; Bormpoudakis & Tzanopoulos, 2019; Chan et al., 2018). More precise understanding of the form(s) of connectivity that are the focus of a conservation initiative can aid in collaboration and support through identifying shared aspirations. Despite recommendations that social aspects are of equal importance (Lambert, 2013; Wyborn, 2011), the connectivity literature focuses almost exclusively on ecological-structural forms of connectivity (Adams & Sandbrook, 2013; Theobald, 2011). And yet, connectivity is also acknowledged as key to facilitating human processes, such as adaptation to climate change (e.g., Worboys et al., 2016) and is sometimes used to portray a broader narrative of connecting landscapes and communities through collaborative approaches (e.g., Wyborn, 2015a). In recognition of the importance of social aspects of connectivity and its lacuna in the literature, this chapter confronts it directly.

Though limited in quantity, the literature focused on social forms of connectivity provides a good starting point for this study (e.g., Bormpoudakis & Tzanopoulos, 2019; Hodgetts, 2018; Wyborn, 2011). Wyborn (2011) discusses social-institutional dimensions and develops a framework of connectivity conservation, which sees social connectivity as the connection between humans and nature (2011). More recent work by Hodgetts (2018) explores the current plural (different-separate) meanings of connectivity and proposes these would be better conceived as “a multiple” of overlapping realities. Hodgetts provides a taxonomy of six forms of connectivity: ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human) (2018), with the aim of examining these currently plural forms of connectivity to highlight the need for “multiplicity”, with one example, social (more-than-human) best representing multiplicity through the focus on connections, rather than attaching

separates. Research by Bormpoudakis and Tzanopoulos (2019) found that practitioners' diverse conceptualizations of connectivity support Hodgetts (2018) discussion of plural types of connectivity. Through interviews with practitioners and review of strategies relating to connectivity conservation and enhancement initiatives, particularly green infrastructure in England, the authors explored how different conceptualizations impact the science-practice interface (Bormpoudakis & Tzanopoulos, 2019). But what is missing to date is an understanding of what forms of connectivity are considered key to conservation planning, and how useful these conceptions are to practitioners on the ground. This gap is especially relevant when it comes to social forms of connectivity; therefore, this research focuses more attention on the less developed social forms of connectivity.

Within this study, I explore connectivity as conceived by practitioners on the ground, in this case represented by experts and other knowledge holders, with a focus on ascertaining the nuanced conceptions and perceptions of connectivity, applying Hodgetts' taxonomy (2018) as a framework. I elicited ideas about social and ecological forms of connectivity through interviews with experts and other local knowledge holders involved in conservation within the Southwest region of Nova Scotia. This region closely aligns with the area known by the Mi'kmaq, the Indigenous people of the region, as "Kespukwitk", which I will use throughout. Research examining the conceptualization of connectivity by experts and other local knowledge holders is important and has not yet been completed within Kespukwitk.

Through my research, I aim to answer the question, how is connectivity conceptualized by experts and other local knowledge holders in Kespukwitk? To do so, I (1) explore perceptions of ecological and social forms of connectivity through interviews with experts and other local knowledge holders relevant to connectivity conservation in the region; (2) identify and describe forms of connectivity through an inductive-deductive hybrid thematic coding approach; (3) explore the prevalence of and relationships between types and nuanced examples of connectivity by examining theme frequency and thematic overlap; and (4) explore conceptions of connectivity as "a multiple" versus "plural" types.

2.3 Background Context

2.3.1 Hodgetts' Taxonomy of Connectivity

Hodgetts' taxonomy of connectivity (2018) is a conceptual framework that depicts both ecological and social forms of connectivity, with the goal of moving towards a conception that views connectivity as "a multiple", by focusing on currently "plural" types of connectivity and the connections between types (see *Figure 2.1*) (2018). Hodgetts depicts "plural" to be problematic through its focus on separate and distinct realities and proposes that "multiplicity" addresses how these realities overlap and interact with each other (Hodgetts, 2018; Law, 2004). The framework involves a taxonomy of connectivity (Table 2.1) and aims to highlight the practical and theoretical linkages between ecological and social theories, equalities, and affectual relations within more-than-human ecologies (Hodgetts, 2018). This includes (1) ecological-functional connectivity, which focuses on species movement throughout the landscape; (2) spatial-structural connectivity, which focuses on habitat being connected; (3) emotional-affective connectivity, which depicts the emotional connection between people and nature; (4) social (economic) connectivity, which focuses on the connection between society and nature through social-ecological systems logic; (5) social (equity) connectivity, which focuses on addressing in-equalities within conservation; and (6) social (more-than-human), which focuses on connections between all actors with agency, not limited to humans (Hodgetts, 2018). Thus, according to Hodgetts, social (more-than-human) connectivity best represents the concept of connectivity as "a multiple" through its focus on connections, rather than attaching separates (Hodgetts, 2018).

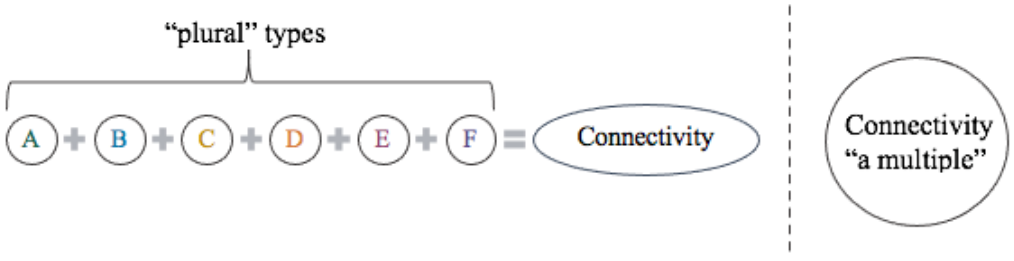


Figure 2.1 Connectivity depicted as a summation of discrete, separate "plural" types that may be considered within a connectivity planning process beside connectivity as "a multiple", an indivisible whole, to be considered at the outset and throughout.

Note that the letters "A, B, C, D, E, F" refer to corresponding types of connectivity depicted in the table below. This figure is based on my interpretation of Hodgetts' (2018) depiction of "plural" types versus connectivity as "a multiple".

Hodgetts does not separate social and cultural, and instead encompasses cultural considerations within the social connectivity types. Social dimensions often refer to norms, structures, and processes while cultural dimensions refer to the livelihoods, religions, worldviews, languages, and knowledge associated with communities and/or groups (Garavito-Bermúdez, 2020; Gavin et al., 2015; Roberts, 2002). Within the literature, social and cultural are at times used interchangeably, which can lead to ambiguity in relation to how cultural and social elements relate to one another (for example, see Gavin et al., 2015). Several authors use terms such as social-cultural (Garavito-Bermúdez, 2020) and sociocultural (Brown, 2005; Kittinger, 2013; Lorimer, 2017) to refer to both social and cultural dimensions. I acknowledge that many authors use social-cultural when discussing both social and cultural dimensions, but when discussing Hodgetts' taxonomy, I use the term social to encompass cultural elements in order to be consistent with Hodgetts' (2018) terminology.

Table 2.1. Summary of Hodgetts' taxonomy of connectivity

Types of connectivity	Focus-description of each type	What is connected?
Ecological/ Functional, *AND*	Functional connectivity focuses on the movement and flow of organisms and processes through a landscape (Calabrese & Fagan, 2004; Kindlemann and Burel, 2008; Rudnick et al., 2012; Taylor et al., 2010).	Species (mobilities), *or*
Spatial/ Structural	Structural connectivity involves the physical layout of landscape features and is influenced by the number and length of gaps, presence of a network or multiple pathways, and presence of nodes or	Habitats

Types of connectivity	Focus-description of each type	What is connected?
	patches of habitat associated with the link (Bennett, 1999; Hilty et al., 2020; Taylor et al., 2010).	
Emotional/ Affective	Emotional connection with species and ecologies (e.g., charismatic species). Spatial connection can ignite emotional connection (getting people out in nature). (Emerges from concern that people have become dis-connected from nature. Connection may foster support for conservation work.) (Derived from conservation biology and cultural geography.)	Personal emotional connection – "people and nature" or "people as nature"
Social (economic)	Connections between nature and society understood through systems logic. Includes policies and economics and their implications for connectivity work, such as land purchases and land use regulations. (Derived from social-ecological systems.)	Ecological, political and economic processes
Social (equity)	Re-connection and equity discourse in policy/practice. Addresses critiques focused on inequalities associated with conservation including exclusion of local people from access to nature and resources. (Derived from political ecology.)	Ecologies, power and equity
Social (more-than-human)	Illuminates "the types, forms and intensities of diverse and heterogeneous connections that exist within and between	All actors with agency, not limited to humans

Types of connectivity	Focus-description of each type	What is connected?
	humans and all manner of non-humans" (Hodgetts, 2018, 87). Critiques the idea of singular "nature" and focuses on living with multiplicity. (Derived from more-than-human geography.)	

Note: Gray-toned cells indicate concepts of ecological connectivity derived from fields of biogeography, conservation biology and landscape ecology, with dotted lines, "and", and "or" to indicate the connection between these types (as done by Hodgetts), which are rarely considered in separation; other cells include social connectivity concepts derived from cultural geography, social-ecology, political ecology and more-than-human-geography. Adapted from Hodgetts (2018) to elaborate on the descriptions of connectivity types and to include supporting literature on ecological-functional and spatial-structural from Bennett (1999); Calabrese & Fagan (2004); Hilty et al. (2020); Kindlemann and Burel (2018); Rudnick et al. (2012); and Taylor et al, (2010).

In this study, Hodgetts' framework is applied, *a posteriori*, to assess local knowledge holders' and experts' responses to questions raised in semi-structured interviews about connectivity conservation in Kespukwitk, Nova Scotia. By doing so, I test the comprehensiveness and relevance of Hodgetts' framework in a novel place-based and context-specific connectivity case study. At the same time, I will reveal the types of connectivity considered by practitioners working on the ground in the study region, and whether they, individually and/or collectively, view connectivity as a set of pluralities or as a multiple.

2.3.2 Case Study Area: Kespukwitk

The southwestern region of Nova Scotia, Kespukwitk, was selected as a study region because of its significant ecological and social-cultural values. Preliminary literature review and discussions with experts and key knowledge holders revealed the relevance and importance of connectivity in current initiatives focused on conservation within the region. Its ecological importance is recognized through several conservation-related designations, such as the Southwest Nova Biosphere Reserve (Drysdale, 2008)

and as one of Canada's eleven priority places under the Pan-Canadian Approach to Transforming Species at Risk Conservation in Canada (Environment and Climate Change Canada [ECCC], 2019). Current initiatives include a collaborative partnership to advance Canada's biodiversity targets in Nova Scotia, under the Target 1 Challenge of the Pathway (Spaces) Program, Canada Nature Fund. Another is the Kespukwitk (Mersey) Corridor Project (Kespukwitk Corridor Project, 2021), which aims to blend the mapping of ecological and cultural values and connectivity. The Kespukwitk Corridor Project attests to the timeliness of the present study. As such I aim to support it and other on-the-ground initiatives by contributing to the discussion surrounding the meaning of connectivity, helping to reduce ambiguity and advance common understanding of the concept for enhanced collaboration.

2.4 Methods

2.4.1 Semi-Structured Interviews

This research uses a mixed qualitative and quantitative approach to conservation research (Drury et al., 2011; Moser & Korstjens, 2017; Newing, 2011; Rust et al., 2017), with the aim of deeply exploring the meanings of connectivity. This involved a qualitative approach to data collection and the subsequent quantification of results through matrix queries. Qualitative interviews are an appropriate approach within conservation research (Young et al., 2018) and serve to explore a topic in-depth by allowing the determination of themes from the participant's perspective (Drury et al., 2011; Gray, 2009; Newing, 2011). The qualitative interview approach employed for this study involved semi-structured, remote interviews. I engaged experts and others with formal and/or tacit knowledge of connectivity conservation in interviews conducted by video conferencing platform (Microsoft Teams), telephone or email according to each participant's preference.

The semi-structured interview guide (*Appendix A*) included open-ended questions, allowing participants to talk about the topic through their own words (Guest et al., 2013; Kallio et al., 2016). Questions and associated probes addressed the meaning of 'connectivity', 'corridor', and 'social' connectivity, with more attention being given to social rather than ecological aspects, consistent with the objectives of the project.

Questions were clustered around a set of *a priori* themes relating to the social dimensions of connectivity derived from the literature (Burgh, 2017; Parrott et al., 2019; Lambert, 2012; Wyborn, 2015a; Wyborn, 2011) and the meaning of connectivity, corridor, and social connectivity within conservation (Burgh, 2017; Calabrese & Fagan, 2004; Hilty et al., 2020; Wyborn, 2011; 2015b), and followed a logical order and pyramid structure with easy-to-answer questions at the beginning, abstract questions near the end, and shifts in topic indicated to the participant (Hay, 2010; Dunn, 2010; Gray, 2009). Relevant maps were shared before and during the interviews as facilitation tools. These maps served as a reference (Dunn, 2010) throughout a spatial section of the interview which focused on key areas for connectivity, results of which are not the focus of this chapter (see Chapter 3). One question about social connectivity, "How would you describe social connectivity [alongside ecological connectivity] within connectivity conservation?" included a prompt to provide a definition of social connectivity (see Appendix A). This was the only formal prompt in the interview guide for participants to provide a definition; and, if the participant could not offer a definition, one was offered. This was the only definition requested and/or offered during interviews as it was centrally relevant to the focus of the present study. Of the sixteen participants, 10 responded prior to being given a definition of social connectivity and of these 10 participants, 5 did not ask for a definition of social connectivity at all, while 11 were provided with a definition, although 5 of these had already provided a response about the meaning of social connectivity prior to the definition, while 6 only had a response after the definition was provided (see *Appendix B* for details).

Rather than formally piloting the interview guide, I chose a reflexive approach to interviewing (Gray, 2009). This allowed the interview guide to be adapted as necessary based on reflective journal entries following each interview. This approach was premised on the idea that interview guides should be dynamic and change throughout the research to best reflect participants responses to questions (Dunn, 2010). Thus, I adapted the interview guide as necessary by adjusting, re-wording, or removing questions and/or probes. Such changes may at times require that follow-up interviews be conducted, and this provision was embedded into the informed consent process of participant

recruitment. In my case, the nature of the changes was such that no follow-up interviews were required.

2.4.1.1 Sampling and Recruitment

The study population was comprised of adult conservation experts and other local knowledge holders with formal or tacit knowledge of conservation in the Kespukwitk region. Inclusion criteria were that they be: (i) knowledgeable about the study area and ecological and/or social considerations relevant to connectivity or conservation planning; and/or, (ii) engaged in conservation organizations and governmental departments concerned with connectivity and/or conservation planning and land management.

When discussing sample size, it is important to note that qualitative methods emphasize the quality of data associated with each observation, rather than the number of participants (Drury et al., 2011; Rust et al., 2017). Interviews allow in-depth analysis from small sample sizes (Young et al., 2018), with a sample size of eight often being sufficient (Gray, 2009). The first round of recruitment involved identifying and contacting 10 individuals, from which 8 consented to and participated in an interview. These individuals were purposively targeted based on our (the research team) knowledge of the conservation community and preliminary contact and discussions with other experts and local knowledge holders in the region. Snowball sampling was then pursued during the interviews, whereby additional participants were recruited based on recommendations from participants (Newing, 2010). Snowball sampling involves initial participants serving as "seeds" through which wave 1 participants recommend other potential recruits for wave 2, and the sample size expands wave by wave (Heckathorn, 2011). This second round of recruitment involved contacting 9 participants, of which 4 participated. In addition, 10 individuals were contacted by participants from the first round (through inclusion in email correspondence), and from this set of individuals, 4 participated. This resulted in a total of 8 participants for the second round of interviews. Following this second round of recruitment, it was determined that saturation had been reached for the population of interest (Morse, Lowery & Steury, 2014), and that no additional participants were needed. In total, 16 interviews were completed, each ranging in length from 27 to 83 minutes.

Three individuals participated who are also members of other groups that are important to engage in connectivity conservation but that were not explicitly targeted for this research due to time and other resource constraints and ethical considerations (see Bull et al., 2019). Two of these individuals are Mi'kmaq and another is from the forestry sector. As a consequence, saturation was not achieved for these groups, though both Mi'kmaq and forestry perspectives are important to include in discussions surrounding connectivity conservation. Purposive recruitment that focuses on one target population, rather than stratifying to capture multiple groups, represents a practical way to delimit the scope of the research, which is an important pragmatic consideration in my study. However, it also limits the interpretation of results to the target population. Accordingly, this study does not attempt to explicitly examine Mi'kmaq or forestry sector conceptions of connectivity, even though a few individuals from those groups participated in interviews.

2.4.1.2 Interview process

Remote options for participating in interviews included Microsoft Teams videoconferencing, telephone, and email. The majority (n=13) were completed through Microsoft Teams; two chose telephone, one chose a hybrid telephone-Microsoft Teams because of technical issues, and none chose email. I conducted all interviews, following guidance on methods from Dunn (2010), such as note taking and de-identification. Microsoft Teams and telephone interviews were audio recorded (with permission) on a digital voice recorder, and hand-written notes were taken as back-up. One participant declined to be audio recorded and I took diligent notes (pen and paper), which I immediately transcribed and elaborated after the interview while recollection was fresh. For all other interviews, I transcribed the voice recordings verbatim. Because of the remote nature of the interview, gestures and visual cues were not evident and therefore not noted. As a form of member checking, I verified with participants any direct quotes in context prior to including them in this thesis and any future publications. This ensured that the context was accurately captured while avoiding the participant having the responsibility of reading a lengthy transcript.

Participant-approved pseudonyms and identification codes were used to de-identify the participants (Dunn, 2010). During the transcription process, codes were

assigned to reflect five participant groups: government organization (GO), non-government organization (NGO), not affiliated (NA), forestry sector (FS), Mi'kmaq (MKM) and no quote (NQ) for those who did not consent to the use of quotes. Each individual was also assigned a number (e.g., GOP1). While the categories were not used within the analysis for any form of comparison within and across groups, they serve to usefully differentiate between the groups.

2.4.2 Data Analysis

2.4.2.1 Thematic Coding

The interview data were analysed through an inductive-deductive hybrid approach to thematic coding of qualitative data to explore key ecological and social forms of connectivity, using NVivo 12 software. Coding involves the process of finding terms or phrases to categorize portions of the data (Van den Hoonard, 2012), with the resulting codes representing theme names attached to pieces of data (Newing, 2010). Preliminary open coding was conducted to become familiar with the data and inductively identify emerging themes and patterns. Once familiarized, I identified an appropriate theoretical framework (i.e., Hodgetts' (2018) taxonomy) and deductively applied it to the data in a focused way. The relative prevalence of the themes was later quantified for the study population. Methods for these steps are detailed as follows.

For preliminary open coding, the interview transcripts were first read in-depth to familiarize myself, the lead researcher, with the data as a whole. Following this, I completed several rounds of preliminary open coding using NVivo 12 software, including identification of 'main themes' characterizing each transcript (Van den Hoonard, 2012) and emergent (inductive) themes. Open coding involves labelling themes in transcripts without attempting to narrow the list or limit the codes based on relevance to research questions (Van den Hoonard, 2012). Next, I organized codes into preliminary categories and applied them across the entire dataset (Cope, 2010). Coded data were then reviewed by theme to assess the diversity within theme groups (Hay, 2010). Some groups of themes were re-grouped or deleted as appropriate to winnow the list (Ryan & Bernard, 2003). Themes were hierarchically organized (Ryan & Bernard, 2003) as themes and sub-themes (parent and child nodes). This refined, thematic organization of the open-coded data represented a sense-making process, facilitating the consideration of open codes

against existing theory, in this case with reference to the conceptualization of connectivity.

To identify a framework and link the results of the inductive thematic analyses to theory, I explored potential frameworks to identify one that was suitable to a sub-set of the emergent open codes. In this case, Hodgetts' (2018) taxonomy of connectivity was selected as an appropriate analytical framework. This decision was made based on the suitability of the framework to the emergent coding hierarchy focused on the meaning of connectivity.

In order to apply an analytical framework, I completed focused coding (Van den Hoonard, 2012) with codes being deductively applied based on Hodgetts' taxonomy of connectivity (2018). Themes were then organized, with relevant inductive-emergent codes often being subsumed within a coding hierarchy organized around the deductive-non-emergent (parent) codes (i.e., Hodgetts' types of connectivity). The resulting coding hierarchy, 'conceptualization of connectivity' (*Appendix B*), was then applied across all transcripts through a final round of coding. The open-coded themes were found to be key examples of theoretical concepts (Boeije, 2009) based on the application of Hodgetts' taxonomy (2018), with meanings for core types (deductive; Hodgetts' taxonomy) and nuanced examples (inductive; open coding) being ascribed.

2.4.2.2 Analysis of Theme Prevalence and Overlap

Once the coding hierarchy was complete, the next portion of the analysis involved examining how the themes relate to each other (Van den Hoonard, 2012). This involved the use of matrix queries on NVivo (Jackson & Bazely, 2019) to examine (i) *theme prevalence* among the core categories-types of connectivity determined through the thematic coding process, and (ii) *thematic overlap between types of connectivity*.

To assess *theme prevalence,* analyses were conducted to quantitatively determine the number of times various types of connectivity were discussed from three analytical/reporting angles: (i) across transcripts in general, (ii) in response to specific categories of relevant questions in the interview guide about the meanings of connectivity, corridor, and social connectivity, and (iii) by participant (see section 2.5.3.). To determine the overall prevalence of types of connectivity discussed across transcripts, a matrix query was run, and the total number of coding references for each type of

connectivity recorded. To determine prevalence in response to key categories of questions, a case was created, and a matrix query run for responses to each of three categories of questions surrounding the meanings of (1) connectivity, (2) corridor, and (3) social connectivity. A separate query was conducted for the "rest of transcript", to capture any relevant responses to questions that did not directly ask about the meaning of connectivity, but for which a participant may have spoken about it nonetheless (though upon examination none were identified). This distinction is of interest to examine whether participants mentioned particular types of connectivity with or without being prompted to do so. I then also determined the prevalence of each type of connectivity by participant.

To look at *thematic overlap between types of connectivity* within participants' responses, a matrix query was run to determine instances of direct overlap of coding references. These instances of overlap represent passages of text that have overlapping coding references (see section 2.5.2.).

2.5 Results

The results are presented in hierarchical order, in that Hodgetts' core types, applied through deductive coding, are presented as section headings, as these are the 'parent nodes' of the resulting coding hierarchy. Within appropriate core types, sub-headings depict descriptions of emergent nuanced examples (determined through open coding). I then discuss the comprehensiveness of Hodgetts' taxonomy through an examination of thematic prevalence, thematic overlap, and an analysis of "plural" versus "multiple" conceptions of connectivity.

2.5.1 Hodgetts' Taxonomy of Connectivity and Emergent Nuanced Examples

When applying Hodgetts' (2018) taxonomy of connectivity through a deductive coding approach, all of Hodgetts' types of connectivity were discussed in the interviews, attesting to the plural forms of connectivity in practice, as well as additional, emergent nuanced examples not explicitly elucidated within Hodgetts' paper. Results for each type and nuanced examples are presented in the following sections, and a summary can be found in *Table 2.2.*

Table 2.2. Application of Hodgetts' taxonomy of connectivity (2018) and emergent nuanced examples

Type	Description based on Interviews	Example of a Key Quote
Ecological Functional, and	Species movement; focal species; ecosystem functioning	"how it impedes or helps movement of a species across … it needs to be defined from the species perspective" GOP4
Spatial Structural	Forest cover; pinch points; protected areas	"I would describe it as the degree to which, certain landscape elements are connected" GOP3
Aquatic	Another form of connectivity, alongside terrestrial	"If you are kind of looking at it broadly, what's interesting is [that] aquatic connectivity is a lot more clear-cut ..." GOP4
Emotional Affective	Connection to land; human and nature connection/dis-connection	"people always have that relationship, to always remember that … we are part of the landscape, we are part of it, we're not above it, or outside of it" MKM1
Some elements of *cultural connectivity* and *well-being* were found to be related **emotional-affective connectivity** – See *Appendix C*		
Economic	Interactions – social-economic & ecological systems	"so, considering connectivity, one objective is to provide benefits to society; then, you need to increase connectivity, and restore connectivity" NAP1
Human	Between groups; individuals; human movement	"... how people are moving within a landscape or how information is diffusing between people across a landscape" NGOP6
Well-being	Dependency on ecosystems, for health & well-being	"... how people, basically, communities, are connected and depend on nature; and it provides for their own well-being, and the well-being of society" NGOP7
Equity	Power dynamics; diversity in conservation; reconciliation; access	"more inclusivity, more diversity, more collaboration and cooperation, then we will start to make some more progress towards connectivity" GOP1
Some elements of *cultural connectivity* were found to be related to **social (equity)** – See *Appendix C*		
More-than human	Natural law; inter-connections *(rather than connecting separates)*.	"...it shouldn't be about human usage, I don't think, right? Because that wouldn't agree with valuing ... nature, nature having its own rights" MKM1
Cultural	Culturally important species; continuation of culture	"I think culture is key ... it's thinking that culture, connectivity is more than, it's a very broad term that really encompasses a lot of different things" NGOP5
Inter-connected-ness	Cultural, social, and ecological dimensions cannot be separated	"The environment and society are the same thing. They are intertwined. You can't have one without the other. So, to me, I would say they are almost synonymous, they should be synonymous …" NGOP5

Nuanced examples shown in grey; for more detailed descriptions of each core type, refer to ***Table 2.1***

2.5.1.1 Ecological-Functional and Spatial-Structural Connectivity

While elucidating ecological-functional and spatial-structural connectivity as separate, nuanced ways in which ecological connectivity is often conceived, Hodgetts (2018) acknowledges that they are related to each other and often difficult to parse. He signals this by using '*and*' to join them within his taxonomy (*Table 2.1*), a convention he does not employ with the other emotional-affective and social types. The same pairing occurs among practitioners' conceptions within the Kespukwitk study region. While examples of participants' responses pertaining discretely to each type do occur, most are an amalgam of the two.

Hodgetts describes ecological-functional connectivity as focusing primarily on species movement but also other ecological flows and functions (2018). One participant explicitly stressed the need to define connectivity from the species perspective: "how that habitat … impedes or helps movement of a species across; so, in that case it needs to be defined from the species' perspective and that's much more difficult to measure" (GOP4). Descriptions of corridors for species movement were noted, with many participants discussing key species in relation to connectivity, such as moose, "... for example, if there's an area that was fragmented that had been previously important for, let's say, moose connectivity, then perhaps restoration of those is important" (NGOP3). Another participant discussed how the landscape needs to function for mainland moose as a species of concern:

> ... a lot of what are generally called charismatic species at risk, mainland moose, that's probably their biggest issue. Habitat loss is definitely a big part of that, as well, but fragmentation is. We've got these isolated pockets of these large mammal, terrestrial mammals, that need that intermingling between the various isolated populations in order for them to continue (NGOP4).

Spatial-structural connectivity focuses on the physical configuration of components of the landscapes, such as patches and corridors of forest habitat (Hodgetts, 2018). In this case, coding was focused on participants' references to structural reasoning for prioritizing connectivity, including descriptions of corridors, connecting protected areas, pinch points, forest or riparian connectivity, forest cover, and removing barriers to river flow. One participant, for example, highlighted the importance of forest

connectivity: “my own meaning to connectivity is making sure as much of the forest stays forest … not converted to something else” (FSP1).

Structural connectivity is often mentioned alongside functional connectivity, “so … you know intactness of a landscape, a measure of the ecological functioning of the landscape, the movement of genes and animals and species on the landscape …” (NGOP1). This is noted in several participants’ discussions of connectivity, with the distinction between the two often not always clear. For example, the following participant mentions how the landscape provides for the movement of wildlife between habitats, therefore focusing on functional-structural connectivity in union, “well in terms of connectivity I think wildlife connectivity. So, … continuous landscape that provides wildlife with passage, uninterrupted passage between habitats, so … you know, not subject to fragmentation by roads or clear-cuts (NGOP2).

Aquatic connectivity was found to be an important example of both ecological-functional and spatial-structural connectivity. Although Hodgetts does not explicitly mention aquatic connectivity, some participants said connectivity pertains to both aquatic and terrestrial environments. One NGO participant stated, “connectivity to me is both terrestrial and aquatic” (NGOP6). A government participant concurred:

> [L]ooking from the kinds of work that I have been doing the corridor [Kespukwitk (Mersey) Corridor] is a way to achieve some of the structural connectivity challenges that we might have, whether it’s an aquatic or terrestrial environment (GOP1).

Another elaborated on how structural and functional connectivity relates to waterways, also in reference to the Kespukwitk (Mersey) Corridor project:

> I mean, watersheds; the Mersey Corridor is already a connection area, going from one coast to the other. Its water, its moving, you know. Not just aquatic animals, but terrestrial animals use that as well, and it was an important area for human movement (GOP4).

Other comments focused on fish passage and the impact of dams, as well as the presence and impact of invasive fish species despite barriers presented by dams. These examples clearly delineate the close association between ecological-functional and spatial-structural connectivity, and the importance of aquatic connectivity for both of

these forms of connectivity and for current, on-the-ground initiatives taking place such as the Kespukwitk (Mersey) Corridor Project.

Although infrequently mentioned, aquatic connectivity emerged as a nuanced example of ecological-functional and spatial-structural connectivity. The importance of aquatic connectivity alongside terrestrial is worth stressing, given that neither aquatic nor terrestrial is explicitly mentioned within Hodgetts' taxonomy (2018). 'Aquatic' connectivity may be assumed given that ecological-functional and spatial-structural systems do not exist solely in terrestrial realms. However, explicit mention of aquatic connectivity when discussing both ecological-functional and spatial-structural connectivity is warranted, as was raised by participants (GOP1, GOP4, NGOP3, NGOP6).

2.5.1.2 Emotional-Affective Connectivity

Emotional-affective connectivity involves a focus on reconnecting people with nature and strengthening the bond, such as by increasing access to nature to foster personal emotional connections with nature. It aligns with the "biophilia" concept (Wilson, 1984), and is sometimes engaged in conservation "through the affective agency of charismatic 'flagship species' (Lorimer, 2007)" (Hodgetts, 2018, p.85). Participants discussed the intricacies of this connection, including attachment to place, connection to land, human and nature connection or dis-connection, and the relationship between humans and the land and water. Some participants were given a 'prompt' when requested, as to what 'social connectivity' means in which it was said to refer to the connection/dis-connection between people and nature (definition from Wyborn, 2011). After being prompted, one participant expressed that the human-nature connection is lacking, "So, what is social connectivity? …We don't have that; we don't have social connectivity. We don't; we've lost it somehow. I mean some people have it, but … this idea that we're somehow separate from nature is pervasive ..." (MKM1). Another participant also recognized this form of connectivity after being given the definition as a prompt but expressed that it is growing stronger: "So, I do think, though, humans and nature, that part of the connectivity, is getting stronger and stronger and stronger every day" (FSP1). This participant attributes this increase in connection to be a result of increased access to crown land, in which "gates have come off, as land was turned over

from private interest to public interest" which has "allowed a lot of people to connect to the landscape in a way they never have before" (FSP1). It is clear that emotional-affective human-nature connectivity was considered important to connectivity conservation, with one participant (un-prompted; no definition provided) mentioning the need for a shift in values: "You know, it needs to be part of a value shift. … Humans are part of the landscape, not separate. Then conservation should be part of people, part of who we are ..." (GOP4).

As the examples show above, several participants focus more generally on the need for human-nature connection, by mentioning the disconnection and/or connection between people and nature (FSP1; GOP1; GOP2; GOP3; GOP4; NGOP2; MKM1; NQP1), such as "re-connecting our children to nature, so that in the future we can all have a more positive impact on reducing the impacts of climate change" (GOP3). At the same time, some participants (MKM1; NAP2) elaborate on their own connection to the land: "but it's knowing that that's where, it's such a deep connection to know that's where you exist and come from" (MKM1). Another participant discusses 'emotional connections' of woodlot owners to the land: "... you see a lot of these woodlot owners, they have this deep, deep emotional connection with the land right" (NGOP2). It is likely that many participants, involved in conservation work themselves, are thinking more broadly about the connections between humans and nature given their positions and roles. One participant articulates this responsibility that many conservation practitioners, ecologists, and Indigenous peoples have and the value of "taking time".

> [W]e are the, not just as Indigenous people but, but we as ecologists are the earth keepers the Guardians, the Earth Guardians. We are the messengers we are the lookers and the watchers, we are the ones going out to the middle of the woods, and we're standing there looking and listening and smelling and it's up to us to actually take, to slow down our [ecologists] data collection and just be there in the land, to be able to get a sense that's more spiritual, intuitive, deeper, emotional, about the health of the land (NAP2)

This expression reflects a struggle for many of those involved in conservation work, in which it can be "quite emotionally traumatizing" (NAP2). Thus, perhaps the value of

"taking time" expressed above could elucidate a path forward to focusing on such emotional-affective forms of connectivity.

Cultural connectivity is also an example of emotional-affective connectivity that focuses more explicitly on connection of a culture to the landscape in a way that is bounded to language and identity. Culture is tied to the land and thus discussions surrounding the ecological and social connectivity across the landscape are also tied to the cultural aspects of the land, including the culture of local populations such as Indigenous or other local, non-Indigenous communities.

2.5.1.3 Social (Economic) Connectivity

Social (economic) connectivity is based on social-ecological systems theory and thus focuses on not only economic processes, but on ecological, social and political processes understood through a systems lens (Hodgetts, 2018). This form of connectivity involves approaches that analyse people-nature connections at an aggregated, society-wide scale (institutions, policies, economics) by focusing on the ecological relationships that underpin society, but at base remains anthropocentric in orientation (Hodgetts, 2018). These connections included interactions such as livelihoods, forestry, mining, infrastructural development, access to nature through recreation and tourism, and other forms of ecosystem services. Livelihood, for example, was noted by one participant as a key consideration for connectivity initiatives: "it's not like you have to choose one or the other [forestry or conservation]. I think that's important, an important thing to communicate, too: that people are going to want to make a living off their land and that's okay" (GOP2).

Some participants (NAP1; NGOP1; NGOP4) mentioned the importance of providing broader societal and community benefits and connections, while at the same time keeping nature intact: "So, considering connectivity, one objective is to provide benefits to society. Then, you obviously need to increase connectivity and restore connectivity, and keep nature intact, where it exists" (NAP1). Tourism and diversifying the economy, technological advances, and changes in demographics such as population growth were mentioned as specific examples. For example, one participant described the "commercial benefits" of "intact" nature for recreation and tourism:

> I would say there is a connection between the recreation values and the economic values; and economic is not, in this context, traditional exploitive activities, but economic meaning tourism. And, commercial benefits of nature conservation are often tied to recreation values and aesthetic values, right? Beautiful landscapes and beautiful places in nature that's intact (NAP1).

Another participant mentioned the importance of focusing on policy and initiatives that aim to connect the public with nature:

> [I]t's been interesting to think about that from a government policy perspective because... we're responsible for the conservation of species at risk, and connecting the public with nature is a very round-about way to get to action on the ground for species at risk. But it is important to approach things at different scales, and so there are initiatives within the federal government that are focused on re-connecting the public with nature … (GOP3)

This relates to policy settings that aim to influence connectivity and conservation more broadly by connecting the public with nature (through personal, emotional connections, i.e., emotional-affective). Thus this example represents a focus on societal-scale connections with nature and policy designed to increase these connections, through interactions with nature, and opportunities for this including tourism and recreation.

Human connectivity emerged as an example of social (economic) connectivity that involves the connection between groups (human connectivity between human groups), individual human-to-human relationships (human to human connectivity), and the movement of people across the landscape (human movement, as functional flows or spatial structures). Human connectivity between some groups of people was said to be "broken" (FSP1). This represents a need for efforts to bring groups together and meaningfully communicate across groups. For example, a participant described a lack of connectivity between forestry and conservation practitioners:

> Yeah, that social connectivity, there's definitely a disconnect, and it comes back to the same thing. There's a, there's a group of organizations that are, that profess to represent the ecological or conservation interests, that don't believe that human interaction on the landscape or use of resource can co-exist … So, it most definitely is broken (FSP1).

Another participant mentioned the need to connect disparate groups within connectivity and broader conservation planning, stating:

> ... [T]here needs to be more of a focus on it, I think, and more of an effort to connect all of these kinds of isolated groups: the Nova Scotia Nature Trust, Nature Conservancy, the protected areas, other private landowners. It's something that can be done, I think. It just needs somebody that puts a lot of effort behind it (NGOP4).

These two perspectives converge on the same principle, that human connectivity between groups is an important form of connectivity within the study area.

Human-to-human connectivity emerged in reference to relationships and interactions between individuals, with a focus on people involved in or impacted by connectivity and conservation initiatives: "I think Southwest Nova is unique not only in its rich biodiversity, but also in the kinds of relationships that have been fostered here over the last couple of decades" (GOP1). Human-to-human connectivity was also found to refer to a broader human need to connect with other humans:

> … [H]umans need connection and connectivity with people, that, without it, without kind of some shared goals and identity, people will often—that's why I say, loneliness is one of the leading causes of death these days—because people are not having that connection ... (NGOP4).

This form of connectivity is different from human connectivity between groups as the focus is on the individual.

Another form of human connectivity is human movement, both historically and currently, across the landscape, and free access for this movement. Human movement throughout the landscape also involves spatial-structural connectivity, such as trail networks, portage routes, and transportation corridors. Some activities associated with human movement, such as trials for off-highway vehicles, are said by one participant to have increased human connectivity by encouraging an increase in access to the forest:

> ... the ability to hop on an ATV and drive from Halifax all the way to Shelbourne on an off-highway vehicle, which you can do now, that's only going to increase the amount of people in the forest and it's because

> connectivity has increased from the trail network and a motorized access network (FSP1).

Likewise, transportation corridors are said to be an "important element" (GOP3) when thinking about "impacts" to connectivity initiatives:

> ... I mean settlement and also transportation corridors, which are closely related to [settlement], but those are two aspects of our impacts on the landscape that I think are really important to connectivity initiatives (GOP3).

These forms of human movement are important to consider as they may work against species movement by disturbing natural areas (as a form of fragmentation) through the development and use of off-highway trails and roads, but they do provide access to nature for those who prefer to access it via vehicle. Generally, however, participants viewed non-motorized trails and portage routes to be better aligned than motorized ones with the goals of connectivity conservation:

> ... because of those portages, which, you know, are sort of quintessential connectivity of people. So that people wouldn't have to be walking through clear-cuts and that people would have the same kind of values and enjoyment of the canoeing that people have had there for a long time, whether you go back to the sporting and guiding era or connect back with the Mi'kmaq ancestors. But connectivity for canoeists, I think, is a tangible and easy one to think about (GOP1).

Such non-motorized forms of human movement and connectivity are said to align with connectivity goals:

> ... some kinds of cultural and recreational uses of land that are compatible with connectivity. So, if we think of some of our historic waterways, and then canoe and portage routes that still exist in the area, they are probably activities that can be managed in a way that is appropriate, an appropriate match with biodiversity or conservation (NGOP6).

Considering human movement corridors alongside ecological corridors could potentially facilitate the goals of both, rather than viewing human movement corridors as solely a form of fragmentation. Similar to wildlife movement, human movement is also critical to support but has been planned with little regard to wildlife movement in the

past. Therefore, human movement as a nuanced form of social (economic) connectivity can better inform initiatives that aim to support both human and wildlife movement.

Social (well-being) connectivity emerged as another example of social (economic) connectivity that captures the dependency of humans on the functioning of ecosystems for overall health and well-being, including basic necessities for survival. These aspects also represent ecosystem services, including cultural, regulating, supporting, and provisioning types (Hilty et al., 2020). Provisioning types in particular align with livelihoods, discussed above as a component of the broader category, social (economic) connectivity. The nuanced example of social (well-being) connectivity was noted as important by some participants (GOP3; NAP2; NGOP1; NGOP3; NGOP6). For example, one participant describes social connectivity as:

> "... basically how people, communities, are connected and depend on nature for their well-being, is how I would describe social connectivity within connectivity conservation, is how people basically, communities, are connected and depend on nature and it provides for their own well-being, and the well-being of society" (NGOP7).

The reliance on the natural ecosystem is of central importance to many participants, with one participant stating it as the main priority "... so, I'd like to start my comment by saying that we need the land mostly for our survival, for clean air, clean water, and that's the most important thing" (NGOP1). Another described human well-being as an important rationale in fostering public support for connectivity conservation initiatives:

> ... you often get asked that question, 'Why should I care about a particular species at risk?' But when you put it in the context of, 'Well, that species at risk may be an indicator that our ecosystems are not functioning well. And these ecosystems are what provide us with things like our drinking water and whatnot and help us adapt to climate change' (GOP3).

In addition, the connection between well-being and the land was discussed by some participants:

> I appreciate that there's increasing recognition of all these other values, about Mi'kmaq cultural values as well as ecosystem services and recreational values, and how they have a positive impact on human health and well-being (GOP3).

Overall, it is apparent that social (economic) connectivity is relevant for broader connectivity initiatives in communicating the importance of such initiatives to the public, and encompasses much more than traditional interpretations of economics, including well-being and ecosystem services.

2.5.1.4 Social (Equity) Connectivity

Social (equity) connectivity is described by Hodgetts as referring to ecologies, power and equity, including to address the inequalities associated with conservation and access to land, nature and natural resources (2018). This form of connectivity was expressed by participants as related to consideration of power dynamics, gender balance, class-based inequities, and the need for reconciliation, diversity and inclusion. As one participant observed, "... think about socioeconomic access to nature, that people who are camping in the park, you have to have a certain level of, you know, disposable income to do that, because it does cost money" (MKM1). Another stressed the role that ecologists play in furthering reconciliation with Indigenous peoples or, alternatively, continuing colonial practices:

> So, it's not just a matter of including a few Mi'kmaq people to ask in, in the work or the project, but actually taking a real serious look at 'What is our job and responsibility as ecologists to help the movement of reconciliation?' Because there's so much that is tied to land and language and voice and power. And so, ecologists are doing work that will affect [Mi'kmaq] voice[s], landscapes, and future[s], without even recognizing the power that they [ecologists] have (NAP2).

Thus, this highlights an influential and privileged role ecologists' take on, with or without realizing it, which also relates to above-discussed quotes focused on access to nature. The importance of diversity and inclusion for connectivity is described by one participation:

> I think if we can find a way to ... have more gender balance, to have women more involved in forestry decisions, and if First Nations can have more power, and more of a voice and more of a say over things that are rightfully theirs to

> say something about. So more inclusivity, more diversity, more collaboration and cooperation, then we will start to make some more progress towards connectivity (GOP1).

Those working within conservation, and other related sectors, such as forest companies, large private landowners, and those in leadership roles in government, are key actors related to social (equity) connectivity.

2.5.1.5 Social (More-Than-Human) Connectivity

Social (more-than-human) connectivity is described by Hodgetts (2018) as re-thinking connectivity in non-binary (e.g., human-non-human; nature-culture) forms through more-than-human multiplicity, which involves the interconnections between all actors with agency. This is distinct from all the other types in that it conceives connectivity as an indivisible "multiple" from the outset, rather than as a set of separate types, or "pluralities" that may eventually be integrated in the planning process. While the more-than-human form of connectivity was seldom encountered in participants' responses, it was clearly articulated by at least one:

> I don't understand connectivity, right? I am still grappling with that. Because, again, it's talking about connecting ecological and cultural factors, and in my mind, and how I grew up, think, they can't be separated, right? ... [A]nd I will say I don't think that's unique to Mi'kmaq culture. I think that it doesn't matter where you come from in the world, it's kind of, that's what it is (MKM1).

Another participant discussed connectivity across space and time, "how I would describe connectivity is basically all centered around interconnectedness, how things are connected, in continuity, and space and time" (NGOP7). And another described inter-connections based on the "health of the land":

> I think that somehow, we've gotten into this that connectivity is a separate project or project type. Or, you know, then something working on Blandings turtles it's a separate project. But for me it's all one conversation about the health of the land and the health of the wildlife. And what do they need? And us responding and listening to that (NAP2).

In expressing this concept of connectivity as 'a multiple', one participant struggled to elucidate or "prioritize" distinct "pieces".

> ... you know, you got all these other pieces, you have your species at risk, and things like that, yes, and moving, and habitat. And, but I think I'm talking about usage, but it shouldn't be about human usage, I don't think, right? Because that wouldn't agree with valuing nature, nature having its own rights. So, that's why I find it very hard; I don't know how to prioritize, I don't know (MKM1).

This participant grounded their explanation in relation to "nature having its own rights" and the challenges that presents in "valuing" discrete parts of nature or types of connectivity. For example, they identified natural law as a key part of social connectivity:

> ... this idea that there's a natural law, and I am starting to see conversations and scholars talk about this, and you know in terms of Mi'kmaq laws and using the language and getting at that. But this idea of, you know, nature and environment having rights … and I think that is so important, and if we, as a society, that would be social connectivity, is to then say, okay, let's realize what we're doing here (MKM1).

Expressions of more-than-human connectivity, such as this, were found to embrace in indivisible ways natural law, the rights of nature, and the interrelationships among animals and humans, the land and language.

Cultural connectivity is a nuanced example of more-than-human connectivity worth giving explicit consideration, based on the importance of 'cultural' forms of connectivity within participants descriptions, the prevalence of 'cultural' forms of connectivity in open coding (thus, attesting to the 'emergent' quality of this category), and because social and cultural in some fields have different meanings. Although Hodgetts' taxonomy (2018) does not explicitly mention cultural dimensions, he subsumes these within social categories. Hodgetts (2018) groups such culturally oriented interrelations under "the social" (Latour, 2005, as cited by Hodgetts, 2018), which depicts a collection of connected actors. Thus, despite drawing on cultural geography work, Hodgetts' focuses primarily on more-than-human forms of cultural geography, in which geographers have focus on forms of attachment that are characteristic of relationships with more-than-humans (Ginn, 2014). Hodgetts considers such interrelationships among the more-than-human to fall under the broader category of 'social'. I found that

distinctions between cultural and social forms of connectivity were necessary and provide nuanced examples through a focus solely on cultural connectivity. I make the distinction of 'cultural connectivity' as an emergent example of social (more-than-human) connectivity based on participants' discussions of cultural values and forms of connectivity and references to key definitions of 'cultural dimensions' found within the literature (i.e., Gavin et al., 2015; Poe et al., 2014).

Cultural connectivity was found to include reference to key elements such as historical travel routes, cultural values, archeological sites, culturally important species, and the continuation and connection of culture, language, and the land. For example, one participant discusses including 'cultural' elements in a local initiative known as the Kespukwitk (Mersey) Corridor Project:

> The approach ... is one of trying to map out cultural and ecological values, and then looking at that connectivity to say, "Okay, well, the connectivity for ecological values really influences these areas', you know, functional connectivity, but let's also include some of the cultural values, archeological sites, culturally important species like Moose or Black Ash ... (GOP4).

This quote also includes reference to "culturally important species", as discussed often in Indigenous scholarship as "bio-cultural" values or species (Geribald & Turner, 2004), and similar to "flagship" and/or "functional or keystone" species, also often serving as "umbrella" species, as is the case for species such as moose and bear, consistent with the focal species approach in Western science (Calabrese & Fagan, 2004; Snaith and Beazley, 2002; Beazley and Cardinal, 2004).

Cultural connectivity is depicted as a key form of more-than-human connectivity, as one participant described the continuation of culture as a key part of an integrated whole, rather than as parts that can be prioritized, one over the other:

> I am struggling, because I am so, I mean, there's no right answer, to me, prioritizing connectivity. I want to see that; I want to see, of course, Mi'kmaq culture, and the history, and land-based education, to ensure cultural survival but, also, that we get that land-based relationship that everybody needs. Yes, I primarily view it from a Mi'kmaq perspective, but I think it needs to be for everybody ... (MKM1).

As such, cultural connectivity aligns closely with social (more-than-human) connectivity through the focus on indivisible interconnections among ecological, cultural and emotional: "... and I am still trying to put that into words, but in order to have culture, you need ecology, they're the same" (MKM1). Thus, the focus on the *inter-connection* between the group, the land, wildlife, and ecosystems are a core tenant of the culture itself. There is no separation between nature and culture.

Interconnectedness refers to the idea that cultural, social, and ecological forms of connectivity and dimensions cannot be separated from one another. While not as prevalent as other nuanced examples, it was determined to be a nuanced example of social (more-than-human) connectivity. For example, one participant focuses on the environment and society, "the environment and society are the same thing. They are intertwined. You can't have one without the other. So, to me, I would say they are almost synonymous; they should be synonymous …" (NGOP5). This form of interconnectedness aligns with social (more-than-human) connectivity through its focus on the interconnectedness of social, cultural, and ecological forms of connectivity as a whole, rather than attaching or reconnecting these dimensions as separates.

2.5.2 Comprehensiveness Of Hodgetts' Taxonomy Of Connectivity

Prevalence of each connectivity type, as well as the nuanced examples attributed as 'child nodes' under the 'parent nodes' (core types) was quantified for (1) the set of transcripts as a whole, (2) discrete sections of the interview transcript as reflected in the interview guide (i.e., in response to questions related to meaning of (a) connectivity, (b) corridor and (c) social connective), and (3) each participant. The proportional prevalence of connectivity conceived as "pluralities" (i.e., five core types) and "a multiple" (i.e., using social (more-than-human) as a surrogate) was also examined across (1) the set of transcripts as a whole and (2) participants.

2.5.2.1 Prevalence of Connectivity Type Across all Transcripts

Based on the themes identified both deductively and inductively (open/emergent) across all transcripts, the forms of connectivity depicted in Hodgetts' taxonomy were found to be comprehensive and relevant within the context of connectivity conservation planning in the study area as conceived by participants. The prevalence of core types and

emergent nuanced examples is depicted in *Figure 2.2*. Deductive coding, based on the taxonomy itself, indicates that each type is present, with social (economic) connectivity being the most prevalent (25% of total coding references), followed by emotional-affective (19%), spatial-structural connectivity (18%), ecological-functional (15%), social (more-than-human) (12%), and social (equity) (11%). Despite these variations, the proportions are relatively evenly distributed. No themes or subthemes emerged that could not be considered within one or another of the types delineated by Hodgetts, if broadly interpreted, suggesting that the taxonomy is comprehensive. It is clear, however, that the diversity of forms of connectivity found in this research support Hodgetts' point that most interpretations or perceptions of connectivity see it as a set of "pluralities", with diverse types existing across all transcripts. Only 12% of coding references across the entire dataset describe connectivity in ways consistent with "a multiple," through the proxy category of social (more-than-human), while 88% of the coding instances were indicative of "plural" types of connectivity. I also found that the proxy of more-than-human did best represent Hodgetts' depiction of a multiple, in particular to the nuanced example of 'interconnectedness', as no other category was found to contain coding references to passages of text that discuss the connections between ecological, social, and cultural realms such that these realms cannot be separated.

Figure 2.2 Six core types of connectivity and emergent nuanced examples. Outer ring represents the number of coding references across the entire dataset for the core type and nuanced examples determined through a Matrix Query

Combined, ecological-structural types represent 33%, and social types represent 67% of the total. When interpreting these results, it is important to note that a higher overall prevalence is expected for social forms, as this was the focus of interviews given the objective of the study to address the gap in relation to social forms of connectivity within the connectivity literature. Given that more attention was given to social forms overall, it is interesting that ecological-structural forms are still quite prevalent across the transcripts despite a more socially-oriented focus. In fact, when looking at responses within parts of the transcript that did not explicitly ask about social connectivity, the majority pertained to ecological connectivity (i.e., spatial-structural and ecological-functional) (*Figure 2.3*). Accordingly, the results do not necessarily indicate that social forms are more prevalent than ecological forms among practitioners in the region.

2.5.2.2 Prevalence of Types of Connectivity by Interview Transcript Section

The themes elicited by inquiring about the meaning of (a) connectivity, (b) corridor, and (c) social connectivity, are illuminating in that they explicitly respond to the issue in question, while (d) themes revealed in other parts of the transcripts may not be as directly linked (e.g., responses to questions relating to broader social dimensions associated with connectivity, potential opportunities and challenges, land ownership, and prioritization of key areas). On the other hand, references to a specific type of connectivity throughout the transcript may indicate a more embedded commitment to the type than would be the case in instances where mention is made only in response to prompting through a direct question. It is important to note, however, that the majority of the interview guide, and thus of the transcripts, contain prompts related to social aspects, such as broader social dimensions and land ownership, and thereby likely results in a bias towards social types within the results, even outside of the question related to social connectivity (c), such as in relation to those in the rest of the transcript (d). Results of the matrix query represented through percentages of coding references across the dataset are depicted in *Figure 2.3*.

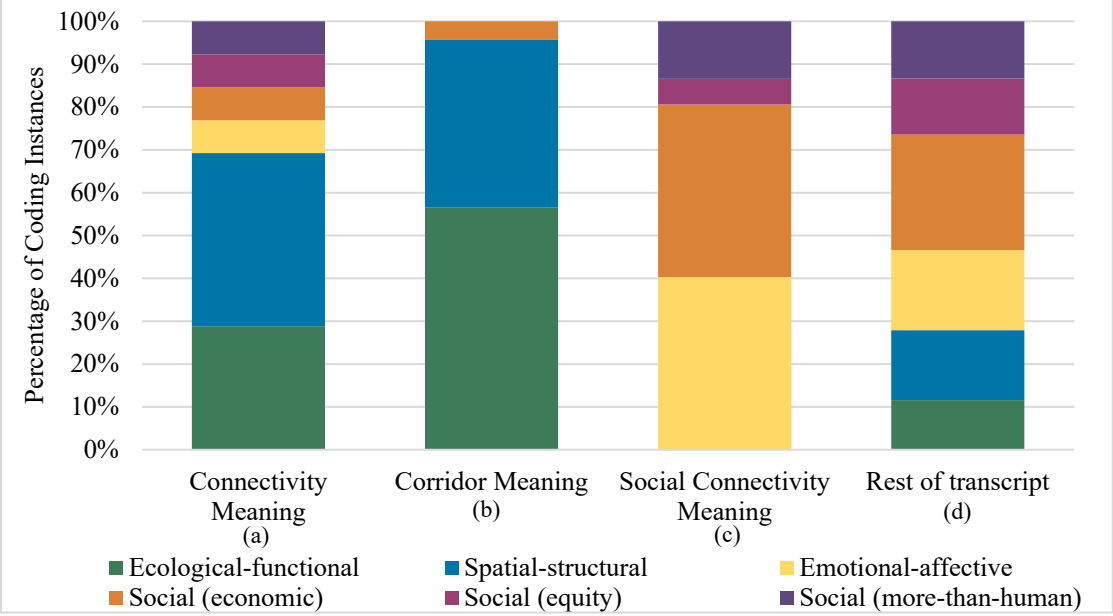


Figure 2.3 Prevalence of different connectivity types differentiated based on location of appearance in transcripts. *Represents the results of a matrix query, with total instances of coding references in percentage by question type. The four question types*

are the meaning of (a) connectivity, (b) corridor, (c) social connectivity and (d) themes revealed in other parts of the transcripts (e.g., responses to questions relating to broader social dimensions associated with connectivity, potential opportunities and challenges, land ownership, and prioritization of key areas).

Differences in prevalence of themes based on where they emerge in the transcripts highlight some interesting patterns. For example, social (economic) connectivity was found to be one of the primary and most prevalent types, but it had minimal coding prevalence under questions asking about the meaning of (a) connectivity (8% of total coding instances for the category) and (b) corridor (4%) and is most prevalent after prompting, under questions asking about (c) social connectivity (40%) and (d) the rest of the transcript (27%). This suggests that when asked about connectivity or corridors in general, social connectivity was not strongly associated with either concept, as it was seldom mentioned prior to prompting. In contrast, ecological-functional and spatial-structural (together, referred to as ecological-structural) considerations predominated in response to questions about the meaning of connectivity (67%) and corridors (95%), even though the interview guide did not prompt for these types.

When prompted explicitly about social connectivity, no responses indicated ecological-structural connectivity. This indicates there may be a clear divergence between ecological-structural and social forms of connectivity, except in the case of social (more than human) connectivity, which, by definition, embeds ecological within more-than-human as inseparable. Social (more than human) connectivity comprised 13% of responses to the question of (c) social connectivity. The most prevalent forms of social connectivity in response to the question are social (economic) and emotional-affective, each at 40% of total coding references by category. There were no instances of emotional-affective responses to the questions relating to (b) corridor and few (7%) for the meaning of (a) connectivity.

Overall, connectivity was most prevalently portrayed as a plurality of types under prompts relating to (a) connectivity, with 92% of responses depicting connectivity as one or more of the five “plural” types, and 8% indicating connectivity as “a multiple” through the more-than-human type. By contrast, responses under the meaning of (b) corridor had

no mention of connectivity as "a multiple" and solely focused on the five plural types. Social connectivity (c) prompts had the highest prevalence of connectivity as "a multiple" with 14% of responses fitting in the more-than-human category. Similarly, throughout 9d) the "rest of the transcript" connectivity was conceived of as "a multiple" (more-than-human) in 13% of responses.

2.5.2.3 Theme Prevalence – Types of Connectivity by Participant

Examining the prevalence of themes across each individual transcript shows the diversity in types of connectivity described by each participant. These findings support the central concept of Hodgetts' (2018) taxonomy in which connectivity is described to be predominantly represented as "plural" types, as each interview transcript encompasses various forms of connectivity. While some participants discussed one form of connectivity more than others, there was no clearly dominant type for each participant and the diversity is best represented by looking at all types within each transcript, as depicted in *Figure 2.4*, which represents the percentage of coding references by participant.

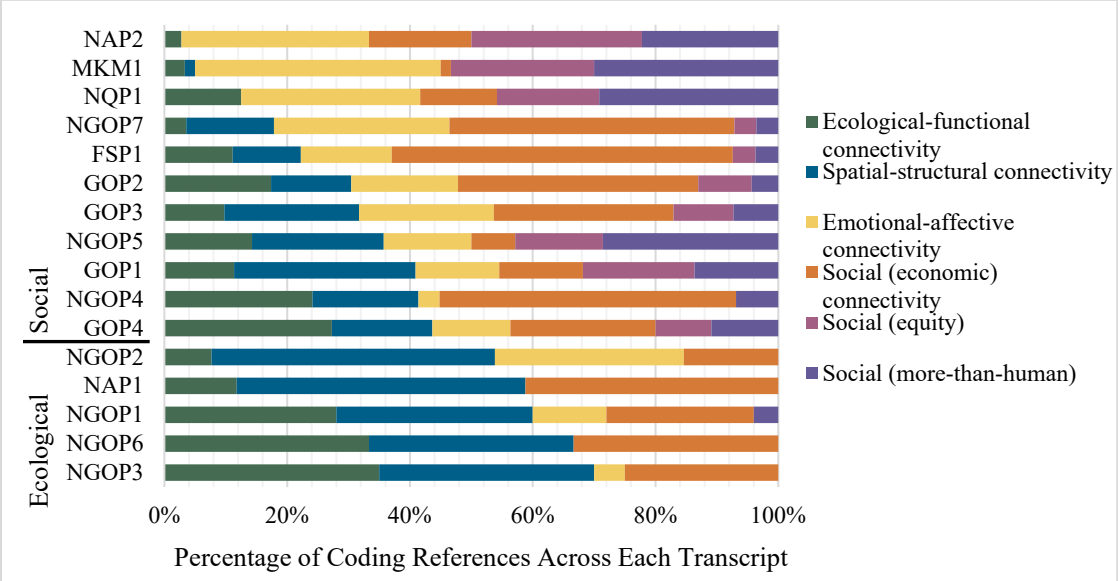


Figure 2.4 Theme prevalence by participant and type of connectivity. *Sorted by Social-dominant (top) and Ecological-dominant (bottom) and in order of increasing ecological-prevalence from top to bottom. Represents the results of a matrix query counting the coding references by connectivity type, across each interview transcript*

The results indicate that almost one third (25%) of the participants more prevalently expressed ecological-structural connectivity types and two thirds (75%) more prevalently expressed social types. This makes sense as interviews were more directed at the social elements associated with connectivity. Some participants expressed fairly even prevalence of connectivity types, while others stressed social or ecological-structural. For example, NAP2, MKM1, and NQP1 discussed more social types, while others such as NGOP3, NGOP6, NGOP1, NAP1, and NGOP2 focused more on ecological-structural types. Six participants' responses were fairly evenly divided (40-60%) between ecological-structural and social types of connectivity, with one of these (NGOP2) close to 50%. This shows that there is considerable variation across participants in the prevalence of the different forms of connectivity discussed, and all expressed diverse forms, both of which support the idea that the meaning of connectivity is predominantly conceived by participants as pluralities that cross and/or integrate both ecological and social domains.

In order to investigate how many participants conceived of connectivity as "a multiple", I looked at the prevalence of the more-than-human type as a proxy and I looked at participants' conceptions of connectivity as "plural" as represented by the five other types. The results indicate that all participants view connectivity as a plurality of types. Twelve of the 16 participants expressed connectivity as "a multiple" (i.e., social (more-than-human)) to some extent. Only four participants (NAP2, MKM1, NQP1, NGOP5) expressed connectivity as "a multiple" (i.e., social (more than human)) in more than 20% of their responses. Many of those who more heavily viewed connectivity as "a multiple" discussed the inter-connectedness of nature, society, and culture, such as MKM1 and NGOP5. On the other side of the range, four participants (NAP1, NGOP6, NGOP2, NGOP3) made no comment reflective of connectivity as "a multiple" through the more-than-human proxy, thereby solely conceptualizing connectivity as a plurality of types.

2.5.2.4 Thematic Overlap Between Connectivity Types

Thematic overlap was used to examine the overlap between and across Hodgetts' six types of connectivity. This was done by looking at instances where coding for one type of connectivity directly overlaps coding for another type through a matrix query. Thus, the numbers in *Table 2.3* represent counts of the instances of overlapping coding

reference (i.e., passages of text that were coded into more than one connectivity type). The amount of overlap between and across the multiple forms of connectivity discussed by participants reveals that there are distinct sub-groupings of "plural" types of connectivity. This also serves to illustrate that there is overlap and thus subjectivity in 'artificially' assigning overlapping and thus interrelated themes to one (or more) type(s) of connectivity or another. It supports the interconnectedness of types, especially those like social (economic), based on social-ecological systems thinking, and more-than-human, premised on indivisibility. Thus, looking at overlap supports moving towards viewing connectivity as a "multiple", especially as the interrelationships are not exclusive to only one other type, with varying levels of overlap being found between all types.

Table 2.3. Overlap between core types of connectivity

Core Types	Ecological -Functional	Spatial-Structural	Emotional-Affective	Social (Economic)	Social (Equity)	Social (More-Than-Human)
Ecological-functional						
Spatial-structural	25*					
Emotional-affective	3	2				
Economic	5	5	20*			
Equity	2	2	47*	5		
More-than human	3	2	45*	4	44*	

**Some nuanced examples fit into two or more types which increased the amount of overlap between types; see the coding hierarchy in Appendix C*

There are notable clusters in the overlap, with ecological and social clusters evident: ecological and social forms overlap considerably less *between* these two clusters and have higher instances of overlap *within* each respective cluster. For example, ecological-functional and spatial-structural types have the highest number of instances of overlap with one another, and social forms have high levels of overlap with one another, such as emotional-affective and economic; emotional-affective and equity; emotional-

affective and more-than-human; and equity and more-than-human. The highest overall instances of overlap are between emotional-affective, equity, and more-than-human, with all three being closely related.

2.6 Discussion

This paper explored the meaning of connectivity as conceptualized in practice by applying Hodgetts' taxonomy to transcripts of interviews with conservation experts and other local knowledge holders. The findings support the relevance and comprehensiveness of Hodgetts' six core types: ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human). I found that Hodgetts' types were comprehensive based on the sorting of emergent subthemes into one or more types delineated in the taxonomy. On the other hand, some of the emergent sub-themes suggest that a more complete description of Hodgetts categories should include explicit references to aquatic, cultural, human, and social (well- being) connectivity, as well as interconnectedness. These sub-themes, which emerged from the interview data, offer a diversity of nuanced examples relating to the six connectivity types. These sub-themes primarily focus on social forms of connectivity (other than aquatic connectivity), which is to be expected given the scope of this work, in which more attention was paid to social forms of connectivity.

The approach used to examine the nuances of how connectivity is conceptualized by experts and other local knowledge holders is part of a broader shift in the discussion associated with connectivity. The majority of research in the past has focused on ecological-functional and spatial-structural forms of connectivity, but more recent work recognizes that connectivity conservation exists within diverse social-ecological systems (e.g., Needham, Beazley & Papuga, 2020) and is conceived holistically in Indigenous conceptions (e.g., *M'sɨt No'kmaq* et al., 2021). Social elements associated with connectivity have been discussed by a variety of authors, including Burgh (2017), Hilty and colleagues (2020), Lemieux and colleagues (2021a; b), Lambert (2013), Parrott and colleagues (2019), and Wyborn (2011; 2015a; b). This study extends such work by examining the 'meaning' of connectivity as it encompasses such social forms, which aligns with the embeddedness of social processes within conservation (Parrott et al.,

2019), tenets of social-ecological system theory (Ostrom, 2007; Resilience Alliance, 2010), and calls to think more holistically and equitably in a more-than-human sense and as conservation through reconciliation (Artelle et al., 2019; Loring and Moola, 2020).

2.6.1 Key Findings

2.6.1.1 Social Forms of Connectivity

Much of connectivity research and practice focuses on ecological connectivity. The present study focused primarily on social forms of connectivity, with participants expressing several interpretations of the meaning of connectivity in general and social connectivity in particular. Participants responses often pertained to broader social considerations, at a society scale, such as collaboration, meaningful engagement, and the need for an increase in the connection between humans and nature. Questions relating to the meaning of connectivity and corridors were found to not elicit discussion relating to social forms of connectivity. Thus, general considerations of 'connectivity' and 'corridors' within connectivity planning initiatives and collaborations may not be sufficiently explicit to ensure social forms of connectivity are addressed. Such initiatives should explicitly include social dimensions relating to connectivity conservation. Four types of social connectivity are identified by Hodgetts, participants described several nuanced examples, and others are discussed in the literature, such as the connection between humans and nature (Wyborn, 2011), meaningful collaboration (Wyborn, 2015a), relationship building (Burgh, 2017), communication and coordination across stakeholders and governance (Lambert, 2012), the role of trust (Burgh, 2017), the values different groups place on the landscape, and the livelihoods the landscape supports (Parrott et al., 2019). Once refined through additional research, key types and characteristics of social connectivity could become critical components of connectivity and corridor planning, but based on the results of the present study, this may not be straightforward. Future research is needed to investigate how such social forms of connectivity should be enacted in conservation planning.

2.6.1.2 Clusters of Ecological and Social Forms of Connectivity

I found clear 'clusters' of ecological and social forms of connectivity, both in terms of overlap and in participants' responses. Examining where coding references

directly overlap indicated that ecological-structural forms (i.e., ecological-functional and spatial-structural) most closely relate to one another, and social forms have high levels of overlap with other, such as emotional-affective and economic; emotional-affective and equity; emotional-affective and more-than-human; and equity and more-than-human. In terms of participant responses, some participants were clearly ecologically dominant, while others were socially-culturally dominant, and some were relatively equally balanced across ecological and social types. The findings suggest that ecological and social dimensions are important to design conservation networks, consistent with the findings of others (Pasquini, Twyman, & Wainwright, 2010; Virapongse et al., 2016; Needham et al., 2020). This extends to incorporating both ecological and social forms of connectivity in planning and management more broadly, across regions and all of society, as it should lend support to connectivity initiatives by illuminating the connections within and across ecological, social, and cultural realms.

The thematic 'clusters' found in this study may extend to not only ecological and social forms, but also perhaps a separate category for economic forms. I found that the economic discourse was both prevalent and challenging in relation to discussions surrounding dominant economic processes, such as forestry. The ideal expressed by Hodgetts (2018) is that none of the forms of connectivity be given temporal priority within connectivity conservation planning, so that all forms of connectivity are considered at the outset, rather than the common approach of focusing on ecological, followed by a consideration of social, economic, and cultural factors. Arguably, however, the entire landscape is already dominated by social (economic) forms of connectivity, many of which ecological-structural connectivity aims to confront or mitigate through consideration of more-than-human species and processes. The current dominant western-colonial systems apply minimal value to ecological and more-than-human systems. Thus, there may be a 'divide' between ecological forms of connectivity, more-than-human and equitable forms of social and cultural connectivity, and dominant economic processes. Future research is recommended to investigate the thematic clusters of connectivity types, and whether grouping of forms by broader categories is appropriate. Future research could examine discourses in more detail, in terms of how and why some people view connectivity more heavily from a social perspective compared those who focus more

greatly on ecological forms of connectivity, and the synergies and contrasts between ecological-structural connectivity and social (economic) connectivity.

2.6.1.3 Extending Social to Social-Cultural Forms of Connectivity

The inclusion of social-cultural forms of connectivity may contribute to working towards a more just conservation (Bennett et al., 2017). For example, through equitable forms of connectivity and by supporting reconciliation and Indigenous-led conservation (Artelle et al. 2019; Zurba et al. 2019), which may include a focus on cultural connectivity and well-being, examples of emotional-affective, economic, equity, and more-than-human forms of social connectivity. This is especially pertinent as the belief that humans are part of the land and not separate from it is integral to Indigenous worldviews (Indigenous Circle of Experts [ICE], 2018). Common to many Indigenous and traditional, non-western narratives, the idea of person is embedded within a web of relations between humans and non-humans and involves a recognition that the natural world is alive (Jax et al., 2018). This is embodied in Mi'kmaq worldviews, as expressed by the concept of *M'sɨt No'kmaq*, which roughly translated means "all my relations" and "reminds us how we are all related and dependent within all the living world" (*M'sɨt No'kmaq* et al., 2021, p.846). Within this worldview, humans are not superior, but a small part of the natural world (*M'sɨt No'kmaq* et al., 2021). These tenets best align with more-than-human connectivity and connectivity as "a multiple", through the focus on the interconnectedness of humans and more-than-humans, and social, cultural, and natural realms. 'Culture' rings loud and true within these texts and also in the voices of many participants. Consequently, the explicit inclusion of culture as part of connectivity may be warranted.

2.6.1.4 Human Connectivity: Nuanced Example of Social (Economic) Connectivity

I found human connectivity to be a nuanced example of social (economic) connectivity, which includes transportation corridors, a major cause of fragmentation discussed within the literature (Jongman et al., 2004). There is potential for social (economic) connectivity to enhance ecological forms, by gaining support and addressing key social issues that underly conservation issues. A noteworthy example is the intersection when looking at social (economic) and ecological-functional and spatial-

structural connectivity. Focusing on human movement as a necessary form of social-cultural (well-being) connectivity may serve to better align the goals of transportation planning with connectivity conservation planning. For example, if road and highway design was planned with ecological-functional connectivity in mind, wildlife movement would be given equal importance to human movement. Focusing on the commonalities between the two forms of movement may be a way forward in trying to balance the need for facilitating the movement of both wildlife and humans across the landscape.

The present study found that motorized vehicle recreationis a form of human movement that potentially connects people to nature through access, and therefore may increase emotional-affective forms of connectivity. However, recreation can have negative impacts on ecological aspects, through habitat degradation and fragmentation (Mitrovich et al., 2020) which is a particular concern when it comes to motorized forms of recreation (Brooks & Champ, 2006), with all-terrain vehicle (ATV)-use often discussed as a form of fragmentation and disturbance within conservation-focused literature (St-Louis et al., 2013). Perhaps a re-framing of this form of recreation is needed to highlight the commonalities between such forms of human movement as a key example of social (economic) connectivity and a key approach to connecting people with nature. Future research is recommended to evaluate this key group of recreation users, their perspectives towards connectivity, as well as conservationists' perspectives towards motorized vehicle recreation as a form of connectivity, in supporting societal connections through movement (economic) and personal connections with nature (emotional-affective).

2.6.1.5 Emotional-Affective, Equity, and More-Than-Human – Social-Cultural Connectivity

I found that cultural connectivity was a nuanced example of broader forms of social connectivity, including emotional-affective, social (more-than-human), and social (equity) connectivity. Previous research discusses cultural heritage connectivity to depict cultural and historical dimensions and to align with other forms of connectivity, such as social, ecological, and economic processes (Antonson, Gustafsson & Angelstam, 2010). Hodgetts' focus on 'cultural' elements is limited to discussion of more-than-human natures and affective types of connection and disconnection as forms of emotion, as

depicted by cultural geography scholars (McCormack, 2013; Thrift, 2008), and groups such culturally-oriented interrelations under "the social" (Latour, 2005, as cited by Hodgetts, 2018), with "the social" referring to a collection of connected actors. Cultural connectivity as an emergent example is notably distinct from broader, social forms of connectivity through its focus on the culture itself (rather than the community, structure or group), such as Indigenous cultural elements, including language, cultural keystone species (Garibaldi & Turner, 2004), and worldviews that hold this premise of interconnectedness and relations as core to belief systems (*M'sɨt No'kmaq* et al., 2021), such as viewing "fish as relatives" (Pinchin, 2021, para. 18), thus more-than-human. Within this work, I found that using social-cultural when referring to both social and cultural dimensions is most appropriate but referred to both as 'social' when explicitly focusing on Hodgetts' taxonomy to be consistent with the terminology used in the framework. Based on the findings of this work, there is a need to preliminarily expand the terminology used to describe categories to depict the cultural dimensions embodied within Hodgetts' core categories. Therefore, I propose that social forms of connectivity be expanded to social-cultural forms of connectivity, such as social-cultural (emotional-affective), social-cultural (equity), and social-cultural (more-than-human) connectivity, as depicted in *Table 2.4*. A broader shift is proposed for social (economic) connectivity, discussed subsequently.

2.6.1.6 Social-Cultural (Well-Being) Connectivity

As previously mentioned, Hodgetts' taxonomy (2018) depicts social (economic) connectivity to be based on social-ecological systems theory, including a focus on ecological, economic, and political processes. The social-ecological system (SES) framework highlights a humans-in-nature perspective that depicts multifaceted relationships with the environment, both collectively and individually (Jones et al., 2016; Ostrom, 2007; Resilience Alliance, 2010). These relationships impact views towards how natural resources should be managed (Jones et al., 2016). However, there is relative ambiguity in the way 'culture' is discussed in relationship to social elements when it comes to discussion of SES (Folke et al., 2005; Berkes et al., 2003). Previous work has explored a revised version of SES, through the development of a 'cultural dimension of social-ecological systems framework' (Poe et al., 2014). This framework attributes

‘livelihoods’ as a key dimension of socio-cultural well-being (Poe et al., 2014), which was found in the present study to be a key feature of social (economic) connectivity. However, it is important to note that the present study did not find cultural connectivity to be a nuanced example of social (economic) connectivity through examination of thematic overlap, therefore future research is needed to clarify the relationship between social (economic) connectivity and the nuanced example of cultural connectivity. Despite this, cultural dimensions are critical to include because of the common theme of livelihoods, the need for cultural considerations in discussions surrounding SES systems, and for consistent terminology with other categories presented above, social-cultural forms of connectivity.

The findings in this study support the potential changing of the broader category name, social (economic) connectivity, to better represent concepts such as relational values and caring for nature and move away from utilitarian focuses applied to nature (Jones et al., 2016) and narratives shaped by economics, demography, and institutions, and towards those guided by notions of well-being (Armitage et al., 2012). For example, social (economic) as a category name implies a focus on the *benefits* nature provides to people as the reason connecting humans and nature. Social (well-being) connectivity, an example of social (economic) connectivity, aligns with conceptualizations associated with approaches to caring for nature (Jax et al., 2018) and is consistent with Indigenous views of well-being in relation to land, culture, reciprocal relations, and natural law (Jax et al., 2018; *M'sɨt No'kmaq* , 2021). Thus, the concept of well-being goes beyond the benefits nature provide and includes caring for nature (Jax et al., 2018). This also relates to what Kashwan and colleagues depict as ‘re-generative environmentalism’, grounded in rural and Indigenous livelihoods and culture, with the aim of diverging from capitalist modes of production and towards human sustenance (2021).

Social (well-being) is a nuanced example found in the present study that focuses on the connection to natural systems for overall well-being, including basic necessities such as air and water, and extends to caring for nature beyond needing it for survival. This includes the relationship with nature for enjoyment and positive connections with nature. Based on the above discussion of the literature and the findings of the present study, in which well-being was a nuanced example of social (economic) connectivity, I

propose a preliminary re-naming of social (economic) connectivity to social-cultural (well-being) connectivity. Future research is needed to clarify the rationale for a potential shift in terminology relating to social-cultural (well-being) connectivity, but there is preliminary evidence to support such a shift towards a focus on 'well-being' within the present study and the broader literature.

2.6.1.7 Ecological-Social-Cultural as a Connectivity "Multiple"

Through integration of the results of the present study with relevant literature, I have proposed a shift in terminology associated with Hodgetts' taxonomy of connectivity (2018), with a summary of such changes depicted in *Table 2.4*. I extend that Hodgetts' social forms of connectivity are best represented as social-cultural forms, based on the nuanced examples of cultural connectivity. Thus, as mentioned above, I propose that the social-cultural portions of the taxonomy be preliminarily changed to depict social-cultural (emotional-affective), social-cultural (well-being), social-cultural (equity), social-cultural (more-than-human) connectivity.

Table 2.4. Proposed preliminary shifts in terminology for social forms of connectivity depicted in Hodgetts' taxonomy of connectivity (2018)

Hodgetts' terminology	**Preliminary Re-naming**	**Rationale**
Emotional-affective connectivity	***Social-cultural (emotional-affective) connectivity***	Accounting for cultural elements; emergent nuanced example of cultural connectivity; connection between language, culture and the land; connection between continuation of culture and cultural revitalization and the land
Social (economic)	***Social-cultural (well-being) connectivity***	Including cultural element in social-ecological systems (from literature); emergent nuanced example of well-being; shifts focus to caring for and needing nature for well-being & away from focus on *benefits* (e.g. economic) of nature.
Social (equity)	***Social-cultural (equity) connectivity***	Accounting for cultural elements; emergent nuanced of cultural connectivity; cultural connectivity as part of social (equity)

Hodgetts' terminology	Preliminary Re-naming	Rationale
		focused on Indigenous protected areas; treaty rights implementation; cultural revitalization
Social (more-than-human)	***Social-cultural (more-than-human) connectivity***	Accounting for cultural elements; emergent nuanced example of cultural connectivity; cultural connectivity as an example of more-than-human focused on the indivisible interconnections among ecological and cultural dimensions

Based on the exploration of the meaning of connectivity in the present study, I propose an additional, broader definition of connectivity that represents a preliminary extension the core definition of ecological connectivity (CMS, 2020; Hilty et al., 2020), to highlight connectivity as "a multiple" by aiming to encompass the connections and overlap between all (plural) forms of connectivity as one whole, an indivisible all-encompassing 'connectivity'. Therefore, connectivity refers to: "the unimpeded movement *of more-than-humans* and flow of natural processes *such as ecosystems and more-than-human processes through inextricable relationships with each other and the land, between communities/groups, nature, and the livelihoods, knowledge, language, and practices* that sustain *and contribute to the diversity of* life on earth". The preliminary extension of the core definition (CMS, 2020; Hilty et al., 2020), shown in italics, extends the definition with the aim of highlighting connectivity as "a multiple", in order to encompass the inextricable connections between the types of connectivity discussed in this research. Future research is needed to evaluate the efficacy of this preliminary definition in both research and practice.

2.6.1.8 Connectivity as "a Multiple" or as Distinct "Plural" Types

This research identified several forms and examples of connectivity described by participants working on connectivity initiatives within the Kespukwitk study area, all of which fit within Hodgetts' (2018) taxonomy. Given the consistency between local perceptions of connectivity types and Hodgetts' (2018) taxonomy, the relevance of the taxonomy within the study area context may be implied. Given this seeming on-the-

ground and practical relevance, initiatives organized around and focused on Hodgetts' taxonomy (2018) may represent a potential approach to addressing or applying the plural types in practice.

I found that connectivity being solely "plural" or "a multiple" was not the case; rather, connectivity was often conceptualized somewhere in between these interpretations. This is evident when looking at the diversity across the way participants talk about connectivity, in that no participant focuses on solely one type, or solely ecological or social, or solely more than human (a multiple). Four participants, however, did not allude to more-than-human concepts at all, and thus are solidly within the connectivity-as-a-plurality camp. According to Hodgetts' framing, the problem of "plural" rather than "a multiple" conceptions of connectivity are both conceptual and practical (2018). The issues are conceptual because different ideas about connectivity are actually meaningfully connected, and practical because how multiple forms of connectivity are enacted has implications relating to how "humans engage with, protect, and manage "natures" (Hodgetts, 2018, p.84). I found that separating the types added to the overall findings relating to the relationships between types and contributes to the identification and understanding of what forms of connectivity are being enacted or given priority. This need for some degree of distinction between the types likely extends to practical contexts as well, such as the planning associated with connectivity initiatives, and what forms may need more attention, with the goal of working towards a holistic approach that considers all types in tandem. This may not be what Hodgetts envisioned when discussing the need to move towards viewing connectivity as "a multiple", but I contend that perhaps, "plural" forms are inherently problematic, as long as the connections between such plural types are a key part of approaches. For example, the present study initially considered each plural type separately for thematic analysis purposes, but subsequently analyzed the overlap and interrelations between the types. The finding that all participants are considering some variation of most, if not all, types of connectivity, sometimes even within a single statement or quote, also provides evidence of an awareness of interrelationships between plural types within many participants' conceptions of connectivity.

2.6.2 De-limitations and Limitations

Some of the potential limitations discussed within this section are 'delimitations' that were made based on practical considerations, such as time and other practical constraints. The following discussion presents them as potential limitations that should be taken into consideration when interpreting the results. The results of the present study do not pertain to Mi'kmaq or forestry perspectives and were not intended to, and the results are embedded with the local context, as intended because of the importance of assessing the context-specific relevance of a conceptual framework, such as Hodgetts' taxonomy of connectivity (2018). Therefore, the results may not be broadly generalizable and future studies, in other contexts, engaging with other groups are warranted and recommended.

Data saturation – Although two Mi'kmaq individuals and one person working in the forestry sector were interviewed, the number of participants in these groups were not sufficient to ensure data saturation. Both groups are part of the broader perspectives relating to the study population focused on experts and key local knowledge holders and were invaluable to the study but were not intentionally targeted as for recruitment within the study (as a conscious delimitation) and are therefore under-represented in this work. It is important to acknowledge this limitation when discussing data saturation and when interpreting the results, although data saturation was achieved with the intended population, experts and other key knowledge holders.

Local context and emergent nuanced examples – One potential limitation to consider when interpreting the results is the impact that local context may have had on the emergent examples of the broader forms of connectivity. This is also a strength, however, and was done purposively, as specific examples are important in determining whether conceptual and general theories such as Hodgetts' taxonomy of connectivity (2018) apply in various contexts and in practice. Thus, as intended, there is potential that the local conservation context may have had an impact on the resulting exploration of core forms of connectivity and emergent examples. The impact of local-context is important to consider when discussing the generalizability of the results, as the results may not be broadly generalizable and future research is needed in other contexts. For example, the prevalence of the emergent nuanced example of cultural connectivity within initiatives in the region may reflect its importance in the local context, but this prevalence

may be context-dependent. A local initiative, the Kespukwitk (Mersey) Corridor Project, was often discussed in relation to cultural connectivity, as it specifically aims to include Indigenous and non-Indigenous perspectives and values. This focus on local context also extends that the examples of connectivity are particularly relevant to local conservation planning and may be of interest to conservation practitioners working in the region.

Relevance of interview guide and questions – Some forms of connectivity were not asked about directly, which may have impacted the prevalence of types. For example, the meaning of connectivity, corridor, and social connectivity were asked about directly, while other types, such as ecological-functional and spatial-structural, and sub-sets of social connectivity (economic, equity, and more-than-human) were not asked about directly. This was done because the primary focus of the research was exploring the meaning of connectivity, and particularly social (cultural) forms of connectivity, rather than deductively applying and assessing Hodgetts' taxonomy, directly or *a priori*. This may be advantageous because the forms that did emerge did so without any direction from the interview questions, and thus are important from the perspectives of the participants. However, this is also a potential limitation to consider when interpreting the results, because some participants may have discussed other forms but were not probed to do so. The qualitative approach used in the present study examined the nuances in participants response to tease out key forms of connectivity elicited based on broad questions. Other research could take a different approach and ask more explicitly about the types proposed by Hodgetts (*a priori* approach), as well as potentially the nuanced examples found in the present study.

2.6.3 Future Research

Based on the findings of the present study, I recommend three key avenues for future research, (1) including key perspectives: local Indigenous and non-Indigenous communities, forestry perspectives and conservationists, and motorized vehicle recreation users and conservationists; (2) key management approaches to social-cultural forms of connectivity; and (3) the spatial prioritization of key areas for social-cultural forms of connectivity.

2.6.3.1 Including Key Perspectives

This research found key ecological and social-cultural forms to be important forms of connectivity for consideration by experts and other local knowledge holders in Kespukwitk, with each participant discussing a variety of different types. To build upon the findings of the present study, a key area of exploration for future research involves exploring how various forms of connectivity are perceived and conceptualized by a key group identified within the present study: local communities, both Indigenous and non-Indigenous. Mobilization of diverse forms of knowledge and ways of knowing is key to facilitating effective conservation decision-making (Needham et al., 2020). Previous research has identified critical weaknesses in the way the Global Biodiversity Framework addresses the perspectives of Indigenous Peoples and local communities (Cariño & Ferrari, 2021). These inadequacies include the embedded framing of a separation between nature and culture and a failure to recognize and embed customary land tenure and territorial management as vital of biodiversity conservation (Cariño & Ferrari, 2021). Therefore, research aiming to inform equitable conservation should focus on understanding diverse values and consider local people and their perspectives, livelihoods, and knowledge (Berkes, 2004; Brown & Decker, 2005; Cook et al., 2018). Within the context of the present study, how local values align with various social-cultural forms of connectivity discussed above, including emotional-affective, well-being, equity and more-than-human, is a potential topic of future research. For example, perspectives towards the (dis)connection between nature and culture, the environment and humans, is needed from a local Indigenous and non-Indigenous perspective. Such research could complement the results in this study by examining how local people conceptualize connectivity and what forms of connectivity align with local values and perspectives. As discussed previously, some categories such as more-than-human connectivity align particularly well with Indigenous worldviews, which provide guidance on "how to live" in reciprocal, circular, and ongoing inter-relationships with all ecologies, including all peoples (*M'sɨt No'kmaq* et al., 2021, p.859). Indigenous ways of knowing are also noted to be "inherently scientific", based on the use of experimentation and observation to learn about nature (Pinchin, 2021, para. 18). Thus, future research is needed in partnership with Mi'kmaq or other Indigenous communities, depending on the

location of the study. This could focus on how Indigenous worldviews, such as *M'sɨt No'kmaq*, align with and inform more-than-human and other social-cultural forms of connectivity.

From this study, it is evident that health of the forest is integral to both forestry and conservation and is discussed relating to social-cultural (well-being) connectivity. Polarization of perspectives in forestry and conservation was also identified as a key theme in preliminary stages of analysis but given the scope of this project, detailed exploration of this theme was not possible. Future research should explore the perspectives of those involved in the forestry sector, especially within the Nova Scotia context, as forestry is a core component of rural economies in the province (NSWOOA, 2017). Therefore, research focused on connectivity conservation should seek to explore this in more detail by focusing in on forestry and conservationists perspectives on this potential 'polarization'.

The present study also found that some forms recreation relating to human connectivity, a nuanced example of social-cultural (well-being) connectivity, actually contribute to other, key forms of connectivity. For example, while ATV use is not typically associated with connectivity conservation, it serves to support human movement throughout the landscape, access to nature, and connections with nature, and thus supports well-being and emotional-affective forms of social-cultural connectivity. Research is needed to determine recreation users' values and relationships with one another, and with the land (Brooks & Champ, 2006). Future research could engage with recreation-users, such as ATV groups, and conservationists to explore how motorized vehicle recreation could potentially align with some social-cultural forms of connectivity.

2.6.3.2 Key Management Approaches to Social-Cultural Forms of Connectivity

This research found that many forms of connectivity are considered important to connectivity conservation planning in the context of Kespukwitk, Nova Scotia, including social-cultural forms such as emotional-affective, well-being, equity, and more-than-human. Translating what is known about science and management practices into effective policy for connectivity conservation currently presents a significant challenge (Lemieux et al., 2021d). How these diverse social-cultural forms of connectivity interrelate with each other and with ecological forms and translate into policy and practice is a key

avenue for future research. However, it is important to note that integrated connectivity planning cannot be achieved by conservation practitioners alone. Such initiatives require a whole of government approach and the engagement of key influencing sectors and agencies, such as departments of transportation and those responsible for urban planning. For social equity and well-being, Indigenous co-governance and co-management, including co-production of diverse knowledge systems, are crucial. Acknowledging and making space for key leaders that are needed for many of the social-cultural forms of connectivity is critical to translating these forms of connectivity into practice.

Dealing with the social-cultural types of connectivity in practice could potentially involve approaches to conservation being adapted to align better with the various types of connectivity. For example, biocultural conservation practices seek to address the protection of both biological and cultural diversity and recognize that they are strongly interlinked (Gavin et al., 2015). Tenets of this approach include shared governance systems and approaches that respect diverse knowledge systems (Wheeler & Root-Bernstein, 2020). This approach may be particularly suited when looking at more-than-human connectivity, especially a nuanced example of this, cultural connectivity. Another suitable approach for more-than-human connectivity involves care-oriented approaches that emphasize relational characteristics of human life, dependencies, and reciprocity (Jax et al., 2018). Values-led management (Artelle et al., 2018) approaches may also be appropriate when considering emotional-affective forms of connectivity and associated nuanced examples. Values-led management approaches are guided by deeply held values that connect people to place (Artelle et al., 2018). Future research could investigate how some of the above-mentioned approaches or other suitable approaches may align with and facilitate implementation of certain forms of connectivity.

2.6.3.3 Spatial Prioritization of Key Areas for Social-Cultural Forms of Connectivity

The present study supported Hodgetts' depiction of both ecological and social connectivity types, finding that all six types were discussed to some extent across participants, as well as a diverse sub-set of nuanced examples. Within the literature, the reasoning underlying the prioritization of areas for connectivity is primarily ecological-functional and spatial-structural. For example, it is clear how ecological-functional and spatial-structural forms of connectivity translate into on-the-ground prioritization and

implementation, as numerous examples exist (Aune et al., 2011; Burgh, 2017; Kindlmann & Burel, 2008). Several projects relevant to the region include ecological-functional and spatial-structural connectivity prioritization approaches, such as work by Reining and colleagues (2006) focused on the Greater Northern Appalachian Wildlife Network Design, and at a provincial scale, including work by Beazley and colleagues (2005) looking at habitat connectivity for moose, as well as more recent work looking at forest connectivity in Nova Scotia by Cunningham and colleagues (2020) and research focused on local tacit knowledge and mapping wildlife movement relating to connectivity in the Chignecto Isthmus bordering New Brunswick and Nova Scotia (Needham et al., 2020). Future work could complement previous spatial research and the present study by investigating whether the ecological and social-cultural forms of connectivity discussed within this research and in Hodgetts' taxonomy (2018) are relevant to the spatial prioritization of key areas for connectivity on the ground (see Chapter 3). For example, how social-cultural forms of connectivity relate to spatial prioritization on the ground will determine the feasibility of these forms of connectivity becoming part of on-the-ground initiatives.

2.7 Conclusion

This research articulates a set of core types of connectivity reflective of Hodgetts' taxonomy (2018) and a sub-set of nuanced examples that emerged through semi-structured interviews with conservation practitioners within Kespukwitk, Nova Scotia. While some of the emergent examples of connectivity types may be limited to the local context, it is clear that there is diversity in the ways that connectivity is conceptualized, even within each individual participant's responses, therefore supporting Hodgetts' depiction of plural types of connectivity (2018). I aimed to address concerns that connectivity is an ambiguous term (Bormpoudakis & Tzanopoulos, 2019), and possibly a 'panchestron' (Allan et al., 2021; Bunnell, 1999; Lindenmayer & Fischer, 2007), which may create challenges to implementation. These concerns highlight a need for specificity when discussing the various forms of connectivity, which can be addressed by distinguishing local examples relating to core categories, such as the nuanced examples (aquatic, cultural, human, well-being, and interconnectedness) of core connectivity types.

It also addressed an identified a gap in attention to social-cultural connectivity in the conservation literature and served to validate Hodgetts' taxonomy (2018) in an applied, place-based context. I proposed a preliminary shift in the wording of Hodgetts' taxonomy, in that social forms of connectivity should be expanded and referred to as 'social-cultural' forms of connectivity, given the emergent discussion of 'cultural connectivity' as a nuanced example and the need for inclusion of cultural elements within SES work. I also found that there was utility in distinguishing between the forms of connectivity proposed in Hodgetts' taxonomy. Differentiating between types highlighted the diversity across interview discussions in the types of connectivity discussed, and the relationships between and across types. Thus, I propose that perhaps "plural" types are useful in both research and practice, as long as the inter-connections and relationships between types is at the forefront of such approaches. I recommend that the forms of connectivity discussed within this literature be examined in-depth with reference to local context and values. Some forms may be more prevalent in other contexts, and new forms of connectivity may emerge. This extends to prioritizing key areas on the ground, as identifying areas based on social-cultural forms of connectivity may facilitate public support and understanding.

While Hodgetts' proposes that ecological forms are given temporal priority within connectivity conservation planning, with social (cultural) factors only being considered later in the planning process (2018), I find that the situation is much more complex, with the plural types of connectivity existing, and at times contradicting one another. For example, the entire landscape is dominated by social forms of connectivity, especially economic and political processes. Ecological connectivity aims to mitigate many of these, alongside more-than-human and equitable forms of connectivity, by delineating portions of the land for consideration of more-than-human. Thus, there are inherent systematic complexities associated with how "plural" types of connectivity interact within connectivity conservation planning, which may have been simplified by statements that depict that temporal priority is given to ecological connectivity in planning. Such 'temporal priority' in conservation planning directly aims to counteract the already existing dominant forces (economic and political) on the landscape within western-colonial systems. I propose that for a truly 'multiple' connectivity, (1) connectivity needs

to be mainstreamed, rather than thought of as a project solely for the conservation community, and (2) some forms of such as equity and more-than-human need to be prioritized, and heal, for a more equitably balanced holism.

New approaches are needed within conservation: without transformational change, precipitous biodiversity decline is predicted to continue at accelerating rates (Diaz, Settele & Brondizio, 2019). Such transformations include broad, systemic societal changes in economics, institutions, governance and other systems applied in equitable ways. The conceptualization of connectivity may seem to be an afterthought when facing the threat of climate change and biodiversity loss, but common ground through terminology is a key contributor to the ability for collective action (Chan et al., 2018). Thus, this research supports the broader call to focus on the inter-connections between ecological, social and cultural realms and representing such types in tandem, through a holistic, all-encompassing approach to connectivity conservation.

CHAPTER 3: SPATIAL DELINEATIONS OF ECOLOGICAL AND SOCIAL FORMS OF CONNECTIVITY IN KESPUKWITK

3.1 Introduction

Connectivity is widely discussed as essential within conservation efforts, yet implementation challenges undermine its effectiveness, limiting on-the-ground action. Translating what is known about the science and best management practices of connectivity into policy and practice is a considerable challenge (Lemieux et al., 2021d). The limited social science research within connectivity conservation poses a potential barrier to translating research into practice (Anderson & Jenkins, 2006; Keeley et al., 2018; Wyborn, 2011), as the ecological prioritization of areas for connectivity are inextricable from the social world within which these priority areas exist. Social processes are therefore critical to consider when working towards effective implementation of connectivity initiatives (Parrott et al., 2019; Keeley et al., 2018). While it is clear that connectivity assessments should integrate both structural and functional aspects of ecological connectivity in order to be robust (Aune et al., 2011), ways in which to integrate social forms of connectivity are not well understood.

Past research discusses inadequacies within the literature when it comes to including social elements (Karimi et al., 2017; Whitehead et al., 2014), but there is evidence of a shift towards an increased focus on social aspects. Within the field of social science research for conservation, the focus is on understanding human society and how and why impacts on biodiversity occur (Sandbrook et al., 2013), which I refer to as 'social dimensions' throughout. Previously, conservation planning on biodiversity features has overlooked the importance of the landscape for social reasons (Karimi et al., 2017), with the influence of social dimensions on spatial conservation priorities being noted to have received limited attention within the literature (Whitehead et al., 2014). In recent years, increased attention has been brought to social and cultural aspects, often through the lens of (1) tourism and recreation, including heritage rivers, canoe routes, and hiking trails (Duke et al., 2021; Hague, 2021); (2) Indigenous contributions to conservation, such as Indigenous protected and conserved areas, biocultural values, guardianship and healthy country programs, and cross-boundary treaties (Artelle et al.,

2019; Gavin et al., 2015; Hilty & Jacob, 2021; Lemieux et al., 2021b; Zurba et al., 2019); and (3) marine conservation planning (Baker-Médard et al., 2021; Bennett, 2019; Breen et al., 2017; Christie et al., 2017; Sykora-bodie et al., 2021).

Such a shift to social dimensions of conservation may also be occurring within spatial aspects of conservation planning. Within the literature, the delineation of areas mainly focuses on the ecological-structural forms of connectivity, often using spatial analyses and modelling approaches to model ecological connectivity (Burgh, 2017; for older reviews, see Kindlmann & Burel, 2008; Aune et al., 2011; for a recent overview of connectivity metrics, see Keeley et al., 2021). Yet, connectivity across a landscape is influenced by not only biophysical attributes but also by social dimensions (Egerer & Anderson, 2020). There is indication of a shift towards including local knowledge within connectivity mapping approaches (e.g., Egerer et al., 2020; Egerer & Anderson, 2020; Duke et al., 2021; Hague, 2021; Needham et al., 2020; Sage, 2019). For example, recent research focused on the application of local tacit knowledge to mapping wildlife movement in the Chignecto Isthmus region bordering Nova Scotia and New Brunswick (Needham et al., 2020). Within this work, local knowledge helped in the identification of species distributions and patterns, as well as landscape features and processes that impact wildlife connectivity in the study region (Needham et al., 2020). Previous research has focused on the integration of social factors into the spatial planning of a large corridor in the High Divide region of Idaho and Montana, through a focus on social acceptance of Grizzly bears (Sage, 2019). Still, a gap remains, as connectivity assessments often do not consider both biophysical and social dimensions of a landscape (Egerer et al., 2020).

Recent research has examined social connectivity as encompassing social processes relevant to ecological forms of connectivity. For example, recent research has focused on social connectivity in cities, for instance relating to ecosystem service flow through the mapping of community gardens as nodes across a city landscape (Egerer et al., 2020) and social-ecological connectivity in dynamic urban landscapes (Egerer & Anderson, 2020). However, a gap remains when it comes to the spatial delineation of ecological and social forms of connectivity in relatively natural landscapes, as to the best of my knowledge, no research to date has examined the spatial delineation of both ecological and social forms of connectivity in this context.

However, there are not solely two types of connectivity, ecological and social. Research by Hodgetts (2018) depicts six distinct types of ecological and social connectivity used within various fields, from landscape ecology to political ecology to cultural geography (see *Table 2.1*, Chapter 2): ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human). Research by Bormpoudakis and Tzanopoulos (2019) supports Hodgetts' depiction of plural types of connectivity as being part of a more complete conceptualization of connectivity. Hodgetts suggests that while some theorists and practitioners acknowledge the need to consider many types of ecological and social connectivity, they still conceive of these as a "plurality" of types, to be addressed separately and perhaps combined later in the planning process (2018). Hodgetts posits that only one of the six types of connectivity—"social (more than human)"—conceives of connectivity as comprising an inseparable, interrelating whole from the outset, which he calls "a multiple" (2018). Hodgetts further argues that we need to move away from conceiving connectivity as a "plurality" of separate interpretations or aspects of connectivity, to viewing connectivity as "a multiple" from the outset, comprised of indivisible overlapping and connected interrelationships (2018). Viewing connectivity as "a multiple" is noted as important within connectivity conservation as both an analytical tool that highlights linkages between ecological, social, and more-than-human realms, and a guide to environmental management that considers biological features as embedded in "social, often unequal, always more-than-human ecologies" (Hodgetts, 2018, p.83).

The present study aims to apply Hodgetts' taxonomy to the spatial delineation of focal areas by investigating how ecological and social forms of connectivity, as previously discussed in a theoretical context (Bormpoudakis & Tzanopoulos, 2019; Hodgetts, 2018; also see Chapter 2), translate into application within the Southwest region of Nova Scotia. This region closely aligns with the area known as "Kespukwitk" by the Mi'kmaq, who are the Indigenous people of the region, and will be referred to as Kespukwitk throughout. Research examining the spatial delineation of ecological and social forms of connectivity by experts and other local knowledge holders has not yet been completed within Kespukwitk, nor, from my investigations, elsewhere. Accordingly, for this project, experts and other local knowledge holders were engaged to

explore their perspectives towards key focal areas for connectivity conservation. This project is novel in its focus on connectivity within a rural landscape that is still in a relatively natural state, in contrast to recent studies in urban areas (Egerer et al., 2020; Egerer & Anderson, 2020), and addresses theoretical types of connectivity, which allows for an in-depth exploration of perspectives towards the spatial delineation of both ecological and social forms of connectivity.

This research draws upon two key bodies of the literature: research focused on the need for including social dimensions within the spatial delineation of key areas for connectivity, and research focused on the meaning of connectivity, including both ecological and social forms of connectivity. This research aims to address the gap relating to the application of both social and ecological forms of connectivity to spatial delineation of key focal areas for connectivity in a relatively natural landscape. This will be done by investigating the following question, how are ecological and social forms of connectivity delineated spatially when discussing focal areas for connectivity in Kespukwitk? To answer this question, I will (1) explore the rationale and characteristics of focal areas for connectivity in Kespukwitk identified through interviews with conservation experts and other local knowledge holders; (2) digitally delineate (in ArcGIS Pro) the spatial areas indicated by participants on a map of the region; (3) thematically code the stated reasons for prioritizing key areas in terms of Hodgetts' connectivity taxonomy; (4) identify potential priority areas through spatial overlay analyses to explore overlap (a) between types of connectivity, (b) within types, (c) within categories (ecological and social); (5) explore relationships between types of connectivity through thematic overlap analyses; and (6) consider instances that represent "pluralities" versus "a multiple".

3.2 Methods

This research used a qualitative GIS approach to participatory mapping (Dunn, 2007; Muenchow et al., 2019) with a focus on delineating key focal areas relating to both ecological and social forms of connectivity within Kespukwitk (refer to section 2.3.2 in Chapter 2 for a description of the study area). A focal area for ecological-structural connectivity conservation is a key area for movement and flows, critical for a variety of

reasons including wildlife movement options based on land cover, land use (Parrott et al., 2019) or overall intactness (Anderson, Clark & Sheldon et al., 2012; Anderson et al., 2016). The term focal area will be used in this study to discuss potential key areas for connectivity identified by participants in the Kespukwitk region and will potentially extend to include not only the above-mentioned ecological features, but social forms of connectivity as well.

3.2.1 Data Collection

I conducted semi-structured remote interviews with a map-facilitated spatial question, completed via Microsoft teams and over the telephone. In this chapter, I analyse the responses to this open-ended question and subsequent discussions, focused on identifying key focal area(s) for connectivity within the study area: "Is there an area you would recommend as a key focal area for connectivity within Southwest Nova Scotia? Why/why not?" (see *Appendix A* for the interview guide). This participatory mapping question involved the sharing of a map through screen-sharing on MS Teams, and also via email attachment prior to the interview in cases when a telephone interview was chosen, to facilitate both discussion and map-based identification of potential focal areas.

To assess the spatial representation of connectivity, I applied a basic participatory mapping approach (Brown, 2012) by engaging participants through the use of maps to convey information about areas they consider important (Whitehead et al., 2014). Participatory mapping may be defined simply as the process of individuals communicating spatial knowledge by using maps (Brown & Kyttä, 2014). My study used a qualitative, expert-based approach following Karimi and colleagues (2017), in which the compatibility of social dimensions, such as human values associated with the landscape, within spatial conservation planning was examined through expert elicitation. This expert-based approach was applied to participatory mapping, as experts often have relevant information "in their heads", i.e., tacit knowledge, that is not contained in digital databases (Noss & Daly, 2006, p.597). The approach served to delineate key focal areas for connectivity and thematically-determined types of connectivity based on discussions of which spatial areas of the landscape participants consider most important and why.

Prior to the interviews, I compiled previous connectivity analyses relevant to the region and used these to create a base map indicating potential key focal areas for

connectivity in the region (*Figure 3.1; Appendix E*). To produce this map, a review of spatial landscape patterns identified in other studies was completed and imported into a geographical information system (GIS). Key spatial layers were identified as appropriate forms of secondary data relevant to the present study based on the relevance of the previous connectivity analyses to the region, these included: 1) 'diffuse areas', 'concentrated flow', and 'pinch points' based on preliminary analysis related to work on forest connectivity in Nova Scotia by Cunningham et al. (2020); and 2) key connectivity areas for ecological-functional connectivity between protected areas in Kespukwitk, as identified by Inglis (2007). Maps with these key spatial layers were produced and shared with interviewees prior to (via email) and during the interviews (via screen-share on MS teams).

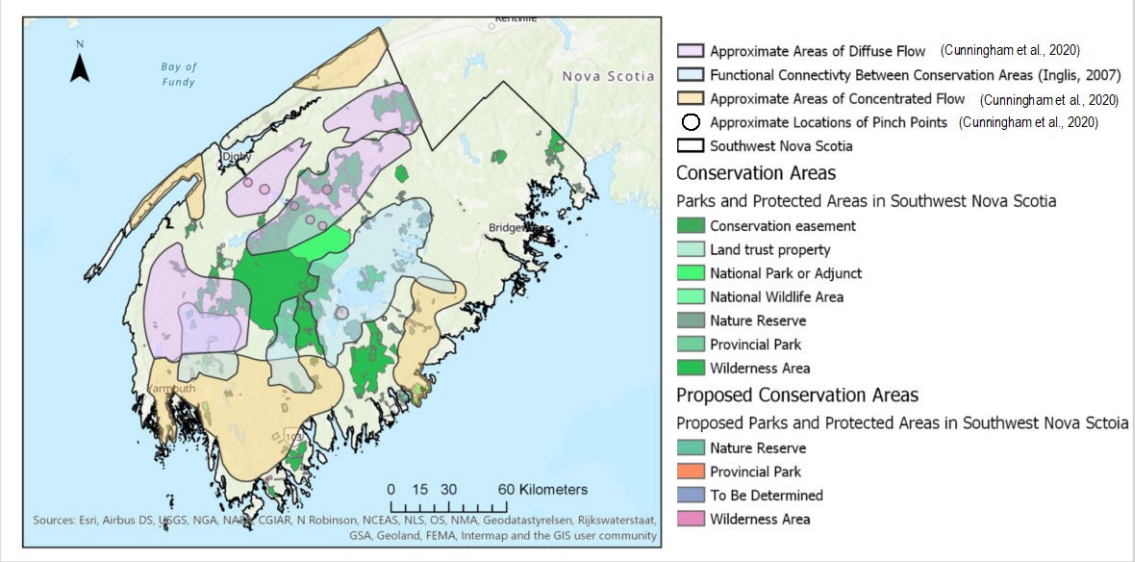


Figure 3.1 Map shared with participants' over email and during interviews. *This same map in landscape view and a map with the three layers separated can be found in Appendix D.*

Participant-approved pseudonyms and identification codes are used within the discussion of results to depict five participant groups: government organization (GO), non-government organization (NGO), not affiliated (NA), forestry sector (FS), Mi'kmaq (MKM), and no quote (NQ) for those who did not consent to the use of quotes. Each individual was also assigned a number (e.g., GOP1).

3.2.2 Data Analysis

The collected spatial and textual data were analyzed in response to the core question surrounding key focal areas in the region. The other portions of the interview transcript were analyzed separately, with results being discussed in Chapter 2. Responses were also included for the question prior to the core one if the individual began to discuss key focal areas at that point, "Based on your knowledge, are there any current efforts/initiatives to implement conservation in priority connectivity areas in SWNS? Why/why not?". Interview transcripts were read in detail to determine that there were no other instances where key focal areas or priority areas were discussed.

The analysis of the spatial data involved digitization of mapped polygons; each polygon was assigned a unique identifier which was input to ArcGIS Pro 10.2. The digitization of focal areas involved two approaches. When the interviewee described the key focal area(s) in detail, I digitized the described areas through careful reading of the participants spatial descriptions of areas. For interviews where I (the interviewer) made edits/drawings on a pdf of the shared maps, I used these pdf-edits as reference along with the transcript to digitize the area(s) discussed. One key area, the Kespukwitk (Mersey) Corridor, was described by several participants as a broad swath from one side (Fundy coast) to the other side of the province (Southern shore); to map this area, I used a reference map from the project's online story map (Kespukwitk Corridor Project, 2021), which was referred to by one participant (GOP4). After member checking, the mapped polygons were assigned attributes reflecting Hodgetts' six connectivity types, based on the themes identified from the textual data associated with each polygon.

Thematic textual analyses were conducted on responses to the question asking participants if there is a key or focal area for connectivity that they would recommend. Only responses relating to these key or focal areas were included. I compiled responses into a Microsoft Word document for analysis. I thematically coded interview responses based on the six types of connectivity proposed by Hodgetts (2018) through a deductive approach. Key focal areas were associated with each type or types of connectivity (*Table 3.1)*. I then created maps for each thematic category and overlay maps showing "hotspots" (Morse, Lowery & Stuery, 2014) where overlapping themes occur. Hotspot maps were created for spatial overlap between types of connectivity and within types of

connectivity. Fuzzy boundaries are inherent with participant mapped layers as space as perceived by people has fuzzy boundaries that are not adequately represented in GIS (McCall, 2006); thus, resulting hotspot maps showing spatial overlap should be interpreted with caution.

To further delineate how conceptualizations of connectivity types transfer into the spatial delineation of focal areas for connectivity, I looked at the relative area (as a percentage of total hectares) of the mapped polygons for each type of connectivity by participant. This involved calculating the area in hectares for each polygon using the 'calculate geometry' function on ArcGIS. The percentage area of each connectivity type mapped by a participant was then calculated relative to the total area they mapped. This produces a standard scale of 100% to facilitate comparisons across participants. However, it is important to note that the polygons have fuzzy boundaries based on participants perceptions of space (McCall, 2006), therefore the area calculations are relative and only indicative of participant interests. To assess the differences and similarities between conceptual types of connectivity discussed by participants (chapter 2) and those delineated spatially (this chapter), percentage comparisons were made.

3.2.2.1 Exploring Overlap

Overlap was examined with analyses through two different approaches: spatial and thematic overlap, depicted in *Figure 3.2.* Spatial overlap refers to the spatial overlap among polygons features, and thus focuses on spatial analyses to determine the number of overlapping features. While thematic overlap involves polygons that were thematically grouped into more than one connectivity type, and thus focuses on overlapping themes. The methodological approach to examining both types of overlap is discussed subsequently.

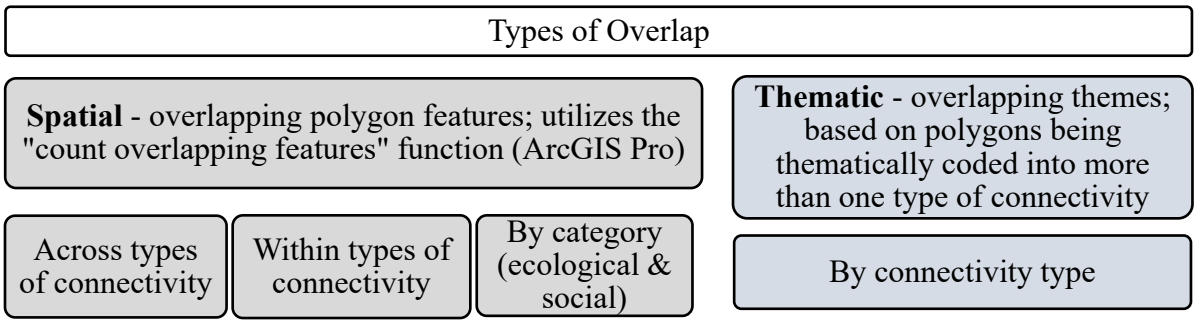


Figure 3.2 The types of overlap considered within the analyses: spatial and thematic.

Spatial Overlap – Spatial overlap was looked at within and across types of connectivity, using the 'count overlapping features' function of ArcGIS Pro. This function "generates planarized overlapping features from the input features", with the count of the instances of overlap written as an output feature (ESRI, n.d., para. 1). When applied to polygons, an area that is occupied by two or more features is considered an overlap (ESRI, n.d.). To use this function, data layer groups had to be created for types of connectivity (e.g., ecological-functional), based on the initial sorting of polygons into types of connectivity (e.g., see *Figure 3.4*). This process can be seen in the flow chart represented in *Figure 3.3.* To create layer groups for types of connectivity, the first step involved using the 'merge' function to create one layer. The merge function keeps overlapping geometry as part of the output, and thus is particularly suited for creating layer files prior to running the 'count overlapping features' function. The 'count overlapping features' function was run for each type of connectivity, resulting in outputs that count the overlap within types. To assess the number of instances of spatial overlap across and within types of connectivity, counts were determined using the 'show statistics' option on ArcGIS Pro.

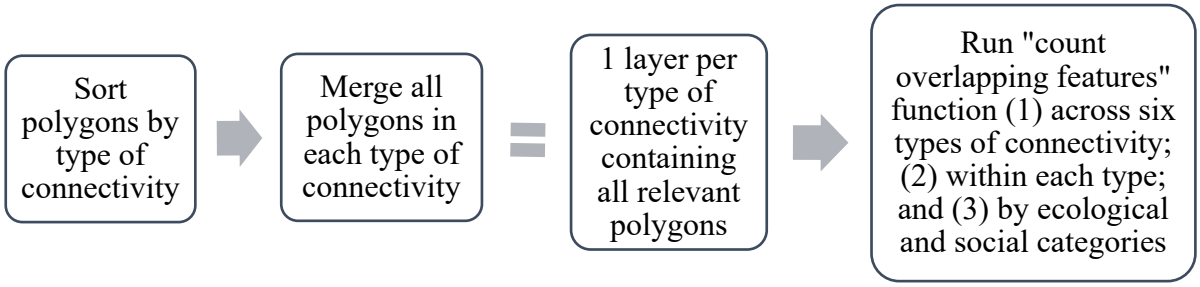


Figure 3.3 Flow chart for the steps involved in determining spatial overlap (1) across all six types of connectivity, (2) within each type of connectivity, and (3) by ecological and social types.

Thematic Overlap – Thematic overlap was examined by compiling all of the polygons that were thematically sorted into more than one type of connectivity. I then color-coded these by what combinations of types were being represented in the polygons and created a layer with only polygons present that represent thematic overlap. Following this, in order to understand the prevalence of overlap between themes, I completed a basic count

of the number of thematic overlaps between types of connectivity. To count the number of polygons representing instances of thematic overlap, a basic count of such instances was completed and recorded (*Appendix H*).

3.3 Results

The spatial delineation of key focal areas revealed substantial areas of overlap, with some hotspots being captured within many polygons *(Figure 3.4).* The highest density of overlapping polygons occurs within the Kespukwitk (Mersey) Corridor, especially surrounding Kejimkujik National Park and Historic Site. Combined, the focal areas were found to represent all of Hodgetts' connectivity types: ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human) (*Table 3.1; Table 3.2; Figure 3.5*). The Mersey Corridor was delineated by four participants for varying connectivity reasons, with two of those participants (MKM1; GOP1) each indicating two separate connectivity types. The approximate amount of area mapped per type of connectivity is explored by participant and overall, across participants. The diversity in types of connectivity is compared for conceptual discussions (Chapter 2) and the spatial delineation of focal areas. Spatial overlap between polygons is examined by type of connectivity, within type of connectivity, and by ecological and social categories. Thematic overlap is also explored through areas thematically grouped into more than one type of connectivity. Potential interpretations of areas of substantial overlapping connectivity types as representing connectivity as "a multiple" versus a "plurality" of types are discussed. These nuanced analyses are each presented in detail, starting with focal areas by connectivity type.

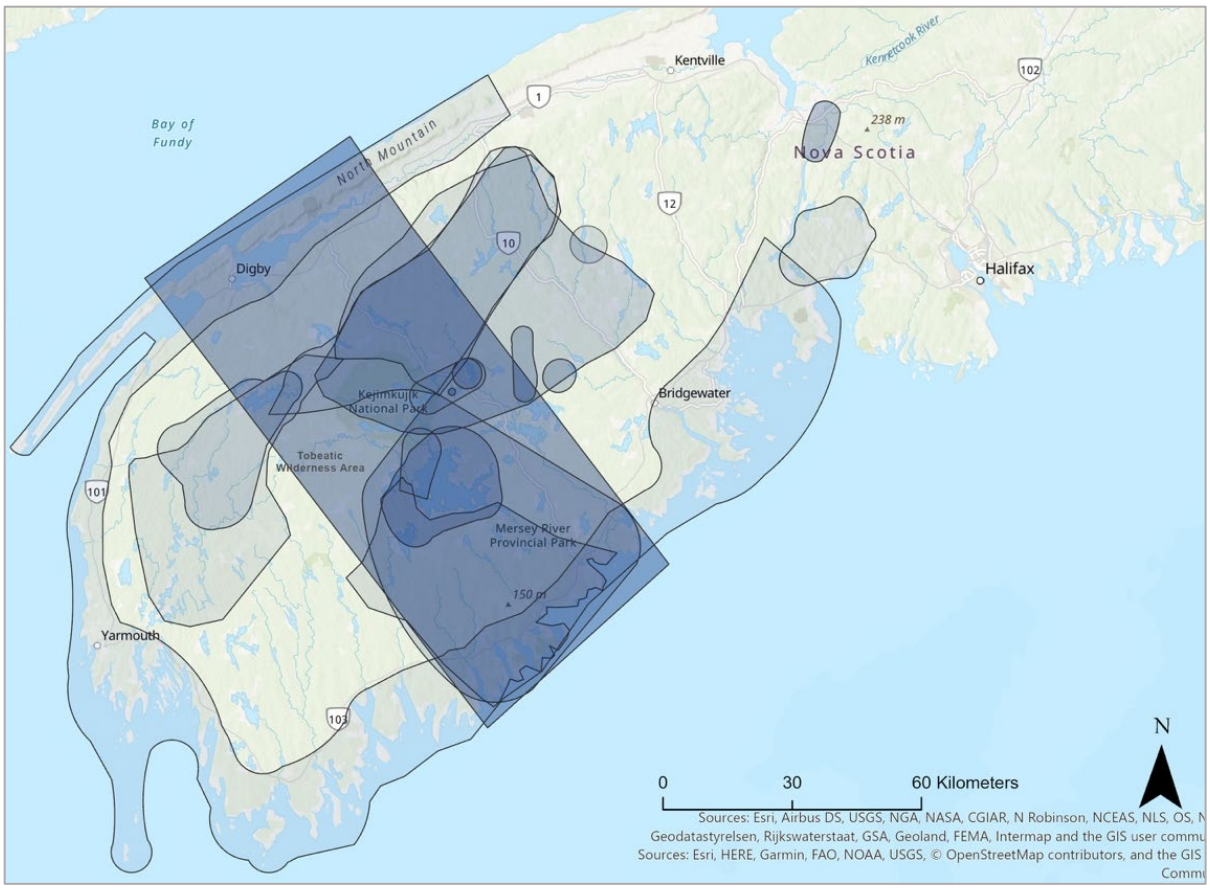


Figure 3.4 Mapped focal area polygons. *All connectivity types are represented by one color for the purpose of visual clarity in presenting the density of overlapping polygons. See Figures 3.2 and 3.7-3.9 for the polygons grouped and overlaid by connectivity type.*

Table 3.1 Focal areas by connectivity type

Type of Connectivity	# of polygons	Area Name	Partici-pant
Types in ecological category			
Ecological-functional	10	Mersey Corridor	MKM1
		Mersey Corridor	GOP1
		North of Panuke Lake	NGOP4
		South of Panuke Lake	NGOP4
		Buffering Tobeatic – Digby county	NGOP7
		All coastal areas	NGOP7
		Caledonia – Medway River	NGOP7
		Between Kejimkujik and Katewe'katik WA	NGOP1
		Between Kejmkujik and the ocean	NGOP1
		Nodes of Connectivity	NGOP1

Type of Connectivity	**# of polygons**	**Area Name**	**Partici-pant**
Spatial-structural	10	Lake Rossignol through Six Lake	NGOP2
		South of Panuke Lake	NGOP4
		North of Panuke Lake	NGOP4
		South Mountain – Cloud Lake-Keji-Tobeatic	GOP1
		Tobeatic-Kejimkujik-Cloud Lake wilderness area	NGOP1
		Between Kejmkujik and the ocean	NGOP1
		Nodes of Connectivity	NGOP1
		Tobeatic-Lake Rossignol-Tidney River-Port Joli & Port L'Hebert-lower Mersey River	NAP1
		Kejimkujik-Tobeatic-Northeast-Medway Lakes & Cloud Lake	NAP1
		Tobeatic-Silver Lake-Carleton-Tusket River-Silver River-Blackadar Brook	NAP1
Types in social category			
Emotional-affective	1	Mersey Corridor	MKM1
Economic	6	North of Panuke Lake	NGOP4
		South Mountain – Cloud Lake-Keji-Tobeatic	GOP1
		Lake Rossignol through Six Lake	NGOP2
		Buffering Tobeatic – Digby County	NGOP7
		East Dalhousie	NGOP2
		Mersey Corridor	GOP1
Equity	1	Mersey Corridor	GOP4
More-than-human	1	Mersey Corridor	NAP2
Total # of polygons	**29**		

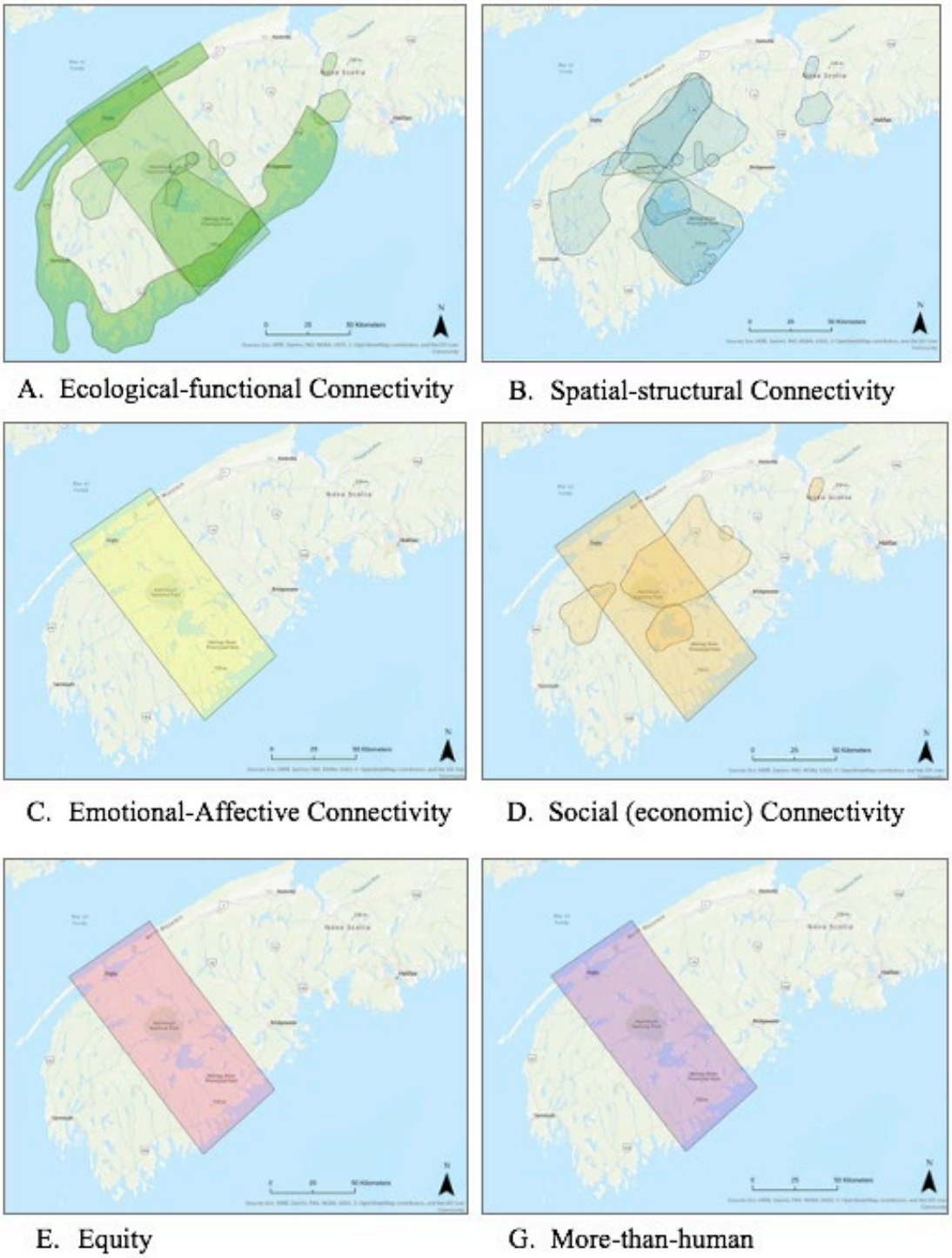


Figure 3.5 Focal areas by connectivity type

Table 3.2 Types of connectivity: spatial delineation

Type of connectivity*	What is connected? Hodgetts (2018)	Example Area	Spatial Application	Key Quotes
Ecological-functional connectivity	Species (mobilities), *or*	South of Panuke Lake	Supporting moose movement	"... it's one [species] that needs that connectivity to get to the other moose concentration area, which is closer to Keji and the Tobeatic. So, if they remain fragmented; then they'll [moose] remain to be in a very precarious position" (NGOP4).
Spatial-structural connectivity	Habitats	North & South of Panuke Lake	Structural features of the landscape	"so, connectivity between Kejimkujik and the ocean: there is a number of important waterways that contain a lot of ecological values" (NGOP1).
Emotional-affective connectivity	Personal emotional connection	Mersey Corridor	People's personal connection to land	"... but you still have people who are coming because they want to be out in nature, and they define that nature their own way, but they're still realizing a relationship to the land" (MKM1)
Social (economic) connectivity	Nature & society – systems logic; ecological, political & economic processes	East Dal-housie	Threat/Liveli hoods - forestry	"... it's so challenging ... you have forestry contractors that basically, they're trying to pay their bills" (NGOP2)
Social (equity)	re-connection and equity discourse; ecologies, power and equity	Mersey Corridor	Indigenous-led conservation; treaty rights	"I think the Mersey Corridor is a really important one ... it's more based on an area that can be managed by the Mi'kmaq, and this is important because we're moving into an era of treaty rights implementation" (GOP4) *Note quote repeated in section 3.1.4.4*
Social (more than human)	All actors with agency, not limited to humans	Mersey Corridor	Connection humans & more-than-humans	"... yet humans and animals have been relating to each other for thousands and thousands of years. So, I would just say for now that [the Mersey Corridor], yes, that is a very important flow" (NAP2) *Note see section 3.1.4.5*

**For more detailed descriptions of each type, see Table 2.1 in Chapter 2*

3.3.1 Focal Areas Spatially Delineated by Connectivity Type

3.3.1.1 Ecological-Functional Connectivity

Ecological-functional and spatial-structural were the most prevalent types of connectivity delineated, with 20 out of 29 polygons being ecological-functional and spatial-structural (10 polygons for each) (*Table 3.1*). Ecological-functional reasons ranged from priority places for key focal species such as Blandings turtles and mainland moose, as well as suites of species such as migratory birds. One participant mentioned that all coastal areas should be priority areas, stating "I think all of the coastal areas of Southwest Nova should be a priority area, because of the amount of the, you know, the migratory birds and other bird species at risk that are located in there" (NGOP7). This person is thus focusing on habitat for a certain portion of a suite of species' life cycle, being migratory birds. Another delineated a series of key areas, referred to as "nodes of connectivity" (NGOP1), based on their ecological value: "the smaller but really ecologically significant areas of Southwestern Nova Scotia; so, places like McGowan Lake, Harmony Lake, Pleasant River, Shingle Lake. These places are extremely important for lots of different reasons: species at risk, old growth forest" (NGOP1).

3.3.1.2 Spatial-Structural Connectivity

Spatial-structural connectivity was also frequently mentioned as a reason for delineating key focal areas. Rationale included areas that are "pinch points" on the landscape, connecting protected areas, goals of large-scale protection, and enduring features (e.g., topography). For example, one participant described two areas that represent natural pinch points:

> ... [T]he lake, as you may know, is Panuke Lake and it's the longest lake in the province and it almost bisects the entire province ... So, it essentially means that everything that funnels in and out of Southwest Nova Scotia has to either come north or south of that lake, and there is only a small, couple of kilometres, on either side (NGOP4).

Another focused on connecting protected areas:

> ... So, I would say that [the area between Tobeatic, Kejimkujik, and Cloud Lake Wilderness Area] would be one of the most important connectivity

> corridors, because it links up several large protected areas, so you are actually in that spatial scale that's for large-scale protection (NGOP1).

One participant pointed out structural features of the landscape that contribute to biodiversity value: "So, for that area, kind of the South Mountain backbone, because it has that enduring feature. I think there are some things about topography that are important" (GOP1).

3.3.1.3 Emotional-Affective Connectivity

Emotional-affective connectivity was the least prevalent type overall, alongside social (equity) and social (more-than-human) connectivity. Only one focal area was recommended based on emotional-affective reasoning, and only by one participant (MKM1). They mentioned people's connection to land and place, referring to Kejimkujik National Park, which is part of the broader focal area they delineated, as an example.

> I grew up along that area ... Ecologically, I know there's, we have all of the species at risk, the biodiversity. That's there, all of those big pieces, but I think, to me, I have seen people and their connection to Kejimkujik, and it's just an area that connects with people already (MKM1).

Within the broader context of their response, this participant starts the discussion of the focal area on the basis of other features, such as acknowledging ecological and cultural importance, and then hones in on the connections between people and land. The participant continuously stressed the human connection, primarily in terms of relationship with the land, as evident in current recreational activities and the historical/archaeological record, both of which they refer to as part of 'culture'.

3.3.1.4 Social (Economic) Connectivity

Within the social (economic) category, four of the six key areas were mainly delineated based on ecological forms of connectivity but were also considered a priority because of the dominant economic influences of logging and forestry in the area. At present, forestry is seen as locally important, yet current practices are perceived to be threatening important ecological values. Participants saw a need to consider both ecology and forestry in connectivity prioritization (such as through ecological forestry practices)

in order to reduce the conflict, such as by shifting away from giving priority to damaging or threatening forestry processes and practices. For example, one participant mentioned that there were people protesting proposed cuttings in an area buffering Tobeatic Wilderness Area:

> ... it's the area that's kind of buffering around the Tobeatic Wilderness Area, where the, you know, where the mainland moose are, and it is an endangered species … It's something that's a controversy now because I know in the areas that are surrounding that wilderness area on Crown land, that there is some harvesting that is getting underway there, and I know that there's protestors on site right now (NGOP7).

Another participant discusses logging in the East Dalhousie area:

> It's so challenging and I struggle with this every day. You have forestry contractors that, basically, they're trying to pay their bills, even some of them, they want to be doing the more sustainable, not all of them but some of them, want to be doing more of the lighter touch forestry, but they still have to offset it with clearcutting because they can't pay their bills otherwise. It's a whole systemic thing of, 'How do you incentivize doing this type of practice?' It can't just be cash value, because the mills also need their fibre to operate, and then you get your jobs and then you get your industry lobbying groups, right. So it trickles down (NGOP2).

This quote highlights the complexities associated with social (economic) connectivity, in which areas are valued based on ecological and economic reasoning, such as livelihoods and potential threats associated with economic processes. While such 'threat' based reasons for delineating key areas does not directly translate into valuing an area for social (economic) connectivity, the social (economic) processes within such areas are relevant to this form of connectivity, and thus are included within this category. The above participant suggests this is a "systemic" issue, in that the broader, economic structure associated with the forestry industry inhibits sustainable forestry by valuing the amount of wood produced, rather than the way it is produced (i.e., sustainable practices). Thus, this fits best into the social (economic) category, premised on systems logic and

economic processes relating to the connection, or dis-connection, between society and nature.

One social (economic) focal area that was not prioritized based on threats was primarily identified for ecological-structural reasonings, but in a follow-up comment the importance of the dominant economic influence of agriculture in the area and on the landscape was also stressed. No succinct quote exists to show this pairing, but instead I added it as a note affixed to the transcript after the discussion.

Another participant discussed social (economic) connectivity in relation to the Kespukwitk (Mersey) Corridor project. Their rationale focuses on "archeological and ecological resources" and the "opportunity and value" in the area:

> ... the Mersey Corridor, because it's a priority for Mi'kmaq communities and because it has amazing archeological and ecological resources and great partnerships with Keji in the middle and the province managing any of those provincial wilderness areas. There's a great combination of opportunity and value (GOP1).

Thus, the reasoning for prioritizing this area encompasses a lot, and is reflective of social-ecological systems thinking; what differentiates the sorting of this area from more-than-human connectivity within Hodgetts' typology is the focus on the human-centered rationale for prioritization: at base it remains anthropocentric. Many components are discussed, but none display the indivisible relatedness of humans and more-than-humans, despite the focus on plural reasonings, such as cultural and ecological reasoning.

3.3.1.5 Social (Equity) Connectivity

Only one participant (GOP4) provided a social (equity) rationale for delineating a focus-area polygon, which was focused on the Kespukwitk (Mersey) Corridor. For example, the area was discussed as important for treaty rights implementation:

> I think the Mersey Corridor is a really important one, and not to have it be something that's so small that it's just focused on archeological sites, that it's more based on an area that can be managed by the Mi'kmaq, and this is important because we're moving into an era of treaty rights implementation. So, it's something that I think is important for them in order to have some

> ability to have a livelihood, use some of their own, you know, incorporating their own, worldview in management of protected area ... it's really up to them (GOP4).

Within the broader context surrounding the reason for prioritizing this area, the participant went on to discuss the "bias in conservation" and the importance of compiling layers and creating a tool that "supports Mi'kmaq communities" (GOP4), thereby further supporting their intention as grounded in 'equity'.

3.3.1.6 Social (More-Than-Human) Connectivity

One interviewee mentioned a particular section of the Kespukwitk (Mersey) Corridor region as representing a "very important flow" for "humans and animals" that "have been relating to each other for thousands and thousands of years":

> ... that's kind of how I vision Kespukwitk, but the spike that goes from the Bay of Fundy out through, Liverpool, Bridgewater is quite strong and significant ... So, I don't know if I can answer the difference between the significance of the wildlife, and then flow, but yet humans and animals have been relating to each other for thousands and thousands of years. I would just say for now that, yes, that is a very important flow. So, some people might have talked about just the Mersey River itself. Hopefully some of them remember that we're trying to connect up to L'sitkuk, so I wouldn't say the park down out to Liverpool or Bridgewater, I would say the whole route (NAP2).

This was the only instance of more-than-human connectivity. It focuses not only in 'indivisible' concepts, but also shows a clear valuing of and relationship with more-than-human, beyond a solely human-centered rationale

3.3.2 Prevalence of Hodgetts' Connectivity Types: Spatial Application

The following section includes quantification (percentage) of the relative area of mapped polygons of each connectivity type and textual attribute data. First, the percentage area mapped for each connectivity type is presented by (1) participant and (2) in total and (3) compared with the percentages of conceptual types (chapter 2) by participant. Spatial overlap was also examined (1) between type of connectivity, (2)

within type of connectivity, and (3) by category of connectivity (ecological and social). Following this, thematic overlap is explored across connectivity types, and, from these, inferences of connectivity as "a multiple" versus a "plurality" of types are discussed.

3.3.2.1 Percentage Area Mapped for Each Type of Connectivity by Participant

Overall, there was considerable variation among participants in the types of connectivity they considered important for the spatial delineation of focal areas *(Figure 3.6*). Most participants emphasized more than one type, and all but three included both ecological and social forms. Three participants focused on a single form of connectivity: NAP1 focused on spatial-structural, NAP2 focused on social (more than human), and GOP4 focused on social (equity) connectivity. Across all participants, connectivity may be collectively conceived as a plurality, although a few individuals see it as only one type, and one participant views it as "a multiple" through the category of more-than-human as a proxy for multiplicity.

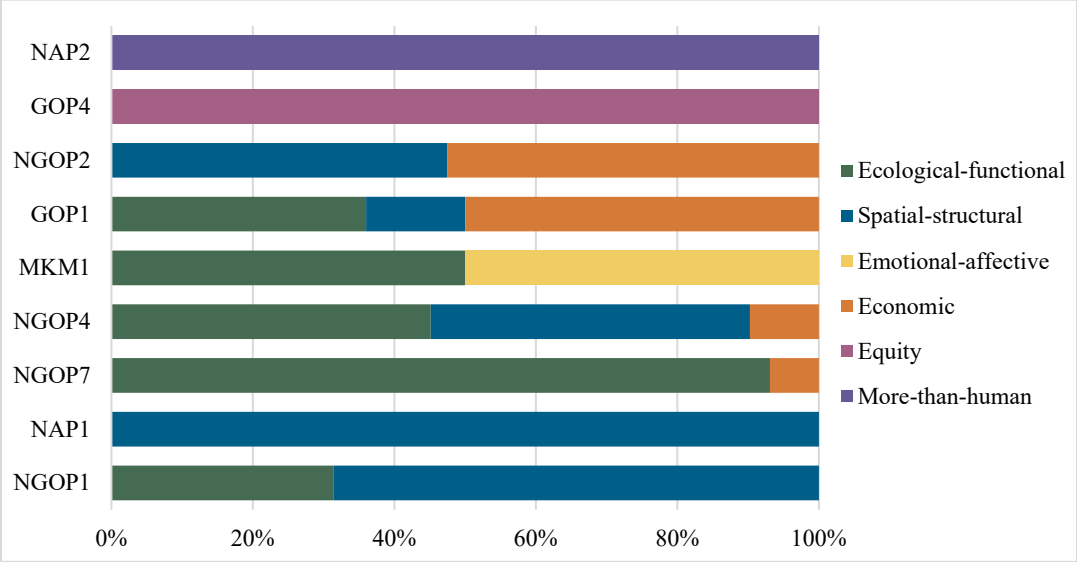


Figure 3.6 Percentage of area mapped for each connectivity type by participant. *Note that participants are sorted by relative predominance of connectivity type, with more-than-human at the top, and from social to ecological predominance, from top to bottom. Note that some participants delineated one area that was thematically coded into*

more-than-one type (e.g., MKM1), thus the percentages are indicative of more area than what was actually mapped.

3.3.2.2 Percentage Area for Each Type of Connectivity Mapped

Out of the total area (hectares) mapped by all participants, ecological-functional connectivity was highest at 32% (see *Figure 3.7*). Together, ecological-functional and spatial-structural connectivity represent 63% of the area mapped. Of the social forms of connectivity, economic was the highest spatial extent, at 15%. In total, social forms comprised 37%, with an even distribution among emotional-affective (8%), equity (7%) and more-than-human (7%). This is noteworthy, as much of the broader interview discussion focused on social aspects, but when it came to the spatial delineation, ecological forms of connectivity represented almost two thirds of the total area mapped.

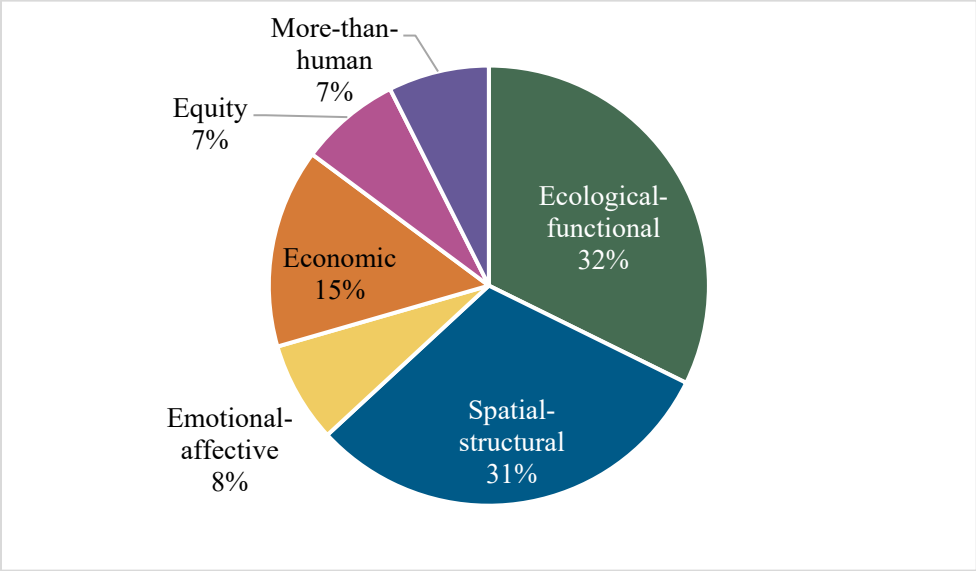
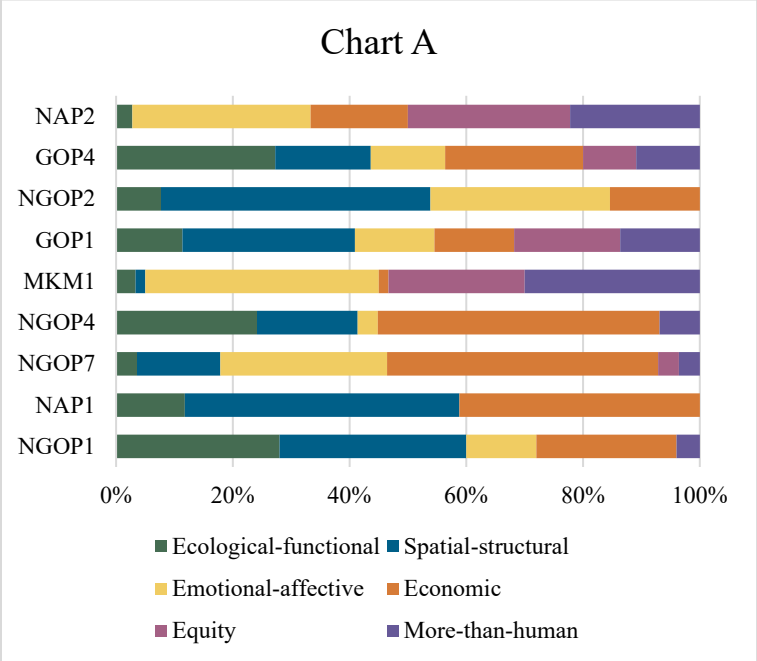


Figure 3.7 Percentage of type of connectivity mapped out of total amount mapped in hectares. *Determined by calculating area for each polygon on ArcGIS Pro and then calculating the total area per type of connectivity.*

3.3.2.3 Comparison of Spatial Connectivity and Conceptual Types by Participant

Within *Figure 3.8*, the proportions are compared for the types of connectivity discussed by participants in their full transcripts (Chart A; from Chapter 2, *Figure 2.4*) to those delineated spatially by participants (Chart B; from *Figure 3.6*). When comparing

the textual and spatial results (*Figure 3.8*), it is clear there is more diversity and varying proportions between participants conceptual discussions of connectivity than in those they mapped in their spatial applications. When spatially prioritizing a focal area, participants tended to focus more predominantly on one type of connectivity, and no participants were found to discuss all types, although one participant discussed connectivity as "a multiple," through a focus on indivisibility that is consistent with the connectivity as "a multiple" and the more-than-human type. Some participants demonstrate considerable differences, such as NGOP7, with minimal mention (16%) of ecological-functional connectivity within the conceptual portion (Chart A), but an almost exclusive focus on ecological-functional (96%) in the spatial delineation portion (Chart B). Based on these comparisons, overall, the types of connectivity that were spatially delineated were less diverse than those discussed conceptually.



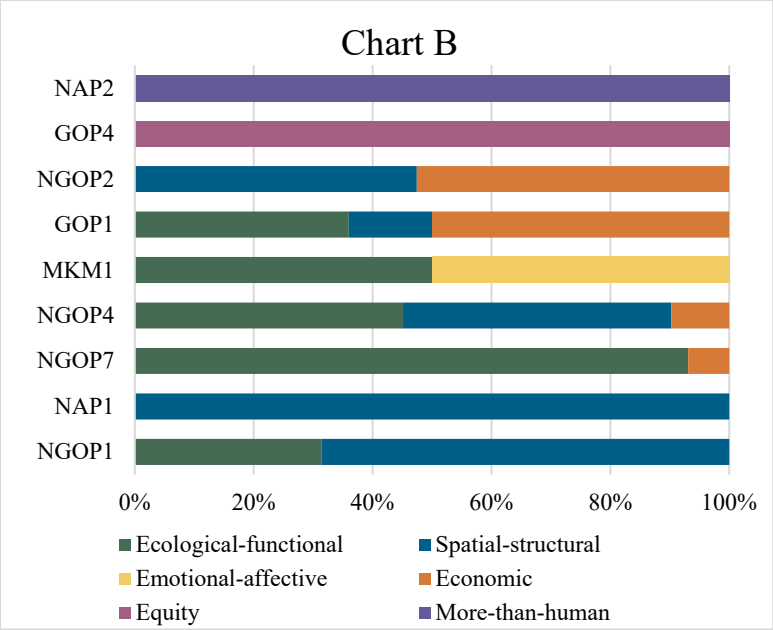


Figure 3.8 Comparison of conceptual (Chart A) and spatial (Chart B) conceptions of connectivity by participant. *Compares percentages of coding references per interview transcript (Chart A) and percentages of area mapped (Chart B) by connectivity type. Note this is only comparing data from participants who delineated a focal area (n=9). Note Chart B is sorted by social-dominant top to bottom.*

3.3.2.4 Exploring Spatial Overlap by Connectivity Type

Spatial overlap is the amount of overlap between polygons delineated by type of connectivity. Maps of focal areas delineated for each type of connectivity were overlayed, resulting in a "hotspots" map (*Figure 3.9*). Hotspots are apparent in the mapped results, such as where as many as 13 polygons overlap (highest amount of overlap). The areas with the most overlap represent areas that are prioritized for multiple types of connectivity. The spatial overlap is indicative of potential priority areas for a "plurality" of forms of connectivity and including connectivity as "a multiple" (more-than-human). The highest clustering of hotspots occurs surrounding Kejimkujik National Park and within the Mersey Corridor.

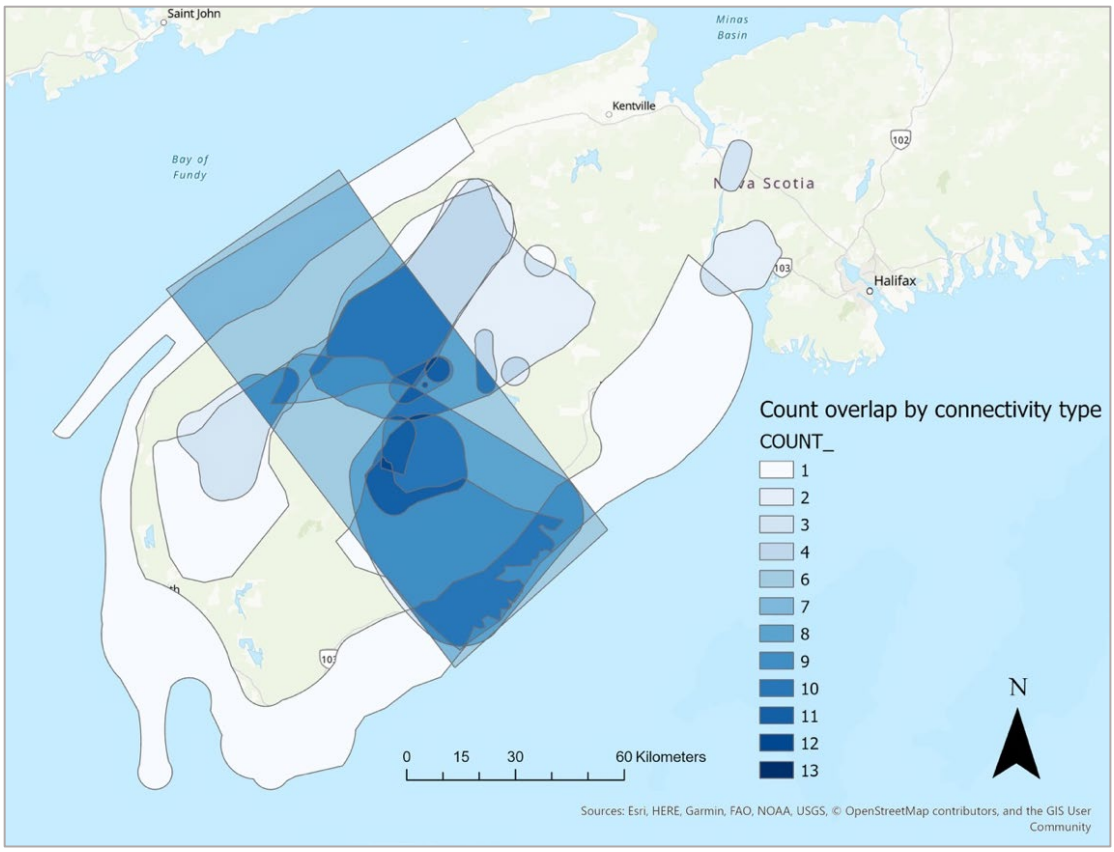
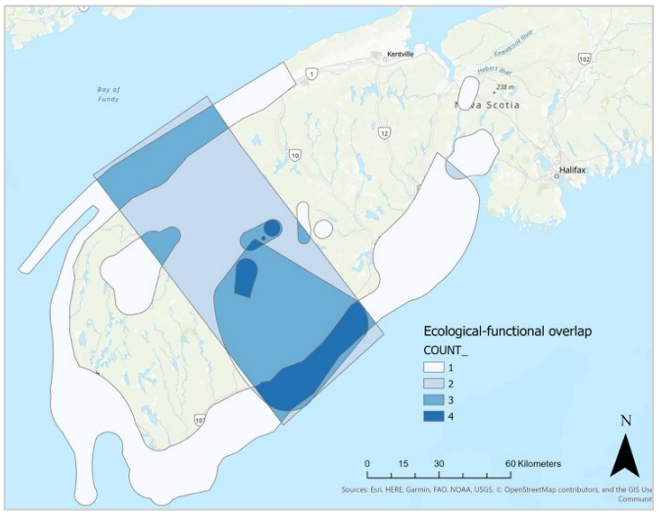


Figure 3.9 Spatial overlap – focal areas for connectivity. *Layers were created for each category and assessed with the 'count overlapping features' function on ArcGIS Pro to quantify the number of overlapping types of connectivity identified by all participants (n=9). Note that most participants indicated more than one polygon and category type, and that there were areas of overlap within category types, and thus, there is often more than one 'count' per category. There was no instance of 5 overlaps, and thus '5' is not included in the legend.*

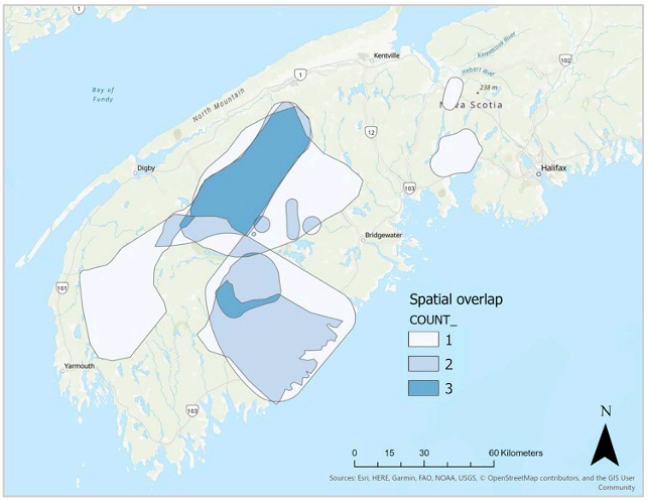
3.3.2.5 Spatial Overlap Within Types of Connectivity

Exploring the spatial overlap within each category is one way to delineate key priority areas for each type of connectivity. This was done for each category of connectivity, with the resulting maps being found in *Figure 3.10.* The dark blue areas are those with the highest prevalence of overlap. Within each category, the amount of overlap differs. For example, social (economic) connectivity has minimal overlap, with one small area showing three instances of overlap, while ecological-functional has higher

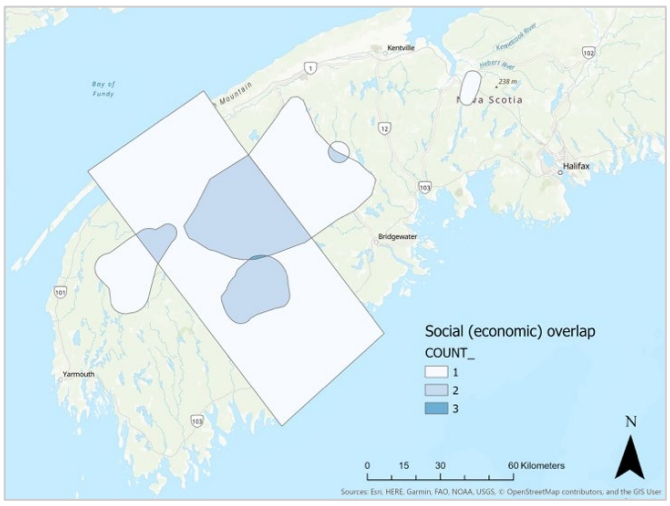
overlap, with several areas of four instances of overlap. Areas with higher instances of overlap could potentially be considered preliminary priority areas for each type of connectivity. However, some areas, such as the small slivers of three areas of overlap in social (economic) connectivity, could be a result of fuzzy boundaries (McCall, 2006), as the mapped polygons are not exact spatial delineations, but rather approximations based on participants responses.

A. 

Ecological-functional overlap

B. 

Spatial-structural overlap

C. 

Social (economic) overlap

Figure 3.10 Spatial overlap within types of connectivity. *Each layer group was assessed with the 'count overlapping features' function on ArcGIS Pro to quantify the number of overlapping types of connectivity identified by all participants (n=9). Only types with more than one polygon are include (emotional-affective, equity, and more-than-human are not included).*

3.3.2.6 Comparing Overlap Between Ecological and Social Forms of Connectivity

Spatial overlap within each of two broader categories of 'ecological' (functional and structural) and 'social' (emotional-affective, economic, equity and more-than-human) types of connectivity was assessed. The results can be seen in *Figure 3.11* and *Figure 3.12*. There was considerably more overlap within ecological forms of connectivity, with 63 counts of overlap in total. Comparatively, there were 10 counts of overlap for social forms of connectivity. Ecological connectivity had two instances of 8 overlapping features, while social only had one small area with 6 instances of overlap. Therefore, ecological forms of connectivity had more spatial overlap than social forms while social forms encompass a large area, with four large polygons for the Kespukwitk (Mersey) Corridor. However, in visually examining areas with 5 instances of overlap in each figure, some areas appear to be equally important to both social and ecological forms of connectivity, again clustered around Kejimkujik National Park and within the Kespukwitk (Mersey) Corridor.

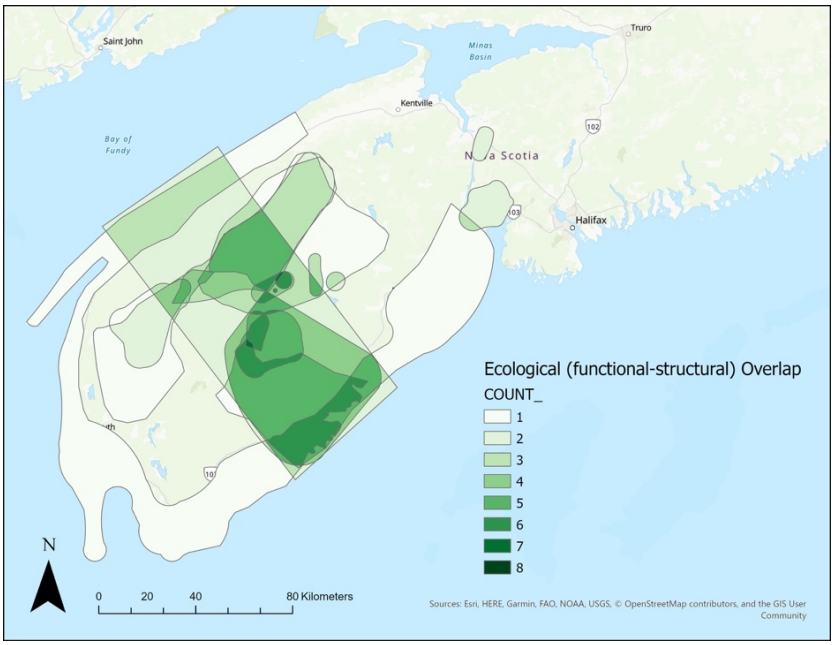


Figure 3.11 Spatial overlap – ecological types of connectivity. *In order to delineate between ecological and social types, types were separated and the 'count overlapping features' was run on ArcGIS Pro to count instances of overlap.*

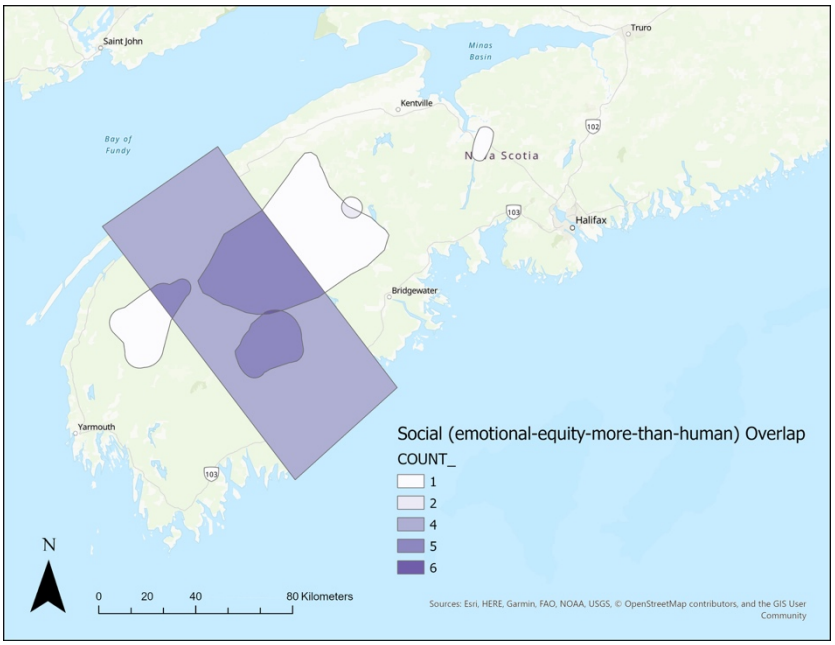


Figure 3.12 Spatial overlap – social types of connectivity. *In order to delineate between ecological and social types, types were separated and the 'count overlapping features' was run on ArcGIS Pro to count instances of overlap.*

3.3.2.7 Exploring Thematic Overlap Across Connectivity Types

Thematic overlap indicates a close relationship between themes. This can be seen in *Figure 3.13*, which illustrates the spatial distribution of polygons delineated on the basis of two or more types of connectivity. None of the polygons represented in *Figure 3.13* are a combination of purely social types, whereas three polygons are purely ecological combinations. Six polygons reflect a combination of ecological and social types, all but one of which are social economic. The same cannot be said for ecological-structural forms of connectivity, as focal areas represent overlap between solely ecological-functional and spatial-structural connectivity without social forms, such as South of Panuke Lake (NGOP4), Nodes of Connectivity (NGOP1), and Kejimkujik and the Ocean (NGOP1) indicated in the light and dark green polygons (respectively) on *Figure 3.13.*

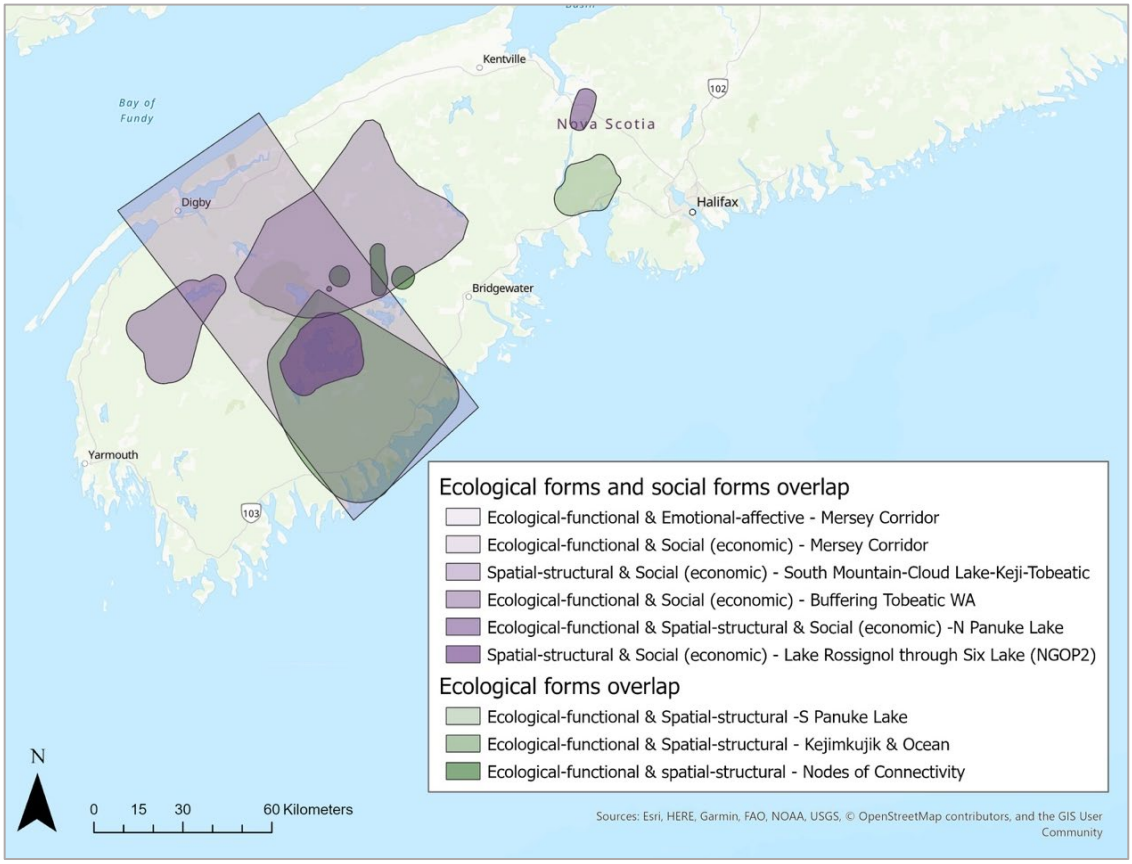


Figure 3.13 Areas of overlapping types of connectivity as delineated by participant. *Polygons delineated by participant on the basis of more than one type of connectivity.*

Three participants (NA1; NA2; and GO4) did not provide more than one type of connectivity as a reason for delineating their focal area (*Appendix F*). Participant NAP1 noted only structural connectivity, and GOP4 focused solely on social (economic) connectivity. Comparatively, in discussions surrounding the Kespukwitk (Mersey) Corridor as a key focal area, NAP2 focused solely on more-than-human connectivity, in a way that is indivisible and values all actors (human and non-human) without privileging one over the other, therefore "a multiple".

Thematic overlap between themes is represented in *Figure 3.14,* which includes counts of the occurrences of overlap among types of connectivity that were grouped into more than one type of connectivity within focal-area polygons. The prevalence of thematic overlap can be seen to represent a close relationship between the types. A supporting chart indicating counts of thematic overlap can be found in *Appendix H.* Interestingly, not all of the core types overlap: some types of connectivity tend to overlap slightly more than others while some do not overlap at all. For example, equity and more-than-human do not overlap with any of the other types, or with each other. Spatial-structural connectivity overlaps with ecological-functional and social (economic), but not with emotional-affective. Ecological-functional has the most instances of overlap and relates to most other types, including spatial-structural, economic, and emotional-affective. Conceptually, social (more-than-human) sees all of the types as interrelated and indivisible, and, thus, by definition, would not be expected to be applied along with other separate types by a participant. As such, the lack of overlap is not surprising.

The exploration of overlaps can be seen to represent an attempt to elucidate the relationships between types by looking at connections, rather than viewing them as separate from one another. The only category that represents connectivity as "a multiple" is more-than-human, which represents an indivisible whole. This type of connectivity is relatively less prevalent among participants' spatial delineations. Other types, such as ecological-functional, which overlaps with three of the five other types, can be seen as moving towards a pluralistic conception by looking at the different types and connections between them, but do not yet convey a system that is indivisible and values more-than-human, and thus remains pluralistic, rather than "a multiple".

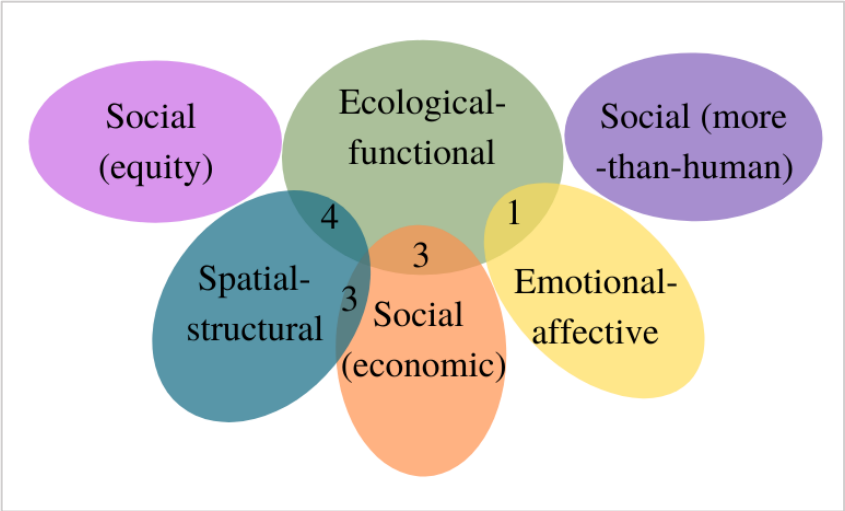


Figure 3.14 Venn diagram representing thematic overlap: types of connectivity. *Created by counting the numbers of polygons coded into more than one category, thus representing instances of thematic overlap between types. Note that equity and more-than-human do not overlap with any of the other types, therefore no overlap is shown.*

3.4 Discussion

The goal of the present analyses of spatial delineations of connectivity was to examine how conceptualizations of both ecological and social forms of connectivity based on Hodgetts' taxonomy (2018) transfer into application, through the spatial delineation of key focal areas. The results indicate that both ecological and social forms of connectivity are considered important to the spatial delineation of focal areas for connectivity by experts and other local knowledge holders in Kespukwitk, Nova Scotia. All six types of connectivity were found to be relevant to the spatial delineations of focal areas if broadly interpreted, including ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human) connectivity. All expressions of rationale for delineating connectivity were found to fit within one or more of Hodgetts' (2018) types of connectivity, and all of Hodgetts' categories were expressed, thereby suggesting that the typology is comprehensive in application within our study area context. Although much overlap occurred between types of connectivity, the most prevalent types expressed in spatial delineations of focal areas in this study are

ecological-functional, spatial-structural, and social (economic). This research is novel in its focus on the spatial delineation of types of connectivity which were only previously discussed in a conceptual way (see Bormpoudakis & Tzanopoulos, 2019; Hodgetts, 2018; and Chapter 2).

This research addressed the need to focus in on why and where increased connectivity will be necessary (Steffen et al., 2019). It included "plural" forms (Hodgetts, 2018) of connectivity, thereby going beyond a common focus on ecological connectivity. Further, I compared how participants conceptualized connectivity (Chapter 2) with how they applied it in spatial delineation of focal areas for connectivity (the present study). I found that the way participants discussed connectivity conceptually was much more diverse overall compared to how they applied it in identifying focal areas. This suggests that the concept of "plural" types of connectivity as discussed by Hodgetts (2018) may be more evident in abstract realms compared to the spatial delineation of focal areas, where overall the number of types of connectivity is less diverse. Nonetheless, there was still some diversity in how individuals prioritized focal areas for connectivity, with many individuals applying social forms of connectivity alongside ecological-functional and spatial-structural ones in their reasons for spatial delineations.

3.4.1 Key Findings

3.4.1.1 Connectivity as "Plural" Types or "A Multiple"

There was substantial spatial overlap among focal areas delineated on the basis of various type of connectivity, both within and across types. I found several potential priority areas based on spatial overlap, with the majority of densely overlapping polygons surrounding Kejimkujik National Park and within the large rectangle delineating the Kespukwitk (Mersey) Corridor project area. This area may represent a social-ecological hotspot, valuable from both a human and environment perspective, such as discussed by Karimi, Brown and Hockings (2015). Applied in the context of connectivity, such areas represent overlapping "plural" types of connectivity, and as conceived by some participants, may also depict a spatial representation of connectivity as "a multiple," as discussed by Hodgetts (2018). Further research is needed to understand the local context associated with such 'hot spots' of spatial overlap and how connectivity may be

represented spatially and implemented on the ground, as a "plurality" or potentially as "a multiple."

Several areas of overlap occur where focal areas were delineated on the basis of many forms of connectivity. The question arises as to whether these might be considered together, as a plurality, and/or with the potential of being articulated as representing "a multiple". Plural types are considered by Hodgetts (2018) to represent discrete, and thus different, realities that at some point may be combined so as to consider them together, while connectivity as "a multiple" focuses on the indivisibility among such realities to the extent that they cannot be seen as separate or as some being valued more/less than others, even at the outset. Hodgetts suggests that what he calls the social (more-than-human) type of connectivity is the closest to the concept of "a multiple". Findings from the exploration of overlapping types may be extended, then, so as to look at whether areas of overlap may serve as a proxy for "a multiple", or whether they remain as pluralities. In theory, if a concept is "a multiple", it would be spatially overlapping across all types but in a way that is indivisible, while spatial "plurality" would involve overlaping types that can be categorized into separate types of connectivity.

Findings indicate that some connectivity types do not overlap within discrete polygons, and thus are clearly not part of a spatial "plurality" at the polygon level. However, taken together, they may represent a broader connectivity network comprised of a plurality of connnectivity types. Focal areas delineated on the basis of ecological-functional connectivity were found to overlap with those delineated on the basis of all other connectivity types. This posits that ecological delineations may be a reasonable proxy for the social types, but social types elucidate key contextual factors that may directly impact connectivity conservation planning in such focal areas. Clearly, such areas represent a plurality of types, but outside of those that overlap with more-than-human connectivity, would they reperesent "a multiple" or, instead, a "spatial plurality"? Further research is needed to examine this relationship and explore how and whether the application of connectivity as "a multiple" is possible within efforts to identify focal areas for connectivity.

Arguably, the Kespukwitk (Mersey) Corridor represents at least connectivity conceived as "a plurality" because the area was often prioritized for overlapping reasons and types of connectivity and had the highest prevalence of spatial overlap within its boundaries. This large focal area was pointed out by four (nearly half) of the participants (NA2; NA3; GOP1; GOP4) as a priority area for conservation practitioners working in the region, and specifically to the potential of a large or several smaller Indigenous Protected Areas (IPCA), which was mentioned frequently within interviews. This could serve to restore relationships with the land, improve equity and contribute to Indigenous leadership (Zurba et al., 2019), as the area was valued for the flow of more-than-humans and cultural values. This example suggests that Hodgetts' (2018) depiction of connectivity as "a multiple" potentially extends to the spatial delineation of key focal areas and may already be applied in practice, such as the Kespukwitk (Mersey) Corridor Project. While all types identified within the focal area may not be conceived of as 'one whole', and all participants may not conceive of connectivity as a whole or "a multiple," a plurality of types are represented throughout. Combined, the consistent plurality and the presence of the more-than-human type as a proxy for "a multiple" indicate that the Kespukwitk (Mersey) Corridor may be a strong example of applying connectivity as "a multiple" in the spatial realm with potential for extension in conservation practice.

Hodgetts describes more-than-human connectivity as representing "the diverse and heterogenous connections that exist within and between humans and all manner of non-humans" (2018, p.87). Only one participant consistently expressed the more-than-human category, which makes examining connectivity as "a multiple" versus "plural" through its use as a proxy less than ideal by virtue of numbers alone. However, such holistic conceptions are largely outside the norm in western knowledge systems, and, as such, this unique representation may be somewhat reflective of the mainstream connectivity conservation community. On the other hand, one participant depicted more-than-human articulately, "And that's kind of how I see that, how I vision Kespukwitk .... [The river system is] quite strong and significant ... So, I don't know if I can answer the difference between the significance of the wildlife, and then flow, but yet humans and animals have been relating to each other for thousands and thousands of years" (NAP2).

Thus, at least one participant's expression of connectivity for spatial delineation of focal areas aligns with Hodgetts' description of "a multiple" as consistent with the more-than-human type.

I extend that the problem of "plural" types of connectivity may not be as prevalent as Hodgetts seems to imply. Hodgetts' extends that the problem of conceptions of connectivity as "pluralities" rather than "a multiple" is both conceptual and practical; conceptual because the different ideas about connectivity are meaningfully connected, and practical because how these multiple forms of connectivity are enacted has 'significant implications for the ways in which humans engage with, protect, and manage "natures"' (Hodgetts, 2018, p.84). My study found that few participants were considering solely one type or types of connectivity in isolation, even with the potential that overlaps are underrepresented spatially given limitations with the remote format of participatory mapping interviews (see section 3.5.1). Most were describing them as meaningfully connected in terms of the focal areas discussed. Based on this finding, I counter Hodgetts' discussion of practical implications, as some level of "plurality," by way of providing a framework for unpacking the various actors, realities and relationships, may be needed to identify, organize, and address the types of connectivity, their connections and overlap, as highlighted spatially in this study. I found that separately considering the "plurality" of types added to a nuanced understanding of the relationships between types and their application in practice. Those involved in conservation planning may also find utility in identifying separate types, in order to see the relationships between types, balances and imbalances, and work towards holistic inclusion of all types. This may not be what Hodgetts depicts when referring to connectivity as "a multiple" but represents a holistic approach to including the inter-related "plurality" of forms. Key to doing so effectively may be in paying attention to the ways in which the pluralities are interpreted in decision making, to ensure that one type is not privileged over the others, and that the more-than-human realm is valued and accommodated, thereby approximating "a multiple" as an ideal.

3.4.1.2 Contrasting Plural Types: Re-framing Threats as Social (Economic) Connectivity

The findings of the present study suggest that 'threats' are a key consideration for delineation of spatial areas. Forestry emerged as a predominant consideration, including references to threats and livelihoods. Forestry related considerations may be an appropriate component of social data to focus on in the region. There are situations and locations in which socioeconomic objectives associated with forestry are incompatible with conservation, not just ecologically but socially. These findings align with those of Karimi and colleagues (2017) in their examination of the compatibility of social values with conservation through a qualitative expert elicitation approach. They found that including 'conservation-compatible values' resulted in relatively few new conservation priorities, while adding 'noncompatible economic values' resulted in a significant change in conservation priorities (Karimi et al., 2017).

This relates to the finding that some participants focused on social (economic) 'threats' (e.g., economic processes such as forestry) to ecological-functional priorities (e.g., mainland moose), as four focal areas were delineated based on the need to address threats (out of 29). Such 'threats' are driven by broader socioeconomic processes (Nielsen et al., 2021). Therefore, social (economic) connectivity could potentially contribute to understanding local-social context associated with such 'threats', with the goal of building support by re-framing such 'threats' as focal areas for social (economic) connectivity. This would involve focusing on areas where 'imbalances' are occurring within processes relating to social (economic) connectivity, such as imbalances between dominant economic processes, livelihoods, and the ecological implications of this. Through identification of such areas, more compatible and balanced forms of social (economic) connectivity can be given precedence through an understanding of the entirety of social and economic processes that encompass such 'threats', such as livelihoods in this example. While reiterating the importance of identifying noncompatible economic values, the findings show that focusing on other aspects of economic processes, such as livelihoods, is also important within spatial delineation of focal areas for social (economic) connectivity. Future research could extend the exploration by comparing foresters' and conservationists' perspectives when it comes to

connectivity conservation planning and spatial delineation of key focal areas on the landscape.

Unsurprisingly, the prevalence of spatial overlap among connectivity types found in my study suggests that potential trade-offs between "plural" forms of connectivity may be necessary. For example, substantial overlap occurred in areas delineated for social (economic) connectivity and ecological-functional connectivity. Other studies have demonstrated the importance of identifying socially feasible conservation solutions, through the identification of potential 'conflicts', thereby facilitating targeted communication strategies (Whitehead et al., 2014). Most conservation decisions involve some sort of trade-off between competing objectives (Keeney, 2002). These findings reflect research on the impact of diverse land uses on connectivity projects, in which successful projects were found to require a case-by-case response at the local-level of use (Moore & Shadie, 2007), as well as research focused on corridor planning and practical decisions made to balance ecological and social objectives (Parrott et al, 2019). Accordingly, future research is needed to investigate how "plural" forms of connectivity, particularly those that contradict or work against one another, can be integrated into conservation planning. For example, future research could examine how integrated and related types of connectivity can be considered in tandem, while simultaneously balancing potentially competing objectives.

3.4.1.3 Spatial Comparisons: Base Map and Mapped Focal Areas

The maps generated by participant-delineated polygons of potential focal areas show some key similarities and differences with the probes shared on the base map. Base maps shared included structural attributes based on preliminary analyses by Cunningham and colleagues (2020) and functional connectivity between key protected areas from work by Inglis (2007). The potential impact of the base map may on participant-mapped polygons is discussed within the limitations section, but it is worth mentioning prior to the subsequent discussion that this may be the reason for such similar patterns across the base map and participant-mapped polygons.

One notable similarity within the participant-mapped polygons and the base-map polygons is the tendency for areas to connect from the center (Kejimkujik National Park

and National Historic Site and Tobeatic Wilderness Area) outwards. For example, the participant-mapped polygons (*Figure 3.4*) have three concentrated areas going out from the center, as well as the larger Mersey Corridor and other key polygons connecting from Kejimkujik down to the Liverpool-Kejimkujik seaside area (Atlantic coast). Similar areas connect from the center outwards on the base map (*Figure 3.1*; functional connectivity, Inglis, 2007; and preliminary areas of structural connectivity, Cunningham et al., 2020). Thus, participants and previous work agree that a priority area projects outwards from the center and overlaps two large protected areas.

There is also a tendency for such areas to extend beyond the arbitrary study boundary indicated on the map. For example, the Mersey and other key polygons connect from Kejimkujik down to the Liverpool-Kejimkujik seaside area (Atlantic coast). Two participants (NGOP4 and NGOP7) discussed polygons that extend further, beyond the study area boundary delineated on the base map, reflecting that connectivity may be conceived and applied at multiple spatial scales, with local focal areas being delineated and located on the basis of consideration of broader scale processes. For example, one participant (NGOP4) considered the broader spatial context and focused on connecting the region to the rest of the province through key pinch points. Arbitrary boundaries, such as the one delineating the Southwest/Kespukwitk region, may hinder consideration of important connectivity concerns, such as by limiting acknowledgement of key linkages and pathways to the broader region, which is itself a critical feature of not only ecological-functional and spatial-structural connectivity but many social types as well. Thus, while looking at the potential commonalities and differences between the mapped polygons and shared base map is interesting, taken together they may work in synergistic and complementary ways, reflecting both ecological and social types of connectivity, as well as diverse forms of social and natural science and informal knowledge perspectives. On the other hand, the base map may have had a direct or indirect effect on the areas discussed by participants, as discussed subsequently.

3.4.2 Limitations

Key limitations accrue to the relatively small sample size, challenges associated with conducting participatory research remotely, the use of fuzzy boundaries (McCall,

2006; Needham et al., 2020; Nobe et al., 2021), and potential influences of the base map used in the study. Within qualitative approaches, small sample sizes are appropriate (Drury et al., 2011; Rust et al., 2017; Young et al., 2018) but with the application of participatory mapping within interviews, a larger sample size would have made statements about priority areas more robust. This is especially the case, as only nine of the sixteen participants had a focal area to discuss, which resulted in a more limited sample size, with a bit more than half of participants engaging with the mapping portion of the interview. This may be because of limitations associated with the remote context, as low response rates are noted as issues with survey-based approaches to remote participatory mapping (Brown & Kyttä, 2014).

Remote participatory methods - The PPGIS approach used in this research was adapted to the remote format given constraints during an era of COVID-19 restrictions (data collection was completed remotely from August 2020-February 2021). The engagement with the shared map is itself a limitation because of the remote format, as participants could not easily draw directly on the map and instead directed the interviewer through spatial descriptions and/or directions. I, the interviewer, interacted with the map on behalf of the participant by drawing on the shared PDF of the map when possible, but this was not always possible depending on the complexity of the area being described. Overall, this adapted version of participatory mapping was fairly limited through the remote form of interview communication. Other remote forms of participatory mapping use surveys (Brown et al., 2019; Brown & Reed, 2009; Brown et al., 2014; Lechner, Brown & Raymond, 2015; Jankowski et al., 2019; Pocewicz et al., 2012), both online (Brown & Reed, 2009; Jankowski et al., 2019) and paper-based (Brown et al., 2014; Lechner et al., 2015; Pocewicz et al., 2012).

Given the scope of this project and the focus on in-depth, qualitative descriptions, I decided to use a semi-structured interview approach to participatory mapping, which was adapted based on a remote format. The remote nature of interviews was a limitation, as it may have impacted the amount of people that had a key focal area to discuss, the amount of discussion associated with the focal area(s) suggested, and the amount of interaction with the map itself, as people may have had more ideas and areas to discuss

elicited by interaction with the map. This limitation reflects a broader challenge in the field of participatory mapping relating to achieving collaboration, rather than solely the collection of spatial data (Brown & Kyttä, 2014). The collaborative nature was limited by the remote format of interviews, which as mentioned above, were chosen because of external constraints in the era of COVID-19. The remote nature of the participatory mapping interviews also may have increased the difficulty of engaging with the map in a remote format, thus limiting the number of spatialized representations, so that the above-discussed overlaps found in the present study are underrepresented spatially compared to those elucidated conceptually (Chapter 2).

Fuzzy boundaries - Another weakness associated with the remote, participatory mapping approach used in the present study is the fuzzy boundaries of mapped polygons, as these boundaries are not exact. This reflects a limitation within participatory mapping research, in that research is needed to focus on the quantity and quality of the knowledge produced, specifically as related to the accuracy of the location-based information that participants provide (Brown & Kyttä, 2018). The purpose of the present study was to explore how conceptualizations of diverse forms of both ecological and social connectivity translated into application, through the spatial delineation of focal areas. Although spatial in nature and therefore related to on-the-ground features, there was no expectation or intent that delineations be exact or precise, but rather illustrative and approximate and thereby fuzzy boundaries (McCall, 2006; Needham et al., 2020). Future research could address such limitations in the quality of data related to on-the-ground features by using sensitivity analysis to discern the uncertainty in a model or system (Fagerholm et al., 2021). Sensitivity analysis has been proposed as a useful approach in participatory mapping in which the inputs are varied and then effects on the outcomes are assessed (Fagerholm et al., 2021). However, sensitivity analysis has not yet received widespread use within participatory mapping but would be potentially useful in addressing the limitations of the quantity and/or quality of the participatory mapped data as inputs in analysis (Fagerholm et al., 2021). With above-mentioned limitations in mind, the intent of the resulting mapped polygons in the present study is thus not to represent accurately delineated areas for connectivity conservation planning, but rather to indicate

general focal areas for further study and more-detailed delineation, and to support the potential of including more diverse types of connectivity within spatial planning.

One approach used in the present study involved examining spatial overlap of focal areas for both ecological and social forms of connectivity as a potential approach to delineate preliminary priority areas. Given that boundaries of mapped areas are not exact, some smaller areas of overlap may be a result of these fuzzy boundaries overlapping, and thus may not indicate real priority areas on the ground. Spatial reality, as perceived by people, has fuzzy boundaries not expressed in GIS (McCall, 2006). Therefore, I recommend that smaller polygons, such as the small area of six instances of overlap amongst social forms of connectivity (*Figure 3.11*), be interpreted with caution, as such areas are likely a result of fuzzy boundaries. Beyond this, future research could build upon the present study by exploring how potential priority areas based on ecological and social forms of connectivity can be implemented and translated into on-the-ground action.

Base map - A key limitation in the study is the use of a base map with connectivity features embedded. The polygons on the base map may have introduced bias through limitations to participant-engagement and remote nature of the interviews, as well as because of a potentially conscious or subconscious desire to echo experts' polygons. Originally, the intended use of the base map in the research was to facilitate identification of a potential focal area that would then serve as a more localized study area for conducting in-person, participatory map-based workshops to look at connectivity in a more detailed way. Features on the map were to provide pre-existing spatial information (from Cunningham et al., 2020 and Inglis, 2007) as background information relevant to connectivity planning in the region. In shifting the research questions and methods to accommodate remote methods of data collection, unfortunately the potential influence or suitability of the original base map was not fully considered.

In hindsight, the areas represented on the base map may have influenced participants' markings and rationale. Participants may have been more likely to focus on these areas because it would be easier to indicate and discuss them. For example, some participants used the areas on the base map as reference points. Others may have viewed

an area on the base map and been reminded of a current threat to the area, or a current project they are working on. Although, this could represent a potential benefit, such as by probing people to think about certain areas, it might also have influenced their spatial delineations. Some may have perceived the base map as representing privileged or authoritative knowledge (Alcorn, 2000; McCall, 2021) and been hesitant to counter it. Others may have perceived the delineation of those areas for those reasons to be already complete, and therefore did not make a point of adding it to map with their own delineations. Some participants, such as NGOP4 who mapped pinch-point areas south and north of Panuke Lake (outside the study area boundaries), were likely not strongly influenced by the features on the map being shared. In contrast, others delineated polygons located within areas shown on the base map, such as the "South Mountain – Cloud Lake – Keji – Tobeatic" area, which aligns with potential areas of 'diffuse flow' from Cunningham et al. (2020). The base map also included protected and other conservation areas in the region, which may have influenced the number of participants who focused on connecting protected areas, such as NGOP1's delineation of the "area between Tobeatic, Kejimkujik, and Cloud Lake Wilderness Areas". Features of the base map increased its complexity, which may have posed a barrier to interacting with it (e.g., seven of 16 participants did not interact with the map at all).

With these potential impacts in mind, the features on the base map may have influenced the results in numerous ways and the results must be interpreted with caution. Some participants may have focused in on the features and added supplementary information to them, whereas others may have considered those areas complete and therefore focused on other areas. Either way, the spatial distribution of participants' focal areas would be influenced. The base map features may also have impacted the types of connectivity being delineated by participants, either by acting as probes for ecological-functional (features from Inglis, 2007) and spatial-structural types (features from Cunningham et al., 2020), or by conveying the impression that these types were already covered and therefore required no further mention. Accordingly, the types of connectivity discussed would be influenced. Such complexities may have been avoided by using a blank base map with little on it other than landmarks to orient participants.

3.4.3 Future Research

This is the first application of Hodgetts' taxonomy (2018), or any typology of connectivity, to the spatial delineation of focal areas. This is also the first application of social forms of connectivity to the spatial delineation of focal areas, in a relatively remote and natural landscape. Thus, the findings of this study are entirely novel, yet preliminary, and future research is warranted and recommended. I found that all types (ecological-functional, spatial-structural, emotional-affective, economic, equity, and more-than-human) were considered as important to varying degrees for the spatial delineation of focal areas for connectivity planning within the study region. The most prominent types of connectivity were ecological-functional and spatial-structural, making up 20 of 29 polygons in total. Following this, social (economic) included six polygons, while emotional-affective, social (equity), and social (more-than-human) each had one polygon; however, all four social categories included the Kespukwitk (Mersey) Corridor. Future research could potentially examine the spatial delineation of both ecological and social forms of connectivity in different contexts, at different scales, and from the perspectives of different groups. This may contribute to the development of long-term shared visions and quantifiable objectives that are achievable given the ecological, social, and economic context, as recommended by Lindenmayer and colleagues in 2008, yet not achieved in the literature. . Doing so will require collaborative approaches to connectivity research and planning, with the aim of promoting connectivity theory and practice in ways such that connectivity, social values, and development are compatible, as stressed by Lechner et al. (2015).

3.4.3.1 Land Tenure, Local Context and Local Perspectives of Focal Areas

Future research should also build upon the identification of focal areas in the present study by exploring their tenure and local institutional and community context, which was beyond the scope of the present study. This is based on discussions within the broader literature, in which opportunities for conservation within identified connectivity corridors depend on both the type of land tenure and on government jurisdiction (Parrott et al., 2019). Such research could also examine the role of private land ownership in key focal areas, as private land ownership can complicate connectivity implementation,

making private landowners a key group to consider within connectivity planning (Keeley et al., 2018). When discussing the need to include local community members in future research, it is important to note that the term community is a "gloss for a complex phenomenon because social systems are multiscale, and the term community hides a great deal of complexity" (Berkes, 2004, p.623). Different landscapes and communities will have varying levels of social willingness and disparate economic circumstances, and thus will require quite different solutions and a mix of programmes (Fitzsimons, Pulsford & Wescott, 2013). Therefore, future research investigating local perspectives towards potential priority areas is needed. Such research could be 'open' to different forms of connectivity, but given the preliminary nature of the present study, such forms may not be the initial focus of such research. Perhaps, first, understanding local perspectives towards various forms of connectivity is needed, followed by research examining the translation of such perspectives into spatial delineation of potential focal areas.

3.4.3.2 Impact of Base Map and Included Polygons

Future research could examine the influences that derive from various types of base maps, which likely affect the areas mapped by participants. Recent research found that base maps need to be selected with the appropriate level of detail of the results in mind, with two base maps at different scales being appropriate (Klonner et al., 2021). In a summary article of key 'lessons learned' in participatory mapping, it was noted that the location of physical landscape information included on base maps can potentially impact where place values are mapped (Brown, Reed & Raymond, 2020). In terms of methods, future research could comparatively examine the differences that result from using a blank base map, versus one showing key areas identified in previous work, versus one showing conservation areas in order to discern how interactions with maps are affected by the level of detail included on base maps. Another option in remote approaches to participatory mapping using an online map could involve participants having the option to toggle on/off data layers (Brown & Weber, 2013). This gives the participant control over the level of complexity associated with the base map. Future research could use this toggle on/off approach to investigate the preferred level of detail appropriate for participatory mapping approaches focused on focal areas for connectivity.

3.4.3.3 Expanding on the Spatial Delineation of Social Forms of Connectivity

I found that elucidating discrete social forms of connectivity was useful in understanding social dimensions relating to opportunities and inhibitors for connectivity conservation. This echoes previous research, in which it was found that integrating social factors into spatial connectivity planning may alter how organizations approach landowners and facilitate connectivity planning (Sage, 2019). Previous research found that community values have the potential to leverage conservation of areas of ecological importance (Lechner et al., 2015), but how areas of social (emotional-affective, economic, equity, more-than-human) importance translate into conservation planning and policy is a potential avenue of future research.

The present study found that some forms of connectivity may be contradictory in the present context, such as conflicts between ecological-functional and social (economic) connectivity in terms of threats relating to current forestry practices. Thus, understanding the local-social context associated with such 'threat-based' priority areas could potentially build support. This could be done by framing 'threat-based' priority areas as focal areas for social (economic) connectivity and deriving ways of reforming forestry practices to be more compatible with ecological connectivity values, such as through ecological forestry. This aligns with previous research focused on strategies for building public support for corridors, which states the importance of making connectivity tangible and relevant to people's lives (Anderson & Jenkins, 2006). Reluctance of conservation practitioners as expressed by Lechner and colleagues (2015) to integrate local community values in conservation planning may be premised on assumption that such values may impede or undermine conservation. For example, facilitating wildlife movement may be contested if it is perceived to reduce economic activity, threaten public safety, or lead to regulatory problems (Aune et al., 2011). Future research could build upon the present study by further exploring social (economic) connectivity, specifically how such 'threats' also translate into livelihoods, in particular to those involved in the forestry sector. This re-framing could allow for more understanding of areas of active social (economic) connectivity, not as a threat to conservation, but as areas valued for both ecological and socioeconomic reasons and managed in ways compatible to both.

3.5 Conclusion

This research contributes to the broader discussion of how to best include social factors within connectivity planning. This work is part of the broader conceptual shift in ecology, which involves a change in perspective to viewing ecosystems as complex, adaptive systems, in which humans are an integral part (Berkes, 2004). This is similar to what is proposed by Hodgetts (2018) as part of the broader goals of considering connectivity as "a multiple", in which no form of connectivity is given temporal priority and all actors and realities are valued. It is important to note that such 'social' forms of connectivity may already exist on the landscape, through a variety of economic-based systems. What is missing is an understanding of how a plurality of types of connectivity interact with one another, and how decisions may be made that do not privilege one set of considerations over another at the outset. The qualitative approach to spatial identification of key areas allowed the examination of why focal areas were considered important for connectivity, from which I found that both ecological and social forms of connectivity are considered within the spatial delineation of key areas for connectivity. I found that in the case of the spatial delineation of key focal areas, ecological-functional and social (economic) may potentially work against one another if not carefully accommodated. In this sense, it is important to note that some forms of social connectivity, such as economic, serve as potential 'barriers' to implementation or 'threats' to other values, and thus contradict or conflict with other types of connectivity. Such contradictions provide opportunities for reframing connectivity conservation, such as by focusing on the connections between complementary attributes, such as the livelihoods associated with social (economic) connectivity.

The present study found that experts and local knowledge holders consider multiple forms of connectivity when prioritizing focal areas for connectivity. I found that one example, the Kespukwitk (Mersey) Corridor Project, best represents the concept of connectivity as "a multiple" in the spatial realm. Thus, I found that Hodgetts' (2018) depiction connectivity as "a multiple" may extend to the spatial delineation of key focal areas. I found preliminary evidence that overlapping forms of connectivity are considered by participants when spatially delineating focal areas for connectivity, representing a

nuanced application of the conceptual types in practice. Areas of overlapping types of connectivity may represent instances where "a plurality" of types are being considered in tandem, thus potentially representing "a multiple".

I found it to be advantageous to classify the types of connectivity, as this aided the overall analyses of thematic and spatial overlap within a comprehensive typology. I acknowledge Hodgetts' (2018) proposition that connectivity should be conceived at the outset as "a multiple" of indivisible actors and relationships, rather than as a "plurality" of separate types, but I also extend that there are advantages to looking at the relationships between and across such types separately. In this case, nuances in how participants spatially delineated the various forms of connectivity were elucidated based on the explicit separation or unpacking of the types. Most participants prioritized focal areas for connectivity based on two or more reasons, with few focusing on solely one form of connectivity, or solely within ecological or social realms. Thus, "pluralities" were rarely considered as separate and stand-alone within the spatial delineation of focal areas; this could potentially extend to on-the-ground prioritization and implementation. The consideration of a plurality of forms of connectivity could potentially contribute to the calls to consider connectivity as "a multiple", integrating social and ecological features of the landscape within connectivity planning in a way that values all actors and relationships, including more-than-human. Such interrelationships and diversity are engrained in the landscape. Whether or not these interrelated social and ecological forces are included within planning is thus arbitrary; these forces exist with or without acknowledgement, however addressing such forces is critical for successful implementation within connectivity conservation.

CHAPTER 4: CONCLUSION

4.1 Discussion

4.1.1 Overview of Findings

This research explored the meaning of connectivity, in particular social forms of connectivity, through an exploratory place-based approach that focused on the local conservation context in Kespukwitk, Nova Scotia. Hodgetts' taxonomy of connectivity (2018) was subsequently applied to facilitate interpretation of how conservation experts and local knowledge holders conceptualize connectivity in practice within the study region. By doing so, this research contributed to the broader discussion surrounding the conceptualization of connectivity in the literature and in the study region. Social connectivity has been described in previous research (Wyborn, 2011) as well as more recent work (Hodgetts, 2018; Egerer et al., 2020) but had not yet been explored within Kespukwitk.

This research involved the analyses of two aspects relating to the meaning of connectivity: conceptual-textual (theoretical) (Chapter 2) and spatial (applied) delineations of focal areas (Chapter 3). I found that a diverse set of both ecological and social forms of connectivity are considered important and relevant to conservation planning in the region in both conceptual and spatial realms. The expressed connectivity types reflect the typology proposed in Hodgetts' (2018) taxonomy of connectivity, including ecological-functional, spatial-structural, emotional-affective, social (economic), social (equity), and social (more-than-human) connectivity.

I also found nuanced examples that are not explicitly mentioned by Hodgetts but that fit within one or more of the six types if broadly interpreted, such as by accepting Hodgetts' conception of the cultural as part of social. Such examples include: (1) aquatic connectivity, which generally was seen to reflect ecological-functional and spatial-structural types but was not explicitly mentioned within Hodgetts' discussion of these types; (2) cultural connectivity, which primarily reflects more-than-human connectivity, but also relates to emotional-affective and equity; (3) human connectivity, which was found to reflect human to human connectivity and human movement and is a key

example of social (economic) connectivity; (4) well-being, which mainly reflects social (economic) connectivity but was also related to emotional-affective connectivity; and (5) inter-connectedness, reflecting social (more-than-human) connectivity. These nuanced examples are grounded in and emerge from the local context of the study area, such as its many rivers, lakes and coastal areas, and the diverse social-cultural-ecological interactions that occur within the landscape, and thus may be of potential utility for conservation practitioners in the region.

While not as diversely applied in the participants' spatial delineations of focal areas for connectivity, Hodgetts' taxonomy (2018) and its six types were all found to be relevant, to varying extents, with the most prevalent being ecological-functional, spatial-structural, and social (economic). While spatially delineating focal areas, some participants focused solely on one type of connectivity. For example, one participant discussed only social (economic) connectivity through SES systems logic, linking both ecological and social aspects; another focused solely on social (more-than-human), describing the indivisibility of the interrelationships and inability to prioritize one aspect over another; and another focused solely on spatial-structural connectivity. Thus, the spatial delineations were less diverse in the types discussed by participant compared to conceptual-theoretical discussions, in that in conceptual realms, most participants focused on almost all forms of connectivity at some point in discussions.

4.1.2 Key Findings

4.1.2.1 Both Ecological and Social Forms of Connectivity are Relevant in Conceptual-Theoretical Discussions and in Spatial Application

This study found that experts and local knowledge holders conceptualize both ecological and social forms of connectivity, with those forms discussed most often conceptually reflected in the spatial delineation of focal areas. This finding highlights the need to consider ecological and social forms of connectivity in tandem within connectivity conservation planning. In much of the earlier research, connectivity was depicted to have only two dimensions: the landscape and the organisms considered (for a review, see Kindlmann & Burel, 2008). From my study and others (e.g., Bormpoudakis & Tzanopoulos, 2019; Hodgetts, 2018), it is clear that the dimensions associated with

connectivity are much more complex and include social forms. The findings address calls to consider social processes and factors within connectivity work (Anderson & Jenkins, 2006; Keeley et al., 2018; Wyborn, 2011), and supports the assertion that a focus on both ecological and social forms of connectivity is needed, despite the sometimes-contradicting elements, as both are part of an inter-connected, broader connectivity. The findings illustrate that including ecological and social forms of connectivity should be a key part of identifying and delineating priority focal areas for connectivity.

Overall, the findings provide evidence of the conceptualization and application of social forms of connectivity, alongside already-established ecological forms. Including and discussing these social forms of connectivity can clarify some of the ambiguities associated with connectivity, in which the focus is often on ecological forms, as well as serve to support calls for increased collaboration and inclusion of social processes. The findings of the present study suggest that collaboration is key, as also stressed by Wyborn (2015a), because of the potential benefits of collaborative knowledge co-production in, and potential of connectivity as a "boundary objective" to unite diverse perspectives and approaches across landscapes (p.297). The findings also depict consideration of social processes to be an important part of both conceptual and spatial connectivity planning. This reflects previous research which found that connectivity initiatives should include economic, political, and institutional dimensions (Wyborn, 2011). The findings support terminology including key forms of 'social connectivity', which reflets recent research in an urban context, in which social connectivity (Egerer et al., 2020) and social-ecological connectivity (Egerer & Anderson, 2020) are used to unite ecological-connectivity planning with key social processes in urban landscapes. Thus, the idea of social forms of connectivity is not new, and based on the findings of this study, they are evident within discussions surrounding connectivity conservation in both conceptual and spatial realms in Kespukwitk, Nova Scotia. Accordingly, part of the contribution of this study is supporting the call to clearly delineate social forms of connectivity as part of connectivity planning within both research and practice.

4.1.2.2 Translating Theory into Practice

This research involved thematic analyses of two aspects of the meaning of connectivity: conceptual expressions based on thematic analysis of textual data (Chapter 2) and how those concepts (Hodgetts' taxonomy) are applied through spatial delineations. In part, this served to explore whether Hodgetts' distinction between the connectivity types in conceptual-theoretical realms transfers into application, through spatial delineation. Hodgetts' (2018) points out that six forms of connectivity are evident in theoretical-conceptual realms, but applications remain primarily ecological-functional and spatial-structural in focus. The findings of the present study counter this statement, in that as a group, participants drew upon all types of connectivity in their spatial delineations, with most participants mentioning more than one type of connectivity for each area. However, the findings also somewhat support Hodgetts' assertion as, overall, participants applied fewer (social) types in their spatial delineations compared to their conceptual-theoretical expressions. Therefore, I found that the key forms of connectivity depicted in Hodgetts' taxonomy (2018) potentially translate into application through spatial delineation of focal areas, however in doing so, some of the overall diversity in types is lost, reflecting that there still may be some limitations in translating some conceptual forms of connectivity into practice. This may be because the mapping social processes is complex and involves accounting for multiple and diverse human values in a way that can be spatially explicit (Karimi et al., 2015). Future research is needed to further clarify how such conceptual forms of connectivity transfer into practice.

4.1.2.3 Challenges in Delineating-Differentiating Between Types

When delineating and differentiating between types of connectivity based on participants' responses, several challenges were noted, in terms of adequately grouping diverse descriptions, which often contained fragments of other types. The importance of not being too narrow in conceptions of connectivity was expressed by one participant:

> … I think it's easy to focus on connectivity, but if you get too narrow it's not particularly helpful because—we've done it, too—we produce something and we think, this is great: this is going to have a big impact. But someone looks at the map and they go, yeah, that's not how I see connectivity. And then, all your

> results are like, okay, we'll just throw those out the window and we'll do another connectivity analysis next year. It's just … it's kind of frustrating that way (GOP4).

This quote emphasizes the frustrations associated with trying to narrow the spatial focus within connectivity conservation planning, without being "too narrow". Often, this was reflected in participants' responses, as what to consider was often expressed as a combination of things, such as ecological and cultural values (Chapter 3). Two categories that were, at times, difficult to differentiate were: social (economic) connectivity, which uses a systems lens incorporating ecological and social realms yet remains fundamentally human centred; and, social (more-than-human) connectivity, which focuses on indivisibility and connections between "all actors with agency, not limited to humans", without privileging one or the other (not human-centered) (Hodgetts, 2018, p. 86). The keys to differentiating these categories, both focused on plural or multiple realms, were: (1) the human-centered focus of social (economic) connectivity, compared to the inter-related more-than-human perspective; and (2) the inseparability or inability to distinguish or prioritize discrete forms of connectivity within the more-than-human conceptualization and application. The overlap between types of connectivity is what contributes to conceptions of it as a "plurality" of related types. However, this poses challenges, as a balance is needed in not being "too narrow" in focus on specific types, while still retaining meaning through an explicit focus on key types and connections between such types. Future research is needed to further explore the relationships between types of connectivity, which would contribute to a more robust depiction of the various forms of connectivity being considered by those working within on-the-ground initiatives and planning contexts.

4.1.2.4 Conflicting "Plural" Types

Within both the conceptual and spatial findings, two types of connectivity often seemed to reflect contrasting considerations: ecological (functional-structural) and social (economic). The conceptual discussion of social (economic) connectivity included a nuanced example focused on human connectivity, with discussion focusing on trails for motorized transportation (all-terrain vehicle (ATV) trails), as well as trails for non-

motorized forms of movement (portage and hiking trails). The latter may be considered as more compatible than the former with ecological and structural connectivity, but conflicts and ecological stresses can occur from both of these forms of social connectivity. The economic dimensions of forestry were a notable theme in both theoretical-conceptual discussions and in spatial delineations. Economic processes were portrayed as a primary threat to ecological and structural connectivity, while also acknowledged as an important social (economic) consideration as a source of livelihoods. Both examples, linear infrastructure for human movement and economic processes of natural resource extraction, could be framed in ways that are more compatible with other types of connectivity. This tension between social (economic) forms of connectivity as both important and potential threats, illuminates the potential for re-framing these polarized discussions. For example, ATV-trails could be re-framed as a key component of social (economic) connectivity because these trails provide access to natural areas, and thus potentially increase emotional-affective connections with nature. There is the potential that such re-framing could integrate the planning for both wildlife and human movement and thus align broader goals and objectives. Likewise, viewing forestry as a key part of social (economic) connectivity through economic processes such as livelihoods could contribute to the discussion on how livelihoods can be compatible with the broader goals of conservation, such as through ecological forestry practices and ecological economic systems. The key to both examples is the focus on the inter-connections, rather than separations, between the ecological and social (economic) realms, without privileging one over the other, as in a multiple or more-than-human conception.

Within broader interview discussions, the topic of 'balance' often came up, often expressing a need for balance between conservation and production, conservation and forestry, or fragmentation and connectivity. This is similar to results of work by Goodale (2013), in which farmers' engagement with biodiversity conservation was found to stem from a motivation to maintain the 'balance' between conservation and production. In the context of connectivity conservation, such balance may be enhanced by focusing on the connections between types of connectivity, rather than polarizations and contrasts. Yet,

differentiating between types of connectivity, such as to include, account for and organize their components, is also key to achieving balance, so long as one aspect is not privileged over another in ways that are detrimental to the system as a whole. Arguably, the dominant social-economic system prioritizes anthropocentric considerations for connectivity (such as roads and industry) over ecological ones, resulting in a reactive conservation approach that understandably prioritizes ecological considerations. Identifying types of connectivity that are disproportionately being given preference in land and resource planning and management practice, such as potentially dominant social (economic) influences of roads and industrial forestry, and in conservation planning, is key to revealing and addressing conflicts and imbalances. Therefore, a potentially balanced approach may need to view connectivity as both a set of "plural" types, for practical purposes of application, and an indivisible whole or "a multiple", as an ideal.

4.1.2.5 Reflecting on Limitations Associated with Worldview and Terminology

Within reflections on the research process, I contemplated how my own worldview impacted the results of this thesis work. Part of qualitative research requires reflexivity, which in this case involved the process of journaling throughout the research project to record notes associated with ideas, feelings, and perceptions (Gray, 2009), which can help the researcher understand data later on (Van den Hoonard, 2012). Based on this premise, I kept a diligent research journal, in order to try to account for my own biases and the impact I had on the results of the present study. After some interviews, especially those with Mi'kmaq participants, I found myself questioning my interview guide and questions, and how my own Western-colonialist perspective impacted the design of the interview guide and questions, and thus potentially limited engagement with other worldviews. For example, one realization I recorded indicated that "'connectivity' is a western word, it is academic jargon, and in a way so is social connectivity and cultural connectivity" (Research Journal, February 16th, 2021). Yet, my interview guide was littered with the word connectivity, and thus, the chosen terminology potentially limited the perspectives included, despite efforts during interviews to adapt such terminology. Given that this emerged later in the process, near the end of the data collection, no formal changes were made to the interview guide, but rather questions

were adapted as necessary based on participants' requests (e.g., asking for the question to be re-phrased).

As I worked through my analyses and the writing process, I found myself questioning whether my worldview had an impact on the extent that connectivity was viewed as "plural" and distinct types, versus an inter-connected, indivisible whole, "a multiple". By asking about connectivity, corridor, and social connectivity, I ascribed the terminology I considered important through the interview guide. However, it is also potentially advantageous that I later applied Hodgetts' taxonomy (2018) in the data analysis process, rather than *a priori*, during the designing of the interview guide in which my intent was to broadly focus on the meaning of connectivity. Thus, while asking specifically about 'connectivity' and 'social connectivity', I did not provide or distinguish between a subset of types of social connectivity. The impact of my own worldview on the designing of interview questions and terminology chosen is thus acknowledged here, in that it may have limited the worldviews I was able to engage with, some of which align with depictions of connectivity as "a multiple" or "more-than-human" worldview, perhaps without using such terminology. Thus, while this work contributes to the literature on the meaning of connectivity, the terminology used throughout is in no way the best or most appropriate, and likely needs to shift substantially to engage with other worldviews, such as Indigenous worldviews, discussed subsequently. Based on such worldviews, conservation can only be achieved "when the *relationships* [emphasis added] that have conserved the lands and waters for thousands of years remain intact or are re-established" (ICE, 2018, p.35). Future research or collaborative efforts should discern suitable terminology to engage with multiple worldviews, as this is beyond the scope of the present work.

4.1.2.6 Indigenous Worldviews and Ways of Knowing

The importance of Indigenous worldviews was overlooked within Hodgetts' taxonomy, in which no explicit reference was made in reference to the connection between Indigenous worldviews and the diverse forms of connectivity, such as social (more-than-human) connectivity. Rather, Hodgetts mentions concerns relating to colonialism in conservation practices during corridor implementation, based on

exclusionary colonial approaches to protected area designation in the past (2018). This brief mention does not adequately represent the potential for such colonial conservation practices to be engrained within connectivity conservation approaches, such as corridor delineation.

Hodgetts taxonomy (2018) also overlooks the synergies between Indigenous worldviews and the types of connectivity depicted in the taxonomy. This is a noteworthy oversight, as the synergies between Indigenous worldviews and more-than-human connectivity are clear, and without noting, may not give proper recognition to such all-important ways of knowing. Indigenous worldviews are premised on interconnectedness and reciprocal relationships *(M'sɨt No'kmaq* et al., 2021), with worldviews embedded in relations with natural ecologies, also referred to as "Land", including air, rivers, lakes and sea *(M'sɨt No'kmaq* et al., 2021, p.845). Such ways of knowing form the basis for a much needed shift among all people, “to support bold and proactive actions” through the (re)Indigenization of conservation (Artelle et al. 2019; Zurba et al. 2019; *M'sɨt No'kmaq* et al., 2021, p.860). This includes concepts such as *M'sɨt No'kmaq,* “all my relations” in which humans are not superior, but a small part of an “overall family” which is the “natural world” (*M'sɨt No'kmaq* et al., 2021, p.846), and relationships with wildlife, such that fish are seen as relatives (Pinchin, 2021). In reference to social forms of connectivity the synergies are glaring, with relationships with land being parallel to emotional-affective connectivity, calls for Indigenous leadership and reconciling past wrongs (*M'sɨt No'kmaq* et al., 2021) relating to social (equity) connectivity, and the final, but perhaps most notable synergy being the connection and relationships with more-than-human beings relating to social (more-than-human) connectivity. Thus, Hodgetts’ lack of recognition of such synergies is a considerable oversight; within the present study I found the limited representation of Indigenous worldviews and perspectives to be a limitation, as Indigenous perspectives were not fully represented. Future research is needed to fill this key gap in relation to Hodgetts’ taxonomy of connectivity and Indigenous worldviews and ways of knowing, in particular to emotional-affective, social (equity), and social (more-than-human) connectivity.

4.1.2.7 Unpacking Hodgetts' Depiction of Connectivity as "Plural" Types or "a Multiple"

I counter Hodgetts' depiction of the "problems of plural" (2018, p.84), as the present study found utility in looking at and separating out "plural" types of connectivity as depicted in Hodgetts' taxonomy (2018). I offer that those involved in connectivity planning may also gain from explicitly considering "plural" types of connectivity, such as the participants in the present study. Without looking at the "plural" types, it may be difficult to discern the inter-relationships between such types, particularly for those immersed in a Western worldview and scientific ways of knowing, which tend to separate and compartmentalize various aspects, including culture and nature, and humans and nonhumans. Applying a plurality of types in practice may also be more practical, as compartmentalization is also reflected in siloed colonial governance systems and institutions. Accordingly, a plural approach may serve to capture all types of connectivity. Such consideration of all types together could serve to illuminate relationships and synergies, as well as reveal conflicts and inequities, thereby facilitating processes to address imbalances between and across the types of connectivity, and thus support the goal of a holistic approach. In this sense, "plural" types may be necessary for approaches that work towards viewing connectivity as "a multiple" because understanding and identifying plural types contributes to approaches that consider all forms of connectivity in tandem, and conceptions that are all-encompassing and holistic. This research suggests that while Hodgetts' (2018) proposes the need to move towards conceptions of connectivity as "a multiple", I contend that there is some value in looking at "plural" types, as long as the search for relationships between types is at the forefront of analyses and connectivity conservation planning. A key to successfully applying it, however, is to not privilege one over another, thereby respecting and valuing the more-than-human realm.

Consideration of the diversity of plural forms of connectivity would embed both social and ecological considerations into connectivity planning. In this sense, "plurality" may be a practical, transitional way for Western-based approaches to apply and move towards connectivity as an interconnected broader whole, "a multiple". This could potentially contribute to a balanced and holistic approach to connectivity conservation, in

which diverse realms are considered alongside one another, as connected parts of a greater, inseparable whole, thus "a multiple". Elucidating how connectivity can be conceived of as "a multiple" in practice could potentially facilitate more collective action and collaboration across groups, through a move away from 'polarizations' and towards a focus on commonalities, with the goal of collective action which supports more-than-human co-existence.

4.1.2.8 Moving Beyond Dichotomies and Towards Inter-Connectedness, or "A Multiple"

Ecological forms of connectivity (functional and structural) were found to be very closely related, and potentially inextricable from one another, with considerable thematic overlap both conceptually and spatially; social forms were also closely related, especially emotional-affective, equity, and more-than-human, but also social (economic) to a lesser extent; thus, the barrier to moving towards truly viewing connectivity as a multiple may be a result of the false dichotomy between nature and culture (Cariño & Ferrari, 2021), and the idea that humans are separate and above nature and non-humans. This is represented by the finding that nature is often represented through the closely related ecological forms of connectivity, human considerations are represented through social forms of connectivity, and the consideration of both as an inseparable whole is rarely expressed. One type, more-than-human, which views all actors with agency as inter-connected and thus rejects this dichotomy, was expressed only by a few participants, one of whom self identifies as Mi'kmaq. Future research is needed to examine the potential for more-than-human connectivity to be understood and advanced in theory and practice, so as to 'connect' social-ecological realms in ways that move beyond this false dichotomy and the privileging of the human in Western worldviews, through a focus on inter-related, inter-woven, indivisible relations among the more-than-human.

The findings of this work therefore illuminate an urgent need to move beyond false dichotomies, which separate human and nature, and ecological and social dimensions. I acknowledge that this phrasing in itself perpetuates the false dichotomy between humans and nature. In contrast, the 'more-than-human' conception represents one inseparable whole. While there may be a benefit in differentiating between social and

ecological domains for operationalizing the concept, much of this 'need' comes from a Western worldview, as Indigenous worldviews are grounded in interconnectedness *(M'sɨt No'kmaq* et al., 2021). Perhaps Indigenous worldviews are vital place to start when moving beyond dichotomies and separations, and towards a holistic view of not only connectivity, but the natural world; conceivably we can learn "to see relationships, to seek the threads that connect the world, to join instead of to divide" (Kimmerer, 2013, p.21). While it is easy to make such a proposition, it may be much more difficult in practice, but a path forward can be found in Indigenous insights, which provide guidance on "how to live" in reciprocal, circular, and ongoing inter-relationships with all ecologies, including all peoples (*M'sɨt No'kmaq* et al., 2021, p.859). The purpose of this research is not to address this dichotomy, the challenges of which start with our very language, including 'human-nature' which itself perpetuates the false dichotomy. Nonetheless, I support broader calls to learn from the Mi'kmaq and other Indigenous peoples, such as through the (re)Indigenization of conservation (Artelle et al. 2019; Zurba et al. 2019; *M'sɨt No'kmaq* et al., 2021). This supports and gives priority to equitable, more-than-human forms of connectivity, with the goal of a holistic approach to connectivity through a focus on an indivisible reality, thus "a multiple," rather than separations and "pluralities".

4.1.3 Limitations

Some potential limitations are worthwhile noting when considering the findings of the present study though many of these are de-limitations, in that they were made for practical reasons surrounding research design. Given the purposive sampling approach used in this research, the results are not generalizable and are specific to the study population, conservation experts and key knowledge holders in the Kespukwitk region of Nova Scotia. Data saturation was reached for this population, but was lacking for other key groups, such as those involved in the forestry sector and Mi'kmaq individuals. These groups emerged as key perspectives relevant to connectivity conservation in the region but were not adequately represented within the present study to the extent that saturation was achieved. This is important to note when interpreting the results of the present study.

There is the potential that the design of the interview guide and questions may have limited engagement with those from other worldviews, such as Indigenous worldviews. The interview guide was designed based on preliminary themes I identified from the literature and may have thus been impacted by the dominant worldviews within the literature as well as my own Western-colonial worldview. Inclusion of terminology most closely related to Western-colonial worldviews was identified as a key limitation within the reflexive journaling process during this study and is important to consider when interpreting the results.

Both in the conceptual-theoretical discussion and spatial delineation of key forms of connectivity, examples and findings are embedded in the local context of the region, which also limits the generalizability of the present study. For example, different nuanced examples may emerge in other studies (conceptual-theoretical) and focal areas may be delineated for a variety of reasons compared to those discussed in the present study. However, the focus on local context was done purposively, as this is advantageous for exploring conceptual theories such as Hodgetts' taxonomy (2018) through a place-based approach, to determine how such theories apply in practice.

The adaptation of the present study to a remote format in response to emerging COVID-19 protocols had a variety of impacts on present study. For example, the base map included was not adequately adapted for a remote format. In hindsight, participants' spatial delineation of focal areas was likely impacted by the layers already included on base maps that focused on protected areas and modelled connectivity features. The existing layers may have biased discussions and identification of focal areas in the region, and thus are critical to consider when interpreting the results. A simplified version of the base map would have been more appropriate to use, perhaps with those conservation features being shared separately in a different section of the interview. Including a base map with polygons depicting both ecological (Inglis, 2007) and structural (Cunningham et al., 2020) forms of connectivity may have impacted the study as whole, as this map focused exclusively on ecological forms of connectivity. Thus, I unintentionally was preferencing ecological forms of connectivity (despite an overall research focus on social forms). This was in part because no previous spatial delineations of social forms of

connectivity exist within the study region. This map was shared about half-way into the interviews, and therefore did not impact discussions relating questions about the meaning of connectivity, corridor, and social connectivity, but may have narrowed discussions surrounding key focal areas and opportunities and challenges to connectivity conservation in the region.

The remote format of the interviews, adapted based on restrictions associated with COVID-19, likely impacted the map-based responses as well as the broader interview discussions and is therefore a key consideration when interpreting the findings. The remote nature of the interviews may have limited the amount of engagement with the maps, in that some people chose not to engage with the maps at all in their responses and/or chose not to discuss any key focal areas. These potential impacts on the findings of the study are critical to consider, but it is worthwhile noting some of the more major decisions, such as the adaptation of the interviews to remote format, were made based on external factors beyond my control, in the era of COVID-19. Such limitations may have introduced implicit and unconscious biases to the present study, perhaps limiting engagement in the interview itself, with the maps being shared, or with the forms of connectivity being discussed. Therefore, results should be considered with caution and with the above-mentioned limitations in mind.

4.1.4 Future Research

Several potential key avenues for future research may build upon the findings of the present study. This includes engaging with a wider diversity of local perspectives such as local Indigenous and non-Indigenous communities, forestry perspectives and conservationists, and motorized vehicle recreation users and conservationists. Expanding upon Hodgetts' taxonomy (2018) and his depiction of the core types connectivity within future research crucial, as Hodgetts' does not explicitly mention how Indigenous worldviews and perspectives fit within these types of connectivity. However, the similarities between features of social (more-than-human) connectivity are apparent, in that tenants of interconnectedness and relationships with all matters of life are central to such worldviews (ICE, 2018; *M'sit No'kmaq* et al., 2021; Pinchin, 2021). Future research is also needed to expand upon and further explore the nuanced examples found in the

present study, which were embedded within the local context to some extent, and thus may not transfer to other contexts. Another key avenue for future research is expanding the present findings by exploring potential management approaches to support social forms of connectivity. It is possible that other nuanced examples may emerge as important to connectivity conservation in other contexts.

In reference to the spatial application of Hodgetts' taxonomy, future research should further explore the focal areas identified in this study, or other relevant focal areas, by exploring the land tenure, local context and local perspectives of focal areas. Future research could also approach the types depicted in Hodgetts' taxonomy more directly through questions directly relating to such types, thus an *a priori* approach. Future research could use a mixed approach, in which the interviews could be designed to see what participants come up with unprompted, which could then be followed by prompts about the particular types of connectivity from Hodgetts' taxonomy (2018), in order to discern if such concepts exist as part of or separate to the discussion surrounding connectivity conservation.

Future research is also needed to delineate the impact of map-based design as included in the present study. For example, research is needed examining the impact of including current conservation focal areas on maps, in particular to how this affects the areas mapped by participants, compared to a more simplified map with little or no such layers. Such methodological-focused research could contribute to the broader literature surrounding approaches to participatory mapping. Future research is needed to expand upon the spatial delineation of focal areas for social forms of connectivity, as the results of this study are preliminary and based on a relatively small sample size (n=9 for the map-based question covered in Chapter 3).

A larger study could expand upon the potential of social forms of connectivity within conservation planning by delineating focal areas in a different locale, such as a national scale through a Canada-wide study. Future research could also expand upon the results of the present study by including a larger sample size relevant to the Kespukwitk region, focusing on a diverse array of perspectives as previously mentioned. Recognizing multiple ways of knowing, especially Indigenous knowledge systems is vital to

supporting the transformative change needed to conserve biodiversity in Canada (Buxton et al., 2021). Therefore, it is critical that such future research is inclusive of both Western and Indigenous conceptions and applications, through a balanced approach that builds addresses a key gap in Hodgetts' taxonomy relating to the lack of recognition of Indigenous worldviews and perspectives, and the synergies between such worldviews and key forms of connectivity. Future research that incorporates such key ways of knowing alongside already dominant Western ways of knowing can contribute to the realization of a balanced representation of the ecological and social forms of connectivity.

4.2 Conclusion

In sum, I found that connectivity is conceptualized and discussed in diverse ways by conservation experts and local knowledge holders. Interesting patterns emerged across both conceptual discussions and spatial delineations in terms of Hodgetts' taxonomy of connectivity (2018). It is apparent that a "plurality" of forms of connectivity are considered important, with diverse and nuanced local examples being expressed. In conceptual realms, most participants discussed all types of connectivity at some point, to varying extents. In spatial delineations, there was less variation overall, but most (six participants) discussed more than one type. Thus, the theoretical-conceptual articulations of connectivity depicted in Hodgetts' taxonomy did translate into spatial application, countering Hodgetts' proposition that primarily ecological forms of connectivity are considered in practice (2018). However, there was considerably less diversity overall in the spatial application, especially when it came to social forms of connectivity, which somewhat supports Hodgetts' assertation that social forms of connectivity primarily exist within conceptual and theoretical realms compared to practice.

Looking at and distinguishing between "plural" types was found to be useful in contributing to an understanding of connectivity as an all-encompassing term, yet in most cases it fell short of " a multiple" or more-than-human understanding, as "more than one – but less than many" (Mol, 2002, p.55, as cited in Hodgetts, 2018, p.83). I found that emphasizing the inter-connectedness between ecological, social, and cultural realms may be indicative of and helpful for transitioning to a view of connectivity as "a multiple".

Identifying and differentiating diverse "plural" types was found to be key to being able to capture and illustrate such multiplicity, such as by delineating distinct types both conceptually and spatially. Through mixed analytical methods of thematic and spatial overlap, I was able to illuminate the relationships between types of connectivity. This enabled the identification of clusters of 'ecological' and of 'social' connectivity, and of areas where both ecological and social connectivity overlapped. From this, it became clear that the human-nature dichotomy, in some form, is limiting the cross-connection between ecological and social forms of connectivity, thus inhibiting conceptions of a connectivity as "a multiple". To call attention to social forms throughout, I discussed as social types of connectivity as separate from ecological forms of connectivity. In doing so, and in exploring ecological and social forms of connectivity, I have indicated that these realms are most often conceptualized and applied as separate. However, I reiterate what some participants described to me: ecological, cultural, and social cannot be separated; they cannot exist without the other.

Humans, as part of more-than-human entities, are inter-related and inter-dependent components of ecosystems, and thus, part of the same indivisible whole. I propose that the concept of connectivity can encompass such key inter-connections and indivisibility, and based on the findings of the present, already does for some participants. Without substantially shifting Western worldviews, however, the dominant tendency to compartmentalize and to privilege human-centered components may continue. Continued efforts to overcome the diversity of meanings and inherent tensions and conflicts may prove fruitless without directly disrupting dominant Western systems. Insights and guidance may most effectively be found by looking to those with other ways of being and knowing. I assert the need for Western systems, including approaches to connectivity conservation, to take a step back, such that Indigenous worldviews, such as the Mi'kmaq concept of *M'sɨt No'kmaq* (all my relations; *M'sɨt No'kmaq* et al., 2021), may have an opportunity to lead towards a more holistic approach to 'connectivity'. I end with an emphasis of the need to reflect on the meaning of the terms discussed within the present study, rather than terminology itself; based on reflections during this research process

that terminology can re-enforce dominant Western worldviews, and thus limit engagement with other, less dominant but indispensable and all-important worldviews.

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APPENDIX A: INTERVIEW GUIDE

#	Question	Purpose
	Connectivity [conceptual questions] The first series of questions are about connectivity broadly, and within Southwest Nova Scotia.	
1	**How would you describe your experience and position relevant to/within the conservation community in Nova Scotia?**	Introductory question – starting broad; opening space
2	**Before I had contacted you, had you heard of the term 'connectivity'?**	Participants previous experience with connectivity
3	**How would you describe it? [connectivity]** **What does it [connectivity] mean to you?**	Defining term connectivity from participants experience; is connectivity defined on basis of connecting already existing conservation areas?
4	**How would you describe the term corridor?** **Prompt/follow-up: Is there a difference between connectivity and corridor?**	Defining term corridor from participants experience; difference between connectivity and corridor (conceptual)
5	**How would you describe the state of natural area in Southwest Nova Scotia?** **Prompt/follow-up: Is fragmentation an issue within conservation efforts?** **Is connectivity an issue within conservation efforts?**	Degree of naturalness Level of fragmentation. Is connectivity a conservation priority in SWNS?

7	**How do you view private land within conservation initiatives?** **Prompt: What role does private land play in connectivity conservation?**	Private land as part of nature? Private land vs. crown/public. Land tenure (challenge)
8	**How do you view Crown or public land within conservation initiatives?** **What is (or should be) its main purpose?** **Prompt: What role does Crown or public land play in connectivity conservation?**	Crown-public land, feasibility for conservation.
9	**Should the focus of connectivity initiatives be on areas that are highly fragmented or on areas that are in a more natural state? How so/why?**	Pro-active vs. reactive conservation approach
10	**How would you describe social connectivity [alongside ecological connectivity] within connectivity conservation?** **Prompt:** ***For example, social connectivity has been described to represent collaboration across different scales, mandates to include local people, and to possibly address the separation between people and nature.***	Social connectivity; the disconnect between people and nature (definition from Wyborn, 2011).
11	**What social dimensions do you think are important to connectivity initiatives?**	Social dimensions of connectivity; social focus & social process
Potential Focal Area [on-the-ground questions] As part of my thesis research, I am looking at focal areas for connectivity within Southwest Nova Scotia. The next set of questions explores topics relating to key focal areas for connectivity. [[Bring up map(s) of focal area(s) on share screen if Microsoft teams is the platform][For telephone interviews, send map(s) of focal area(s) to participants ahead of time and say]. Please refer to the map(s) if needed when answering these questions.		

	Ecological Dimensions	
12	**Based on your knowledge, are there any current initiatives in priority connectivity areas in SWNS?** ***Why/why not?***	Broad Q: experience with connectivity in SWNS
13	**Is there an area you would recommend as a key focal area for connectivity within Southwest Nova Scotia?** ***Why/why not?*** **[If no focal area suggested, do not read the bracket part of questions starting now]** ***Show map of focal areas for connectivity: pinch points, concentrated flow, diffuse flow, functional connectivity between protected areas***	Prioritizing connectivity in SWNS
14	**How do you think connectivity should be prioritized within SWNS?** ***For example, is connecting existing protected areas a priority? Should the focus be on pinch points for movement (more fragmented) or areas of diffuse flow (natural state)?***	Multiple approaches for prioritizing connectivity
Social-Institutional Dimensions		
15	**What features of the landscape within SWNS [or the focal area suggested] do you think are valued for socio-economic reasons, for example, cultural, recreational, economic values?**	Local-social values placed on landscape; how this influences connectivity initiatives; opportunity and/or challenge
	Do you think these values could provide a potential opportunity for connectivity conservation initiatives [in the discussed focal area]? How so/why not?** ***For example, aesthetic values as motivation for conservation	
	Do you think these values could serve as a challenge for connectivity conservation initiatives [in this area]? How so/why not?** ***For example, economic values as a potential barrier	

16	**Are there any key community or other local groups that would be associated these landscape values? (e.g. cultural, recreational, economic, aesthetic, etc.)** **Who/what are these various groups?** ***Do you think communication between such groups is occurring already? How so/why not?*** ***Could facilitating communication between such groups be a potential opportunity (e.g. collaboration) and/or a challenge (e.g. conflict) for connectivity initiatives [within this focal area]?***	Key groups/users of landscape; collaboration & communication between key groups
17	**How can alternative approaches to conservation facilitate connectivity initiatives?** **How can values be part of/included in alternative approaches? [how can social connectivity be included in approaches to protecting/conserving ecological connectivity?]** ***For example, community conservation approaches, private land stewardship/ incentives.***	Practical-feasible; implementation; potential of other approaches to conservation
18	**From what we discussed today, what social features do you think are important to consider when working towards connectivity within Nova Scotia (SWNS)?** **What ecological features do you think are important to consider?**	Wind down question
19	**Is there anything else you would like to add, that we have not talked about or that I haven't asked, but you think is relevant or important?**	Wrap up question

APPENDIX B: SOCIAL CONNNECTVITY PROMPT

Participant	Definition not provided	Definition provided
FSP1	"social connectivity as in how people are socially connected to the landscape you mean or?"	"So, I do think though, humans and nature, that part of the connectivity is getting stronger and stronger every day, and primarily because especially on crown land over the last 10 years, gates have come off, as land was turned over from private interest to public interest, gates have come down, which sort of allowed a lot of people to connect to the landscape in a way they never have before"
GOP1	"we sort have been talking about cultural connectivity in and around Keji, particularly in the last couple of years"	"Yeah well I think that's relevant, and I think that although it may not be within that kind of knowing quite sure, I think that's a really important theme, I guess of the Conservation Collaborative"
GOP2	"it's not a term that I was familiar with ... I had to think about it, and maybe it has some sort of academic definition but if I had to take a guess at what it means I would say, and maybe you can educate me a little bit but maybe it has to do with what we were talking about before and people having a connection to the land and to connectivity and species issues and so I don't know if it's, if that's kind of getting at it or because I think in order to have successful conservation initiatives, especially when you're looking at connectivity in a place like Nova Scotia that relies so much on public support and private land owners, you have to have a basic understanding and appreciation as a citizen for what	"yeah but it seems really key right, I think you got to have buy in not just from government people that are, are talking about these concepts, but yeah everybody's got to be on board, and one thing I mean maybe we are going to get into this but one thing, I think it's something that it, once you talk about it and it becomes more mainstream it's a really easy concept to grasp, especially when you use maps and look at actual corridors"

	it all means and you have to a connection to the whole idea to want to make it happen"	
GOP3	"I'm definitely not as knowledgeable about social considerations, you know and what constitutes social connectivity, certainly within the Kespukwitk Southwest Nova Scotia priority place, compared to you know previous initiatives, there's been greater emphasis on recognizing human well-being values and ecosystem services that are associated with natural areas, I'm thinking that this would fall into the realm of social connectivity"	" yeah, the idea of the disconnect from nature has come up in a couple of our workshops ... it's been interesting to think about that from a government policy perspective because you know this is coming out, we're responsible for the conservation of species at risk, and connecting the public with nature, it's a very round-about way to get to action on the ground for species at risk, but you know it is important to approach these things at different scales, and so there are initiatives within the federal government that are focused on re-connecting the public with nature, it's important to have that, as you might have more on the ground action for species and ecosystems …"
GOP4	"so I have a lot less experience in social connectivity but you know in terms of academic, I think we're really trying with the Kespukwitk Conservation Collaborative to include and increase that social connectivity within conservation groups … we're kind of, I've been struggling a little bit with getting some of the non-conservation groups, themes, you know people involved, because that is, it's a big issue, where we kind of look at it from the conservation point of view and then we you know, talk to industry or we talk to local people, landowners, and then try to make the two fit together but there's quite a bit of a disconnect I think between the local people and industry in terms of the importance of protected areas"	No definition requested
NGOP1	No response prior to definition	"we do that, we do all of that work, so we are constantly reaching out to local groups, local businesses, Indigenous communities, building that social cohesion to be able to implement conservation, we don't typically refer to it as social connectivity"
NGOP2	No response prior to definition	"I think particularly initiatives tied to citizen science are really important, because there is that disconnect between humans and the land, not as much in the Southwest, I think people are generally more involved with things that are going on in the woods in the Southwest because most people are so, the populations so dispersed, there's not the big urban center where Halifax, yes people are definitely disconnected from the ecological world"

NGOP3	No response prior to definition	"... I was actually just talking about this earlier, I feel like you kind of need people to extremes, you need those extremes because sometimes people really need to jump up and down and make noise to actually get things done and to get laws changed and to get governments to pay attention but ultimately I think long term success happens when people really start to sit and listen to each other and share thoughts and ideas and really understand where, why people are doing things in a certain way, so I feel ultimately in the long-term having, being able to kind of work alongside each other and collaborate and understand"
NGOP4	"so it's that societal connection and those discussions are something that, I'm optimistic that the way that they're happening more and more ... so it's, it's to a large extent, a lot of the issues that we face in conservation are based in societal values, the impact is an ecological consideration but it's because of a societal or anthropogenic value that's causing that impact right, so it's arguably the most important element of the discussion of how do we ensure that people understand the full scope of these problems"	No definition requested
NGOP5	"I think it's very similar to the same idea of ecological connectivity, it's just the ways in which society and culture are connected across different landscapes"	No definition requested
NGOP6	"when you say social connectivity does that mean like how maybe people move through the landscape as opposed to non-human wildlife?"	"it's not a term that I've used, so I'm kind of just thinking off the cuff about what it conjures, because I'd either think about like how people are moving within a landscape or how information is diffusing between people across a landscape"
NGOP7	"… well I guess when I read that question, I had put basically how people, communities, are connected and depend on nature for their well-being, I guess, is how I would describe social connectivity within connectivity conservation, is yeah, how people basically, communities are connected and depend on nature and it provides for their own well-being, and the well-being of society"	No definition requested
MKM1	No response prior to definition	"so what is social connectivity, well I think overall, just talking in our whole society, we don't have that, we don't have social connectivity, we don't, we've lost it somehow, I mean some people have it, but it seems so few and far between, and this, this idea that we, we're somehow separate from nature, is pervasive, and the further that we, I mean even this, what we're doing now, this you know on our

		computers, our virtual connection, our phones, our things, but realizing that we're all, we are all, we came from that land, we are all going back to the land"	
NAP1	No response prior to definition	" yeah, that would be important although there is a lot of things that government can do, you know on its own with you know appropriate levels of public engagement, and public consultation"	
NAP3	No response prior to definition	"Yes, I can see how people would start to adopt that. Yeah, we talk about those things; we just talk about them differently. So, I use the word relationship, so what is the relationships between people and people, what is our relationship to the land and to water, how can we, so we do use the word reconnect, so I can see how that's very, very similar to just using social, that's a good question, I don't doubt uh, yeah anyway. So, human, human connectivity, so human to human and human to land and uh the way that they, and what kind of relationship they have and way of communicating and relating	
NQP1	Response provided without definition of social connectivity *Note that NQP1 is not included here because the individual requested no quotes.*		No definition requested
Total	10 had a response without a definition, but 5 of these participants also requested a definition	11 had a response with a definition provided, however 5 of these had already requested a definition, while 6 only provided a response after being given a definition	
5 participants responded before asking for a definition, and then also provided a further response after being given the definition			

APPENDIX C: CODING HIERARCHY

Name	Description	Files	Refer-ences
Finding 1 – Conceptualization of connectivity		16	537
Conceptualizing connectivity	Defining terms – conceptual ambiguity of connectivity	16	537
Connectivity multiple – Hodgetts' taxonomy of connectivity	maps existing plural definitions; connections between these understandings of connectivity as a multiple identifying the ways that "plural" ideas about connectivity are invoked in situations – analysis of where and how they are enacted together.	16	537
Ecological-functional connectivity	Species (mobilities); Functional connectivity focuses on the movement and flow of organisms and processes through a landscape (Calabrese & Fagan, 2004; Kindlemann and Burel, 2008; Rudnick et al., 2012; Taylor et al., 2010).	16	76
Aquatic connectivity	Another form of ecological connectivity (other than terrestrial). Focus on the impact of dams	4	12
Ecological-functional connectivity general		16	60
Focal species - connectivity		1	1
Blandings Turtle		2	3
Flying squirrels		1	2
Mainland moose		7	14
Spatial-structural connectivity	Habitats: Structural connectivity involves the physical layout of landscape features and is influenced by the number and length of gaps, presence of a network or multiple pathways, and presence of nodes or patches of habitat	14	91

	associated with the link (Bennett, 1999; Hilty et al., 2020; Taylor et al., 2010).		
Aquatic connectivity	Another form of connectivity (other than terrestrial). Focus on the impact of dams	4	12
Spatial-structural general		14	76
Emotional-affective connectivity	Personal emotional connection – "people and nature" or "people as nature"; Emotional connection with species and ecologies (e.g., charismatic species). Spatial connection can ignite emotional connection (getting people out in nature). (Emerges from concern that people have become dis-connected from nature. Connection may foster support for conservation work.) (Derived from conservation biology and cultural geography.)	14	106
Cultural connectivity (2)	Historical travel routes; archeological sites; culturally important species; the continuation of culture; connection between culture and the land	10	45
Cultural connectivity general		10	44
Emotional-affective connectivity general	human-nature connection	12	44
Social connectivity (well-being)	Dependency of humans on functioning ecosystems, for health and well-being, clean air and water, as well as beyond benefits, time spent on land, recreation.	5	13
Social (economic) connectivity	Ecological, political and economic processes; Connections between nature and society understood through systems logic. Includes policies and economics and their implications for connectivity work, such as land purchases and land use regulations. (Derived from social-ecological systems.)	16	132
Human connectivity	Connectivity between groups – broken between certain groups; human to human connectivity and relationships; human movement across the landsca9pe through trail networks, portage routes; transportation corridors.	11	45

Human connectivity between groups	Connectivity between people – broken between certain groups (forestry and conservation organizations)	7	21
Human movement	Historically and current access and movement across landscape; trail networks, portage routes; transportation corridors.	6	16
Human to human connectivity-relationship	Human to human connectivity and relationships	3	8
Social (economic) general		15	72
Livelihoods	the livelihoods that the landscape supports (Parrot et al., 2019) sub-themes: rural livelihoods, resource-based	9	20
Social connectivity (well-being)	Dependency of humans on functioning ecosystems, for health and well-being, clean air and water, as well as beyond benefits, time spent on land, recreation.	5	13
Social (equity) connectivity	Ecologies, power and equity	10	56
Cultural connectivity	Historical travel routes; archeological sites; culturally important species; the continuation of culture; connection between culture and the land	10	45
Cultural connectivity general		10	44
Social (equity) general	Ecologies, power and equity; Re-connection and equity discourse in policy/practice. Addresses critiques focused on inequalities associated with conservation including exclusion of local people from access to nature and resources. (Derived from political ecology.)	6	10
Social (more-than-human) connectivity	All actors with agency, not limited to humans; Illuminates "the types, forms and intensities of diverse and heterogeneous connections that exist within and between humans and all manner of non-humans" (Hodgetts, 2018, 87). Critiques the idea of singular "nature" and focuses on living with multiplicity. (Derived from more-than-human geography.)	12	77
Cultural connectivity	Historical travel routes; archeological sites; culturally important species; the continuation of culture; connection between culture and the land	10	45

Cultural connectivity general		10	44
Interconnectedness - cannot be separated	The idea that cultural, social, and ecological dimensions cannot be separated from one another	7	13
Social (more-than-human) general		5	19
natural law		1	5

APPENDIX D: OVERLAP BETWEEN CONNECTIVITY TYPES WITHIN NUANCED EXAMPLES

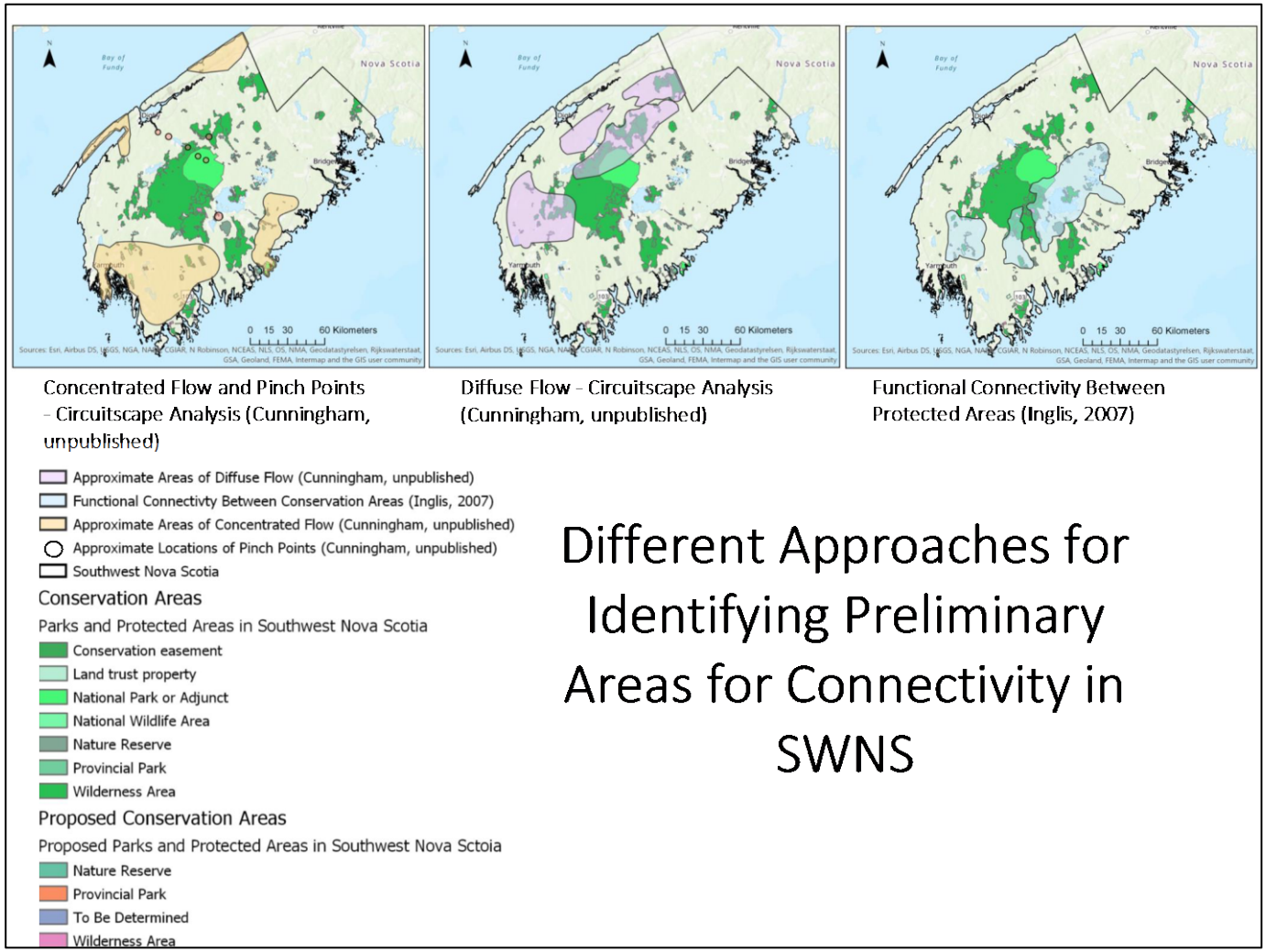
Thematic overlap was used to support the sorting and assignment of examples to the Hodgetts' core six types of connectivity. This was done by looking at instances where coding for one type of connectivity directly overlaps coding for another type. The amount of overlap between and across the multiple forms of connectivity discussed by participants reveals that there are distinct forms of nuanced examples, discussed above, related to the six types proposed by Hodgetts (2018). The total instances of overlap between Hodgetts' six core types of connectivity and five examples that emerged during this study can be seen in *Table 2*. This information was used to provide rationale for the assigning these examples to one of the six types, and also illustrates that several examples relate to more than one type. This highlights that there is overlap and thus subjectivity in 'artificially' assigning complex examples to one (or more) type(s) of connectivity. It supports the interconnectedness of examples and of types, especially social (economic), based on systems thinking, and social (more-than-human), premised on indivisibility. Thus, looking at overlap supports the plural nature of connectivity, and sometimes its conception as "a multiple."

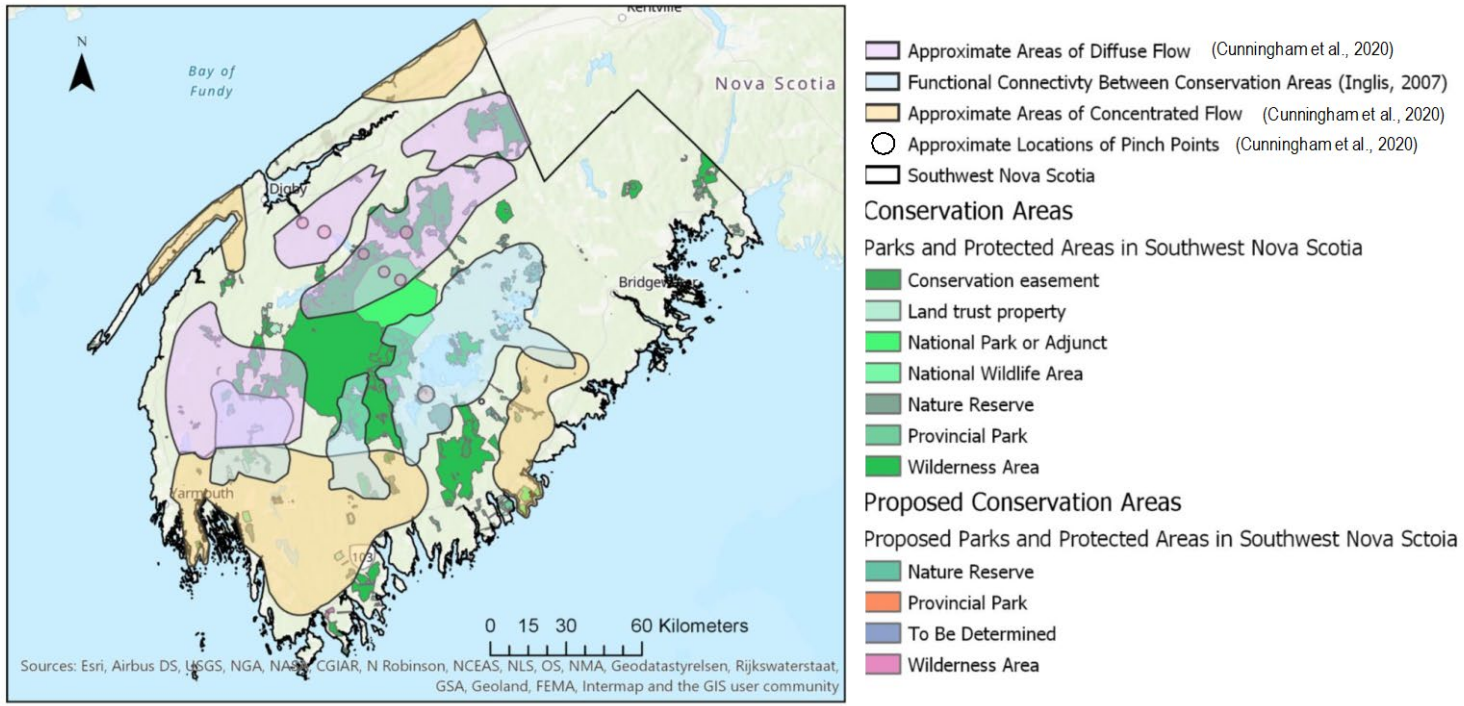
TABLE 2. OVERLAP BETWEEN CONNECTIVITY TYPES WITHIN EXAMPLES

Types & Examples	Ecological - Functional	Spatial-Structur-al	Emotional -Affective	Social (Economic)	Social (Equity)	Social (More-Than-Human)
Cultural	1	2	8*	0	3*	6*
Human	0	0	1	2*	0	0
Social (Well-Being)	0	0	2*	5*	0	0
Aquatic	2*	2*	0	0	0	0
Intercon-nectedness	1	1	1	0	0	8*

*key areas of coding overlap indicating a close relationship

APPENDIX E: BASE MAPS SHARED IN INTERVIEW



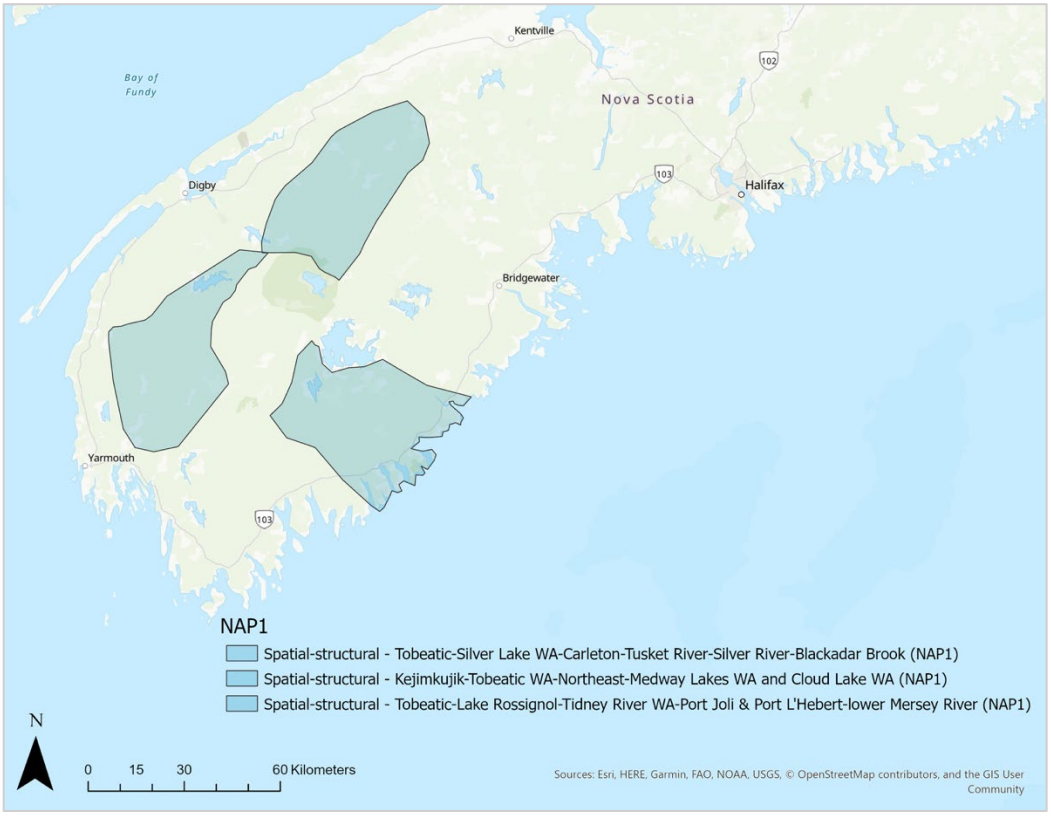


Different Approaches for Identifying Preliminary Areas for Connectivity in SWNS

APPENDIX F: MAPS WITH SINGLE CONNECTIVITY TYPES

Mapped polygons for participants NA1, NA2, and GO4, who did not delineate polygons based on overlapping types of connectivity.

A.



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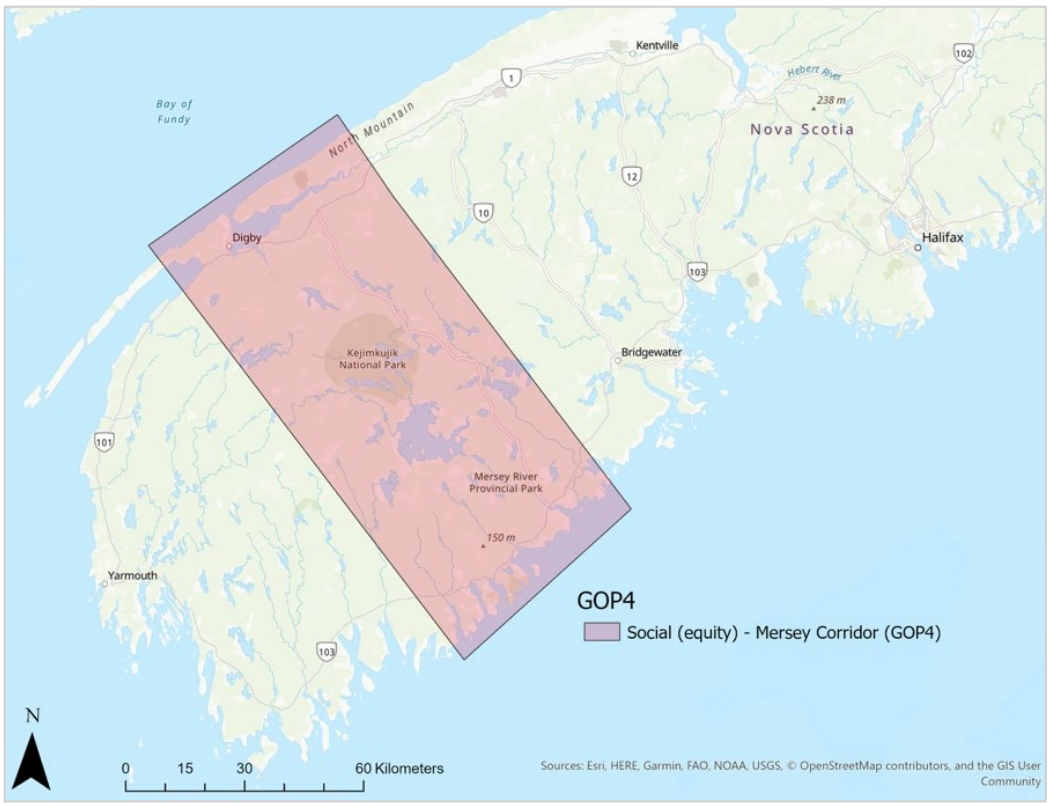
Kentville
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Nova Scotia
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Bridgewater
Mersey River Provincial Park
150 m
Yarmouth
GOP4
Social (equity) - Mersey Corridor (GOP4)
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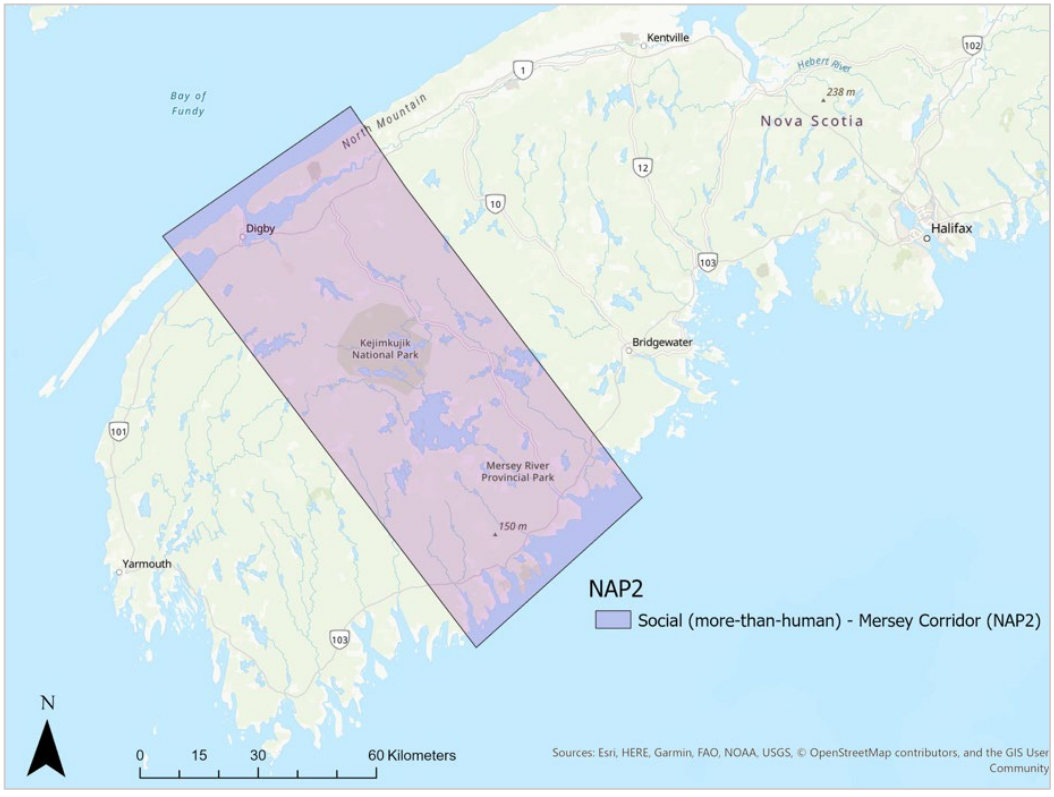
0 15 30 60 Kilometers
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

C.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Mersey River Provincial Park
150 m
Yarmouth
NAP2
Social (more-than-human) - Mersey Corridor (NAP2)
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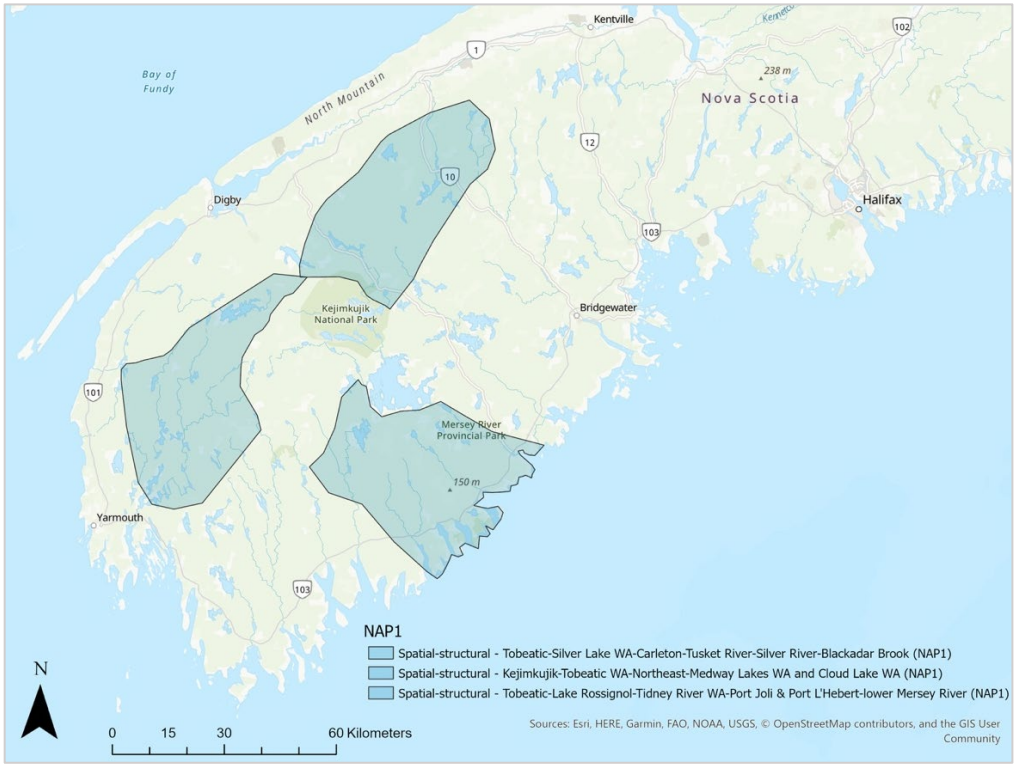
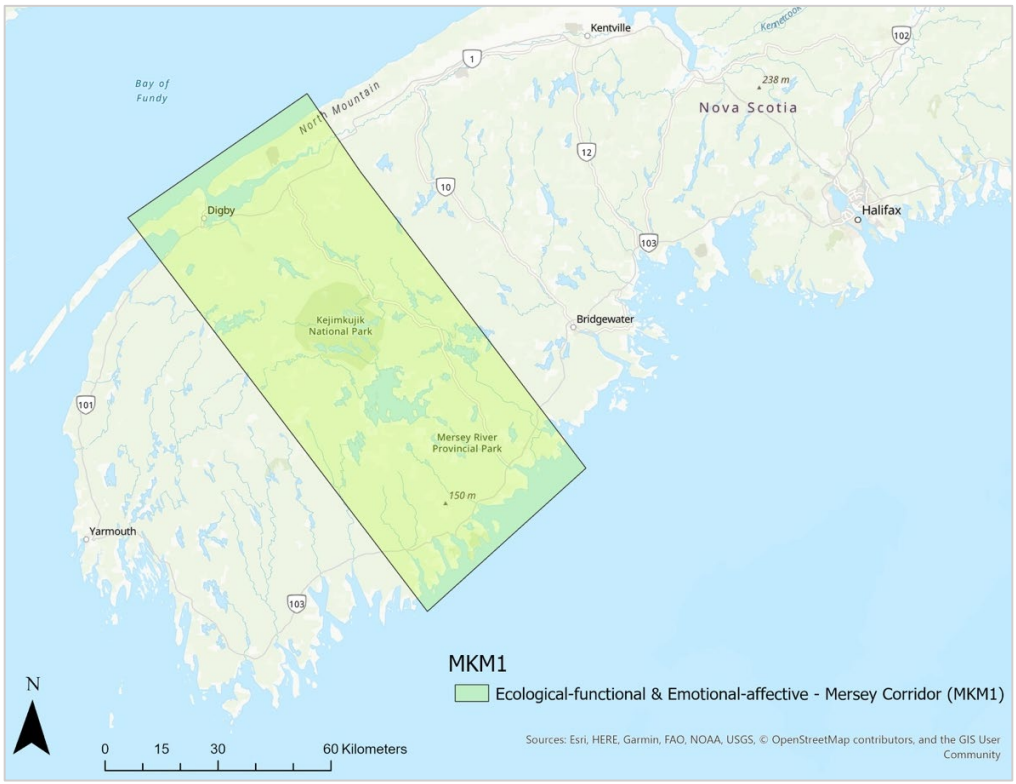
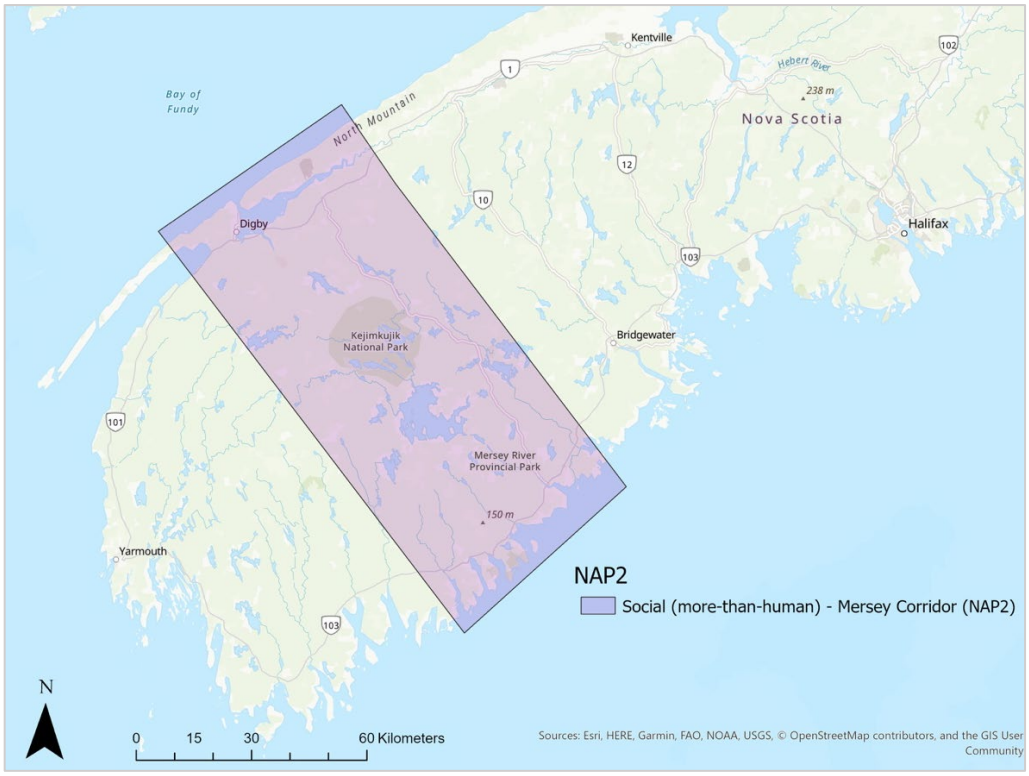
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

APPENDIX G: MAPS BY PARTICIPANT



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Yarmouth
NAP2
Social (more-than-human) - Mersey Corridor (NAP2)
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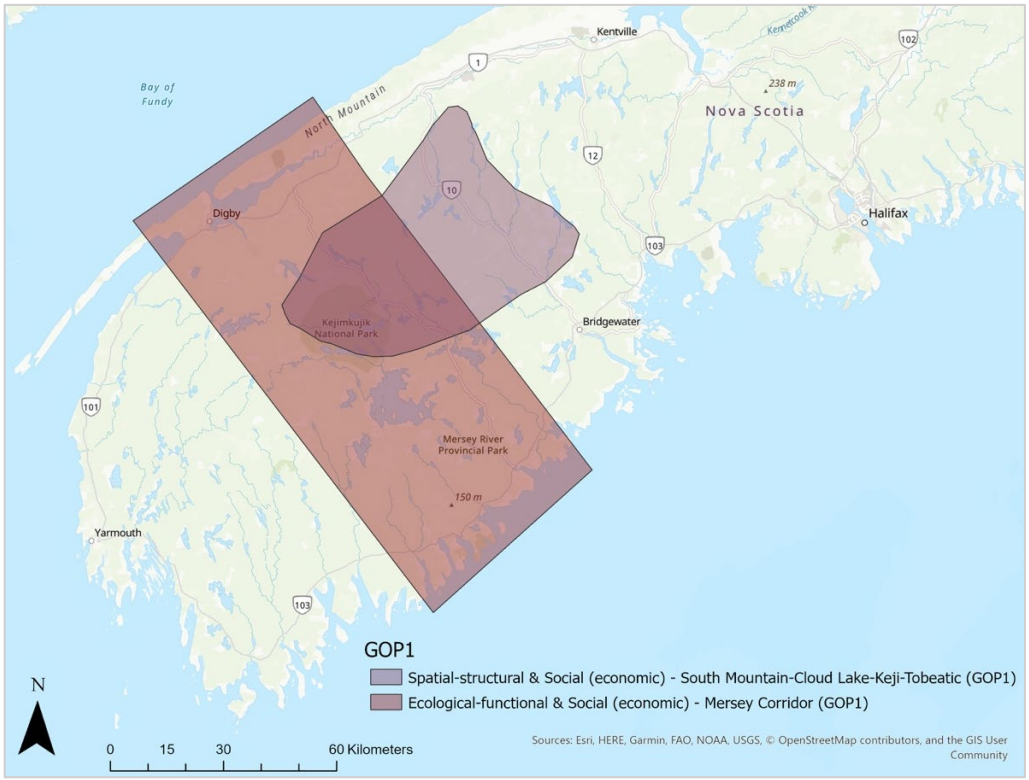
0 15 30 60 Kilometers
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community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Halifax
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Kejimkujik National Park
Mersey River Provincial Park
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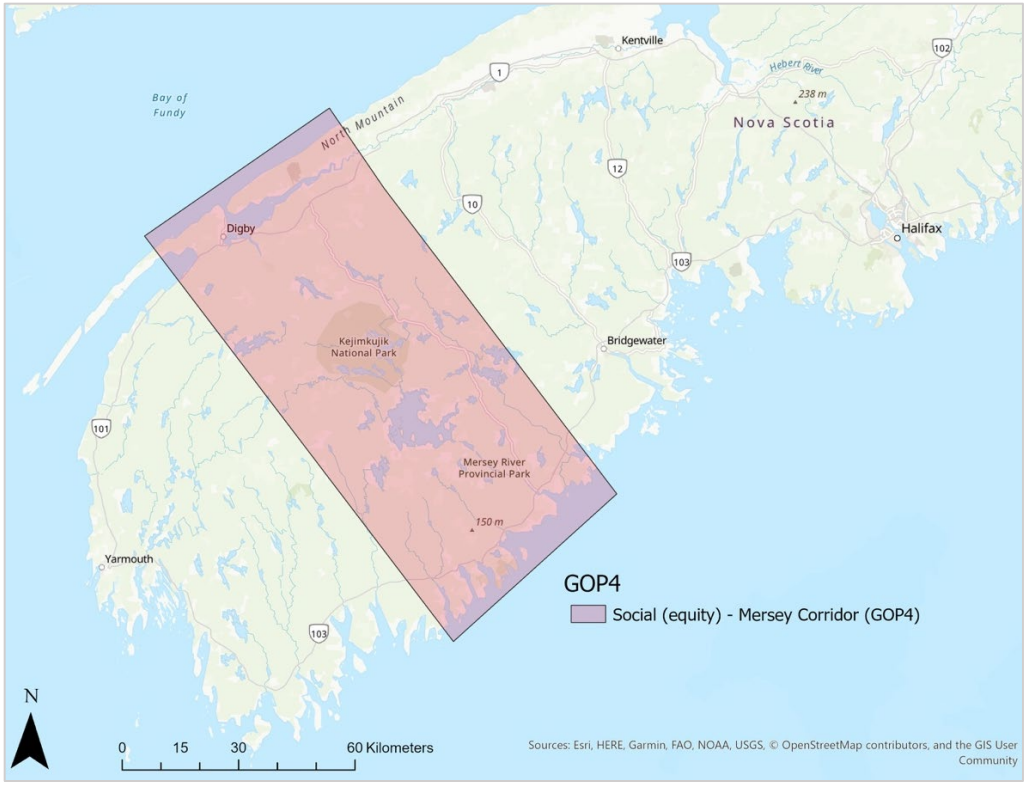
GOP1
Spatial-structural & Social (economic) - South Mountain-Cloud Lake-Keji-Tobeatic (GOP1)
Ecological-functional & Social (economic) - Mersey Corridor (GOP1)
N
0 15 30 60 Kilometers
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community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150 m
Yarmouth
GOP4
Social (equity) - Mersey Corridor (GOP4)
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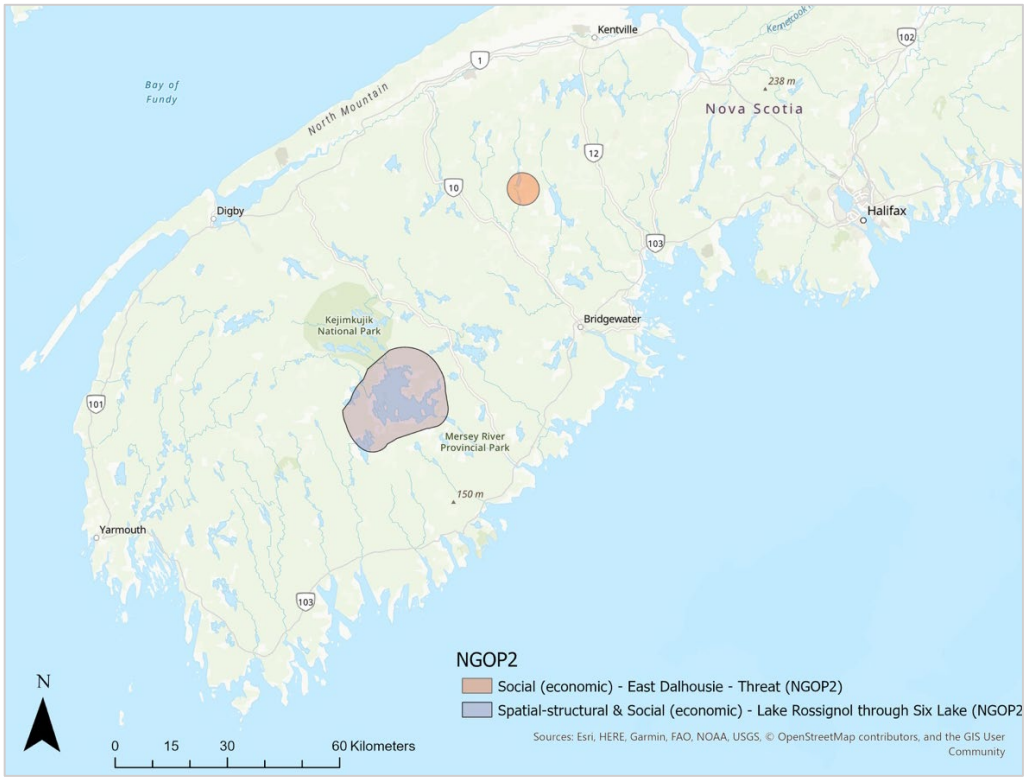
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community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Kejimkujik National Park
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NGOP2
Social (economic) - East Dalhousie - Threat (NGOP2)
Spatial-structural & Social (economic) - Lake Rossignol through Six Lake (NGOP2
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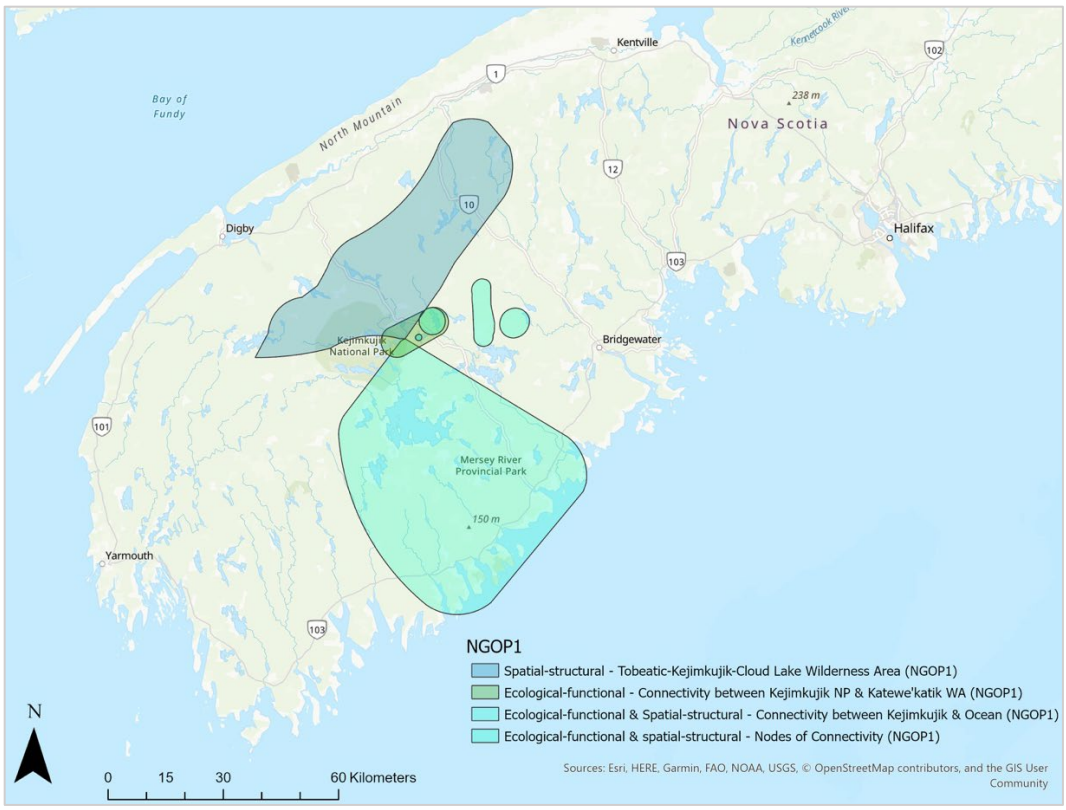
0 15 30 60 Kilometers
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community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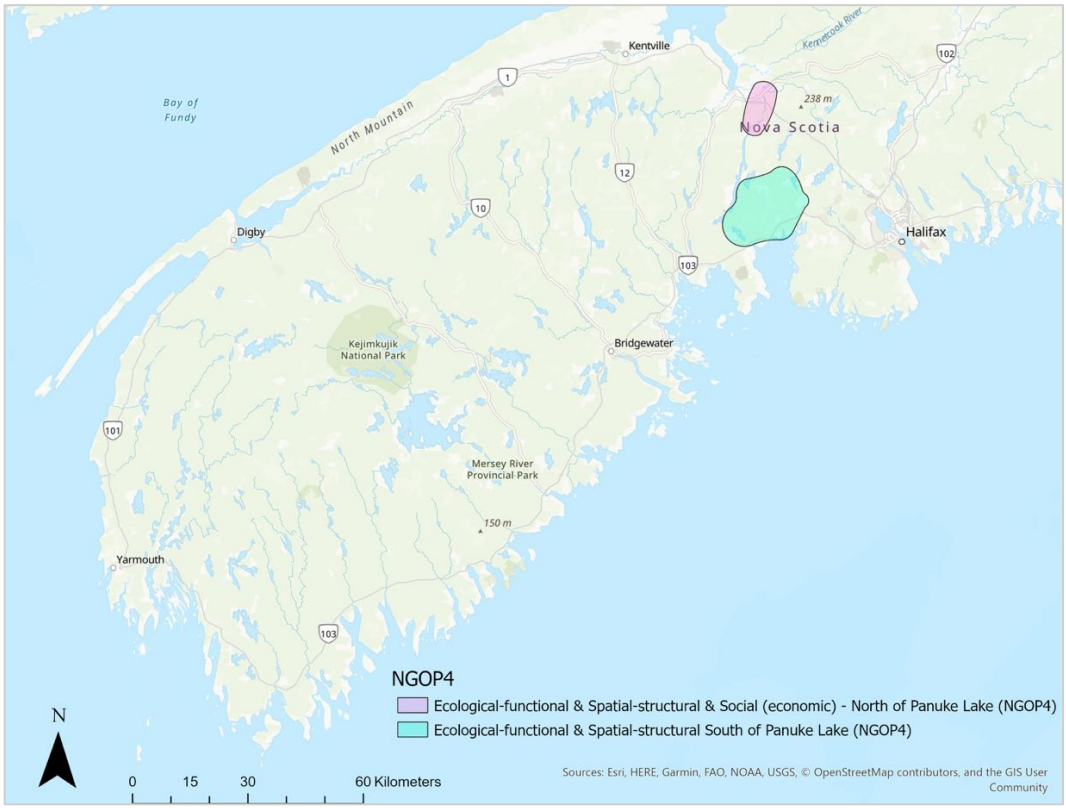
Kejimkujik National Park
Bridgewater
101
Mersey River Provincial Park
150 m
Yarmouth
103
NGOP1
Spatial-structural - Tobeatic-Kejimkujik-Cloud Lake Wilderness Area (NGOP1)
Ecological-functional - Connectivity between Kejimkujik NP & Katewe'katik WA (NGOP1)
Ecological-functional & Spatial-structural - Connectivity between Kejimkujik & Ocean (NGOP1)
Ecological-functional & spatial-structural - Nodes of Connectivity (NGOP1)
N
0 15 30 60 Kilometers
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community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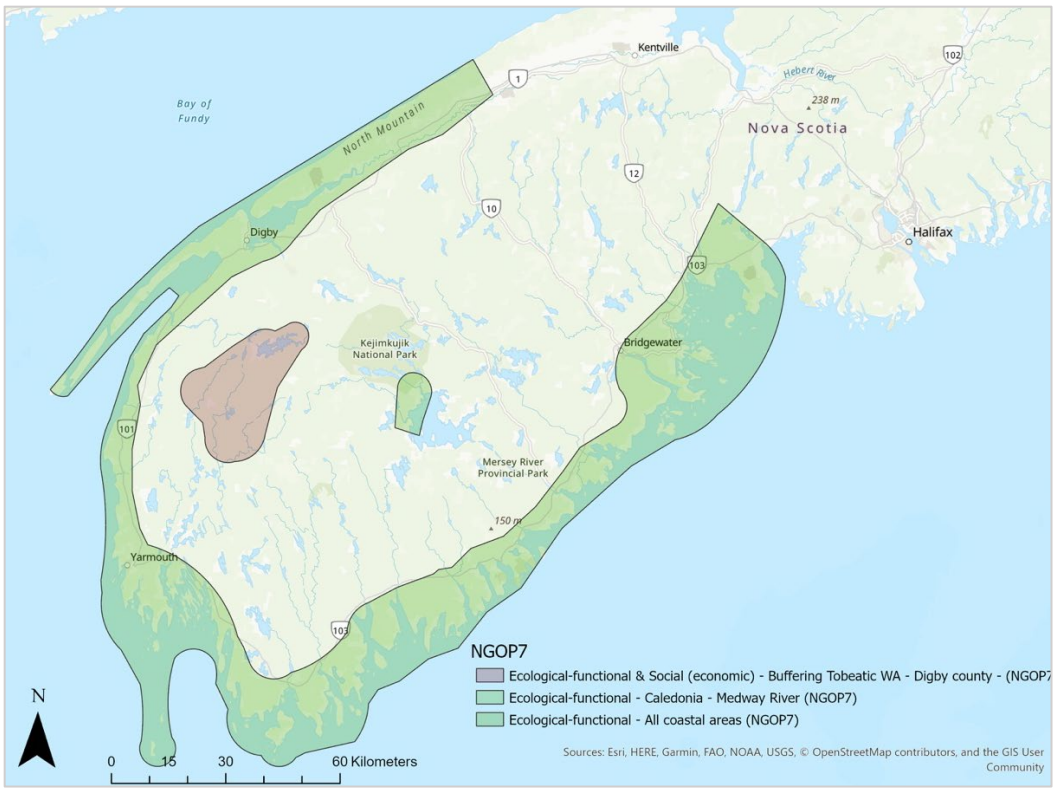
10
Digby
Halifax
103
Kejimkujik National Park
Bridgewater
101
Mersey River Provincial Park
150 m
Yarmouth
103
NGOP4
Ecological-functional & Spatial-structural & Social (economic) - North of Panuke Lake (NGOP4)
Ecological-functional & Spatial-structural South of Panuke Lake (NGOP4)
N
0 15 30 60 Kilometers
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community


Kentville
Hebert River
102
Bay of Fundy
North Mountain
1
238 m
Nova Scotia
12
10
Digby
Halifax
103
Kejimkujik National Park
Bridgewater
101
Mersey River Provincial Park
150 m
Yarmouth
103
NGOP7
Ecological-functional & Social (economic) - Buffering Tobeatic WA - Digby county - (NGOP7
Ecological-functional - Caledonia - Medway River (NGOP7)
Ecological-functional - All coastal areas (NGOP7)
N
0
15
30
60 Kilometers
Sources: Esri, HERE, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community

APPENDIX H: SUPPORTING MATERIAL FOR THEMATIC OVERLAP

	Ecological functional	Spatial-structural	Emotional-affective	Social (economic)
Ecological-functional				
Spatial-structural	4			
Emotional-affective	1	0		
Social (economic)	3	1	0	

**Social (equity) and social (more-than-human had no instances of thematic overlap*