

Influence of identity on human well-being benefits of blue space

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Molly J. Wick

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## *Abstract*

Blue spaces, or the publicly accessible environments around and within oceans, estuaries, rivers, streams, and other waterbodies, provide benefits to human well-being. Cultural ecosystem services (CES) are a leading framework for understanding and assessing these benefits. CES are defined as services produced through the interaction of humans and nature that give rise to intangible benefits to human well-being. Sociodemographics and other forms of social and personal identity influence CES benefits, which are inequitably distributed to diverse populations. Environmental decision-making about blue space has the potential to help reduce or possibly exacerbate these inequities. Assessment of CES may help inform equitable environmental decision-making, but this application of CES assessment is challenged by a limited understanding of the complex ways that benefits of and barriers to CES are influenced by personal and social identity in diverse and multi-cultural communities. This dissertation addresses this gap by exploring the question of how benefits of and barriers to CES associated with blue space are associated with individual identity, defined as an individual's personal characteristics and social group affiliations. We adopted a community-engaged, mixed methods approach in a case study of blue space CES in a Great Lakes coastal multi-cultural community. The study area included the communities of Duluth, Minnesota and Superior Wisconsin, and the entire reservation of an Ojibwe Tribal Nation. The study area is located within ceded territory in which the Ojibwe retain treaty rights to traditional lifeways. A community advisory group and an Indigenous advisory group helped develop, deploy, and analyze results of this study. We conducted a qualitative and quantitative survey of 532 study area residents, followed by thematic analysis of qualitative interviews with a subset of participants to assess multiple dimensions of CES.

In this dissertation, we first address the process of navigating university openness in research policy and Indigenous data sovereignty (Chapter 1). We found that existing university open research policies do not account for the unique case of university research partnership with a sovereign tribal nation and need to be revised to fully support and facilitate research partnerships among universities and Indigenous communities. Survey (Chapter 2) and interview (Chapter 3) results demonstrated that social and personal identity fundamentally structure the experiences of blue space CES by individuals. Gender, age, life stage, ethnicity, income level, and health status, among others, influenced participants' experiences of blue space. Highlighting the inherently

relational nature of CES, our results showed that both benefits of and barriers to CES are emergent properties that arise from an individual's perception of themselves relative to blue space. Challenging existing simplistic CES conceptual models, our results reveal the complex ways that identity informs the individuals' perceptions about themselves relative to the environment over the course of life to give rise to, or to prevent, emergent wellbeing benefits associated with blue space. Our results demonstrate the importance of engaging and incorporating the perspectives of historically underrepresented and marginalized communities in blue space research and decision-making processes to advance the equity of CES benefit distribution, especially Indigenous organizations and tribal nations, due to the unique relationships Indigenous communities have with blue space.

**Human Subjects Review** This research was approved by the University of Minnesota Institutional Review Board (protocol number 15205) and the Fond du Lac Band of Lake Superior Chippewa Institutional Review Board (protocol number 102).

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## *Introduction*

Blue spaces, or the publicly accessible environments around and within oceans, estuaries, rivers, streams, and other waterbodies provide benefits to human well-being. These benefits are conferred through mechanisms such as attention restoration, stress reduction, evocation of positive emotions, physical activity, leisure, social engagement, and support (Abraham et al., 2010; Smith et al., 2021; Völker and Kistemann, 2011; Gascon et al., 2017). However, these benefits are not distributed equitably across populations (e.g., Pitt, 2019, Gascon et al., 2017). Consequently, environmental decision-making that does not account for inequities among individuals in, for example, access to blue space, risks exacerbating inequities. On the other hand, decision-making that addresses inequities can contribute to normative goals to reduce societal inequities by helping to equalize the distribution of human well-being benefits of nature among community members.

Cultural ecosystem services (CES), defined as services produced through the interaction of humans and nature that give rise to intangible benefits to human well-being (Chan et al., 2012; Fish et al., 2016), is one framework for assessment of benefits to enhance equitability (Gould et al., 2020, Chan et al., 2016; Jones et al., 2022; Gould et al., 2019). However, utilizing a CES framework to enhance equitability has been limited by a gap in understanding of how CES, and barriers thereto, are affected by the identity of community members in diverse communities. Although social processes are widely acknowledged to influence human well-being benefits, CES studies to date have focused on either understanding the environmental or landscape influences on CES delivery, or a specific type of CES, rather than the social and cultural processes that influence CES delivery (Reyers et al., 2013). Studies that do approach CES from the beneficiary perspective typically focus on a group defined by a single demographic (e.g., a specific ethnicity) rather than variability across multiple demographics (e.g., Mucioki et al., 2021; Gould et al., 2019).

To address this knowledge gap, this dissertation explores the research question, “How are CES benefits and barriers associated with blue space (also referred to here as simply, “water”) associated with individual identity?” We applied a community-engaged, mixed methods approach to investigate how social processes influence CES in a Great Lakes coastal multi-cultural

community case study. The case study was focused on the “Twin Ports” community of Duluth, Minnesota and Superior, Wisconsin, USA, located on Lake Superior and the St. Louis River estuary, which included the reservation for an Ojibwe Tribal Nation and is located within ceded territory in which the Ojibwe retained rights to traditional lifeways. We employed a survey followed by interviews with a subset of participants to assess multiple CES dimensions for diverse CES beneficiaries in this multi-cultural community case study. In Chapter 1, we address the process of navigating university openness in research policy and Indigenous data sovereignty in our community-engaged project. In Chapter 2, we report the findings of a survey of CES benefits and barriers across a range of sociographic identities in the Twin Ports. In Chapter 3, we explore how CES benefits are associated with self-identity using the themes identified in interviews. We conclude with a summary of findings, and a discussion of the significance and application of this research.

## **Background**

Cultural ecosystem services assessment has potential for informing beneficial and equitable environmental decision-making (Gould et al., 2019; Gould et al., 2020). CES were initially conceived in the Millennium Ecosystem Assessment as the intangible benefits from ecosystems that do not fall within the clearly defined categories of provisioning, regulating, and supporting services (MA, 2005). Chan et al. (2012) proposed the definition that CES are “*ecosystems' contributions to the non-material benefits that arise from human–ecosystem relationships.*” This definition reflects the current understanding of CES as being inherently relational, co-produced through the interaction of people with the environment (Chan et al., 2016; Fisher and Eastwood, 2016). However, CES can also give rise to cultural goods, so they are not strictly non-material (Fish et al., 2016).

CES fall within the ecosystem services paradigm, which has been criticized for its failure to acknowledge the full range of interpretations of nature’s value (Díaz et al., 2018) or reciprocal services *to* ecosystems (Comberti et al., 2015). The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services’ (IPBES) alternative concept of “nature’s contributions to people” recognizes the role of culture and relational values, acknowledges Indigenous knowledge, and can account for positive and negative contributions of nature to people (Díaz et

al. 2018; Pascual, et al., 2017; Kadykalo et al., 2019). Currently both “ecosystem services” and “nature’s contributions to people” are used in varying contexts (Pires et al. 2020). For this project, we consider CES as fundamentally relational but use the more prevalent term “cultural ecosystem services.”

Authors have presented several frameworks to help conceptualize CES holistically and account for their challenges. They include traditional economic frameworks (e.g., the stock-and-flow model of Jones et al., 2022 or the cascade model of Blicharska et al., 2017) and relational models (e.g., Fish et al., 2016; Sangha et al., 2018; Mucioki et al., 2021). Winthrop et al. (2014) identified several challenges to applying a stock and flow framework to CES. First, many CES stem from a held personal or communal value associated with a moral belief system. Benefits stemming from ethical beliefs are incommensurate with ideas of supply and demand: they may not depend on a stock of natural capital, nor do they reflect some characteristic demand function. Further, economic valuation methods represent a Western ideology that may not be consistent with all worldviews. For example, ideas of nature as a service provider, and of ideas property and landownership are inconsistent with many Indigenous worldviews (Winthrop et al., 2014). Lastly, neoclassical economics assumes that the human is a self-regarding, rational actor, but studies in behavioral psychology and neurobiology have shown that is not accurate (Parks and Gowdy, 2013). Hybrid or relational models are better equipped to incorporate Indigenous and Eastern value systems and worldviews, and acknowledge the importance of identity and socio-historical context (Gould et al., 2020), but they do not explain or facilitate assessment of how diverse constituents of a community might relate with water differently or experience associated benefits differentially (e.g., Zoeller and Cumming, 2023; Fish et al., 2016; Sangha et al., 2018; Mucioki et al., 2021).

Fundamentally, social processes are integral to CES. CES “potential” or service areas rarely correlate with actual use or benefits (e.g., Crouzat et al., 2022). Because they are relational, CES arise only with their perception and value by people. An individual’s experience, culture, and background are important in how they perceive, experience, and benefit from CES (Fish et al., 2016). Sociodemographic groups, personality characteristics (e.g., ecocentrism), and personal values all influence experiences with nature and CES benefits (Martín-López et al., 2012;

Martinez-Harms et al., 2018; Sagie et al., 2013; Cuni-Sanches et al., 2016; Dou et al., 2020; McGinlay et al., 2018; Jones et al., 2022; Riechers et al., 2019) Large-scale social processes may also influence CES (Felipe-Lucia et al., 2015; Langemeyer and Connolly, 2020). This can include long-term social and land use patterns. For example, in the upper Great Lakes region, cession of treaty lands by the Anishinaabe, colonization, changing land uses, and historical industrial pollution have influenced the availability of traditional CES to the Anishinaabe, as well as influenced Anishinaabe culture itself (Whyte, 2018). Understanding the influence of these kinds of social processes on CES is essential to conceptualize CES holistically and to derive recommendations for equitable decision making.

**Human Subjects Review** This research was approved by the University of Minnesota Institutional Review Board (protocol number 15205) and the Fond du Lac Band of Lake Superior Chippewa Institutional Review Board (protocol number 102).

## References

- Abraham, A., Sommerhalder, K., and Abel, T., 2010. Landscape and well-being: A scoping study on the health-promoting impact of outdoor environments. *International Journal of Public Health*, 55, pp.59-69.
- Blicharska, M., Smithers, R.J., Hedblom, M., Hedenås, H., Mikusiński, G., Pedersen, E., Sandström, P., and Svensson, J., 2017. Shades of grey challenge practical application of the cultural ecosystem services concept. *Ecosystem Services*, 23, pp.55-70.
- Chan, K.M., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., Gould, R., Hannahs, N., Jax, K., Klain, S., and Luck, G.W., 2016. Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences*, 113(6), pp.1462-1465.
- Chan, K.M., Guerry, A.D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., Bostrom, A., Chuenpagdee, R., Gould, R., Halpern, B.S., and Hannahs, N., 2012. Where are cultural and social in ecosystem services? A framework for constructive engagement. *BioScience*, 62(8), pp.744-756.

Comberti, C., Thornton, T.F., de Echeverria, V.W., and Patterson, T., 2015. Ecosystem services or services to ecosystems? Valuing cultivation and reciprocal relationships between humans and ecosystems. *Global Environmental Change*, 34, pp. 247-262.

Crouzat, E., De Frutos, A., Grescho, V., Carver, S., Büermann, A., Carvalho-Santos, C., Kraemer, R., Mayor, S., Pöpperl, F., Rossi, C., and Schröter, M., 2022. Potential supply and actual use of cultural ecosystem services in mountain protected areas and their surroundings. *Ecosystem Services*, 53, p.101395.

Cuni-Sanchez, A., Pfeifer, M., Marchant, R., and Burgess, N.D., 2016. Ethnic and locational differences in ecosystem service values: Insights from the communities in forest islands in the desert. *Ecosystem Services*, 19, pp.42-50.

Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M., Baste, I.A., Brauman, K.A., and Polasky, S., 2018. Assessing nature's contributions to people. *Science*, 359(6373), pp.270-272.

Dou, Y., Yu, X., Bakker, M., De Groot, R., Carsjens, G.J., Duan, H., and Huang, C., 2020. Analysis of the relationship between cross-cultural perceptions of landscapes and cultural ecosystem services in Genheyuan region, Northeast China. *Ecosystem Services*, 43, p.101112.

Felipe-Lucia, M.R., Martín-López, B., Lavorel, S., Berraquero-Díaz, L., Escalera-Reyes, J., and Comín, F.A., 2015. Ecosystem services flows: Why stakeholders' power relationships matter. *PloS One*, 10(7), pp.e0132232.

Fish, R., Church, A., and Winter, M., 2016. Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. *Ecosystem Services*, 21, pp.208-217.

Fischer, A., and Eastwood, A., 2016. Coproduction of ecosystem services as human–nature interactions—An analytical framework. *Land Use Policy*, 52, pp.41-50.

Gascon, M., Zijlema, W., Vert, C., White, M.P., and Nieuwenhuijsen, M.J., 2017. Outdoor blue spaces, human health, and well-being: A systematic review of quantitative studies. *International Journal of Hygiene and Environmental Health*, 220(8), pp.1207-1221.

Gould, R.K., Morse, J.W., and Adams, A.B., 2019. Cultural ecosystem services and decision-making: How researchers describe the applications of their work. *People and Nature*, 1(4), pp.457-475.

Gould, R.K., Bremer, L.L., Pascua, P.A., and Meza-Prado, K., 2020a. Frontiers in cultural ecosystem services: Toward greater equity and justice in ecosystem services research and practice. *BioScience*, 70(12), pp.1093-1107.

Jones, L., Boeri, M., Christie, M., Durance, I., Evans, K.L., Fletcher, D., Harrison, L., Jorgensen, A., Masante, D., McGinlay, J., and Paterson, D.M., 2022. Can we model cultural ecosystem services, and are we measuring the right things? *People and Nature*, 4, pp.166-179.

Kadykalo, A.N., López-Rodríguez, M.D., Ainscough, J., Droste, N., Ryu, H., Ávila-Flores, G., Le Clec'h, S., Muñoz, M.C., Nilsson, L., Rana, S., and Sarkar, P., 2019. Disentangling 'ecosystem services' and 'nature's contributions to people.' *Ecosystems and People*, 15, pp. 269-287.

Langemeyer, J., and Connolly, J.J., 2020. Weaving notions of justice into urban ecosystem services research and practice. *Environmental Science & Policy*, 109, pp.1-14.

Millennium Ecosystem Assessment (MA), 2005. Ecosystems and human well-being. 563 p.

Mokos, J.T., 2017. Stigmatized places as therapeutic landscapes. *Medicine Anthropology Theory*, 4(1), pp.123-151.

Martín-López, B., Iniesta-Arandia, I., García-Llorente, M., Palomo, I., Casado-Arzuaga, I., Amo, D.G.D., Gómez-Baggethun, E., Oteros-Rozas, E., Palacios-Agundez, I., Willaarts, B., and González, J.A., 2012. Uncovering ecosystem service bundles through social preferences. *PLoS One*, 7, p. e38970.

Martinez-Harms, M.J., Bryan, B.A., Wood, S.A., Fisher, D.M., Law, E., Rhodes, J.R., Dobbs, C., Biggs, D., and Wilson, K.A., 2018. Inequality in access to cultural ecosystem services from protected areas in the Chilean biodiversity hotspot. *Science of the Total Environment*, 636, pp. 1128-1138.

McGinlay, J., Parsons, D.J., Morris, J., Graves, A., Hubatova, M., Bradbury, R.B., and Bullock, J.M., 2018. Leisure activities and social factors influence the generation of cultural ecosystem service benefits. *Ecosystem Services*, 31, pp. 468-480.

Mucioki, M., Sowerwine, J., Sarna-Wojcicki, D., Lake, F.K., and Bourque, S., 2021. Conceptualizing Indigenous Cultural Ecosystem Services (ICES) and Benefits under Changing Climate Conditions in the Klamath River Basin and Their Implications for Land Management and Governance. *Journal of Ethnobiology*, 41, pp. 313-330.

Parks, S., and Gowdy, J., 2013. What have economists learned about valuing nature? A review essay. *Ecosystem Services*, 3, pp.e1-e10.

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., Watson, R.T., Dessane, E.B., Islar, M., Kelemen, E., and Maris, V., 2017. Valuing nature's contributions to people: the IPBES approach. *Current Opinion in Environmental Sustainability*, 26, pp.7-16.

Pires, A.P., Padgurschi, M.C., de Castro, P.D., Scarano, F.R., Strassburg, B., Joly, C.A., Watson, R.T., and de Groot, R., 2020. Ecosystem services or nature's contributions? Reasons behind different interpretations in Latin America. *Ecosystem Services*, 42, pp. 101070.

Pitt, H., 2019. What prevents people accessing urban bluespaces? A qualitative study. *Urban Forestry & Urban Greening*, 39, pp.89-97.

Riechers, M., Strack, M., Barkmann, J., and Tschardtke, T., 2019. Cultural ecosystem services provided by urban green change along an urban-periurban gradient. *Sustainability*, 11, pp.645.

Sagie, H., Morris, A., Rofè, Y., Orenstein, D.E., and Groner, E., 2013. Cross-cultural perceptions of ecosystem services: A social inquiry on both sides of the Israeli–Jordanian border of the Southern Arava Valley Desert. *Journal of Arid Environments*, 97, pp.38-48.

Sangha, K.K., Preece, L., Villarreal-Rosas, J., Kegamba, J.J., Paudyal, K., Warmenhoven, T., and RamaKrishnan, P.S., 2018. An ecosystem services framework to evaluate Indigenous and local peoples' connections with nature. *Ecosystem Services*, 31, pp.111-125.

Smith, N., Georgiou, M., King, A.C., Tieges, Z., Webb, S., and Chastin, S., 2021. Urban blue spaces and human health: A systematic review and meta-analysis of quantitative studies. *Cities*, 119, p.103413.

Völker, S., and Kistemann, T., 2011. The impact of blue space on human health and well-being—Salutogenetic health effects of inland surface waters: A review. *International Journal of Hygiene and Environmental Health*, 214(6), pp.449-460.

Whyte, K., 2018. Settler colonialism, ecology, and environmental injustice. *Environment and Society*, 9, pp.125-144.

Winthrop, R.H., 2014. The strange case of cultural services: Limits of the ecosystem services paradigm. *Ecological Economics*, 108, pp.208-214.

Zoeller, K.C., and Cumming, G.S., 2024. Towards an integrated framework for understanding social-ecological interactions: nature's contributions to people meets cultural ecosystem services. *Ecosystems and People*, 20(1), p.2329576

## *Chapter 1: Navigating university openness in research policy inconsistent with Indigenous data sovereignty: A case analysis*

### **Abstract**

Indigenous nations and communities in the United States have rights as sovereign governments to exercise control and ownership over all data and information generated by or from the tribes, tribal members, or tribal resources. Indigenous nations exercise these rights through data ownership policies established in response to unethical research practices in research involving Indigenous communities. Most universities in the U.S. have “openness in research” policies to ensure academic freedom to publish freely, exercised by retaining university control of data. Here, we describe our study of cultural ecosystem services in the St. Louis River estuary region (Nagaajiwanaang in the language Ojibwemowin) in Duluth, Minnesota, and Superior, Wisconsin, U.S., an area that includes portions of the 1854 and 1842 Ceded Territories and reservation lands of a local band of Ojibwe (hereafter referred to as “the Band”). In this university-led, Band-supported study, both the university and the Band sought ownership of data collected based on their respective policies, resulting in a research delay of nearly a year. We found that open research policies that do not consider Indigenous sovereignty can hamper collaboration between university researchers and tribal nations, even when there is broad agreement on research goals and objectives. University open research policies that do not explicitly address Indigenous sovereignty fall short of the open research principles they intend to support and should be revised. Formal adoption of principles for ethical research with sovereign tribal governments by universities is needed to improve coordination and trust among university and tribal researchers and members.

### **Introduction**

American Indian and Alaskan Native tribes and Native Hawaiian and Pacific Islander communities (hereafter referred to as “Indigenous communities”) have rights as sovereign entities to exercise control and ownership over all data and information generated by their tribal nation, members, resources, or land (United Nations General Assembly, 2007). Universities have “openness in research” policies that assert control or ownership of data collected by university researchers to ensure the universities’ ability to publish findings freely (Robinson, 2013). These

two principles, data sovereignty and openness in research, can create challenges to collaboration between university researchers and Indigenous communities. Here, we describe our recent study in which this occurred and summarize its resolution. Based on our case analysis, we affirm that U.S. research institutions that wish to conduct research in partnership with Indigenous sovereign nations must respect tribal data ownership policy, regardless of university institutional policy. We found that university open research policies that do not explicitly address Indigenous sovereignty fall short of the research principles they intend to support and need revision.

This case analysis is based on our University of Minnesota (UMN) PhD-level graduate student study of regional cultural ecosystem services, defined as the intangible benefits that arise from the interaction of people with the environment (Fish et al., 2016). The objective of the research was to examine how social factors including sociodemographic group, personal and social identity, and social context influence cultural ecosystem services associated with local surface waters (lakes, rivers, and streams) to inform equitable natural resource management. The approach included a survey of a purposive sample of community members about their experiences related to cultural ecosystem services, followed by semi-structured qualitative interviews with a subset of survey participants with diverse backgrounds. The study area was the St. Louis River estuary region, located in the traditional and contemporary lands of the Anishinaabe people, also known as Ojibwe or Chippewa.<sup>1</sup> The area included the reservation of a local federally recognized band of Ojibwe. The project aimed to include local Native American residents as one sociodemographic in the regional study; the focus of the study was not specifically on Native American cultural ecosystem services. At the time of publication of this article, data analysis and reporting are ongoing.

The five of us identify as White scientists and educators with training and work experience in institutional settings established based on Western philosophies, and we have a cumulative 96

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<sup>1</sup> The term Anishinaabe people or Anishinaabeg (noun) means “original people,” and refers to culturally related peoples of the Great Lakes region including Ojibwe, Odawa, Potawatomi, Mississauga, Nipissing, and Algonquin peoples. The Anishinaabe in the study area are the Ojibwe, which was anglicized as “Chippewa.”

years of experience working in the study area. We frame our discussion within the paradigm of institutional science to address the question of how institutions could better engage in sustained and mutually beneficial partnership with Indigenous communities. We endeavor to include accurate and vetted representations of Indigenous perspectives and scholarship.

### **Indigenous research and data sovereignty**

In 2007, the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP), supported by the U.S., affirmed that Indigenous peoples have inherent rights to self-determination. These rights include the right to “maintain, control, protect, and develop their cultural heritage, traditional knowledge, and traditional cultural expressions, as well as the manifestations of their sciences, technologies, seeds, medicines, knowledge of properties of flora and fauna, sports and traditional games, and visual and performing arts. They also have the right to maintain, control, protect and develop their intellectual property over such cultural heritage, traditional knowledge, and traditional cultural expressions.” (United Nations General Assembly, 2007).

There are currently 574 federally recognized tribes in the U.S. (Indian Affairs Bureau, 2022). Although the UNDRIP grants all Indigenous peoples inherent rights to self-determination, there are approximately 400 non-federally recognized Indigenous tribes in the U.S. (U.S. Government Accountability Office, 2012), and the Indigenous communities in Puerto Rico, Guam, American Samoa, the Virgin Islands, the Northern Mariana Islands, the Republic of the Marshall Islands, the Federated States of Micronesia, and the Republic of Palau are also not federally recognized (Advisory Council on Historic Preservation, 2018). Although tribal sovereignty in the U.S. was affirmed in *Worcester v. Georgia* (1832.) and despite continual Indigenous resistance, history abounds with examples of theft of lands; genocide; forced relocation, sterilization, and assimilation; and other grave harms perpetuated by colonial governments and federal policies (Adams, 1995; Clinton et al., 2007; Carpio, 2004; DeJong, 2007). These harms have had lasting effects on individuals and communities including generational trauma and loss of Indigenous languages, cultures, and lands (Clinton et al., 2007; Methot, 2019).

“Research sovereignty” refers to the right of Indigenous communities to set standards for research conduct and to expect equal participation in research (Díaz Ríos et al., 2020; Harding et al.,

2012). Data sovereignty includes “the right to govern the collection, ownership, and application of data about Indigenous communities, peoples, lands, and resources.” (Rainie et al., 2019). Examples of the abrogation of research and data sovereignty include medical experimentation on tribal members without consent (Foulks, 1989; Hodge, 2012; NRCC, 1996) and exploitation of tribal knowledge for private-sector benefit (Gupta, 2004; Roy, 2005; Twarog and Kapoor, 2004). Research relationships in the past have often been based on subjugation, fraught with White saviorism, and lacked reciprocity or respect for cultural norms (Brugge and Missaghian, 2006; James et al., 2014; Koster et al., 2012). Research design often included little or no involvement from Indigenous communities and little understanding of or concern for community priorities, values, or protocols (Brugge and Missaghian, 2006; James et al., 2014). Research reporting has included stereotyping, publication of sensitive materials without consent, and inadequate reporting back to the community (Burnette and Sanders, 2014; Brugge and Missaghian, 2006; James et al., 2014). These examples suggest the critical importance of research sovereignty to Indigenous communities.

In the U.S., the Common Rule, the federal policy for the protection of human subjects in research (45 C.F.R. 46(a)), has helped address some of these issues by protecting individuals from harms due to research. However, issues persist. For example, as recently as the 1990s, researchers at Arizona State University took blood samples from members of the Havasupai tribe in Arizona with consent for use in a genetic study of diabetes (Drabiak-Syed, 2010). Researchers shared the samples with other universities and used them in additional published studies about the tribe without the knowledge or consent of individuals or the Havasupai tribe. Blood holds cultural significance for the Havasupai, who found that these additional studies were harmful, stigmatizing, and culturally offensive (Pacheco et al., 2013).

The Common Rule explicitly protects individuals but may not adequately protect groups or communities from harm (For critique of the harms of a narrow focus on protecting the individual, rather than communities, see Saunkea et al., 2021; Tsosie et al., 2019; Williams et al., 2010). This emphasis on individual protections is consistent with Western philosophies, but Western and Indigenous epistemologies and methodologies have different assumptions, values, beliefs, rules, and cognitive structures (Steinmetz, 2005; Díaz Ríos et al., 2020). Although each Indigenous

community is unique, Indigenous worldviews often value holistic approaches over the isolation of system components, whereas Western science tends to be reductionist and based on testing hypotheses and isolating effects (Burnette and Sanders, 2014; Brugge and Missaghian, 2006; James et al., 2014; Clinton et al., 2007; Carpio 2004; DeJong, 2007). Unlike Western worldviews, Indigenous knowledge is often cocreated, shared among a group, and held by knowledge custodians (Kovach, 2010). Indigenous cultures often value group identity, which contrasts with the Western emphasis on individual identity, autonomy, and property ownership (James et al., 2014). In the absence of a national ethics policy for conducting research involving Indigenous peoples that protects their communities, Díaz Ríos et al. assert that research and data sovereignty are “a right, but [in practice are] still an aspiration for many Indigenous peoples.” (Díaz Ríos et al., 2020). Therefore, Indigenous communities can exercise research and data sovereignty to protect themselves from harms (Harding et al., 2012).

Indigenous communities have acted to protect their research and data sovereignty by establishing their own institutional review boards (IRBs, Harding et al., 2012). In 1996, the Navajo Nation of the Southwestern U.S. was the first to establish a tribal IRB (Brugge and Missaghian, 2006). Currently, there are 15 independent tribal IRBs in the U.S. (Indian Health Service, 2024). For federally recognized tribes without IRBs, human subjects research is reviewed by regional Indian Health Service (IHS) IRBs (Brugge and Missaghian, 2006). Because tribal IRBs aim to protect both individuals and communities, they can have requirements that go beyond federal requirements in the Common Rule. For example, the Tribal Research Code of the Ho-Chunk Nation (Wisconsin) applies to all research “conducted within the Nation’s Territory, whether involving human subjects or not, and all research regarding materials wherever . . . the Nation has a claim of intellectual, cultural or other ownership, legal or equitable.” (Ho-Chunk Nation, 2005; Harding et al., 2012). In addition, many tribal and IHS IRBs also require prepublication review of research results (Angal et al., 2016; Sahota, 2007).

### **Case analysis**

The St. Louis River estuary of Lake Superior (Nagaajiwanaang) includes the lower 39 miles of the St. Louis River and the immediate watershed downstream (see Fig. 1.1). Our study area largely coincides with the St. Louis River Area of Concern (AOC), a designation by the U.S.

Environmental Protection Agency (EPA) for areas with a legacy of industrial contamination and habitat loss (FDL, MNDNR, MPCA, and WDNR, 2023). This AOC has received at least 87 million federal dollars to address impairments in designated uses from 2010-2021 (Great Lakes Restoration Initiative, 2022). Although the AOC program is focused on restoring beneficial uses of waterways, limited assessment has been done to evaluate the impacts of these investments on communities, and it is unclear if the benefits of the investments are socially equitable (Angradi et al., 2022; Angradi et al., 2019; Josephs et al., 2021; Garcia et al., 2021; Norris et al., 2022). The research objective of our case study was to examine community impacts and equitability of AOC and related investments through cultural ecosystem service assessment.

The study area included the communities of Duluth (Onigamiinsing in the Ojibwe language) and Cloquet (Bapashkominigong), Minnesota; Superior (Gete-oodenaang), Wisconsin; and several additional townships situated on the St. Louis River (Gitchigami-Ziibi) estuary, at the eastern end of Lake Superior (Gichigami). The study area is in the traditional and contemporary lands of the Anishinaabe people, which includes the reservation lands of a local Ojibwe Band (hereafter referred to as “the Band”), and is situated within the 1854 and 1842 Ceded Territories (U.S. and Chippewa Indians of Lake Superior and the Mississippi, 1854; U.S. and Chippewa Indians of the Mississippi, and Lake Superior, 1842). People who self-identify as “American Indian or Alaska Native” constitute 2.5% of the population of the three major towns in the study area (U.S. Census Bureau, 2022). The Band is a partner in ongoing restoration activities in the St. Louis River estuary and, along with other projects, is leading a major effort to restore manoomin (wild rice), an annual aquatic grass and a sacred food and medicine vital to Ojibwe lifeways, food sovereignty, and cultural identity.

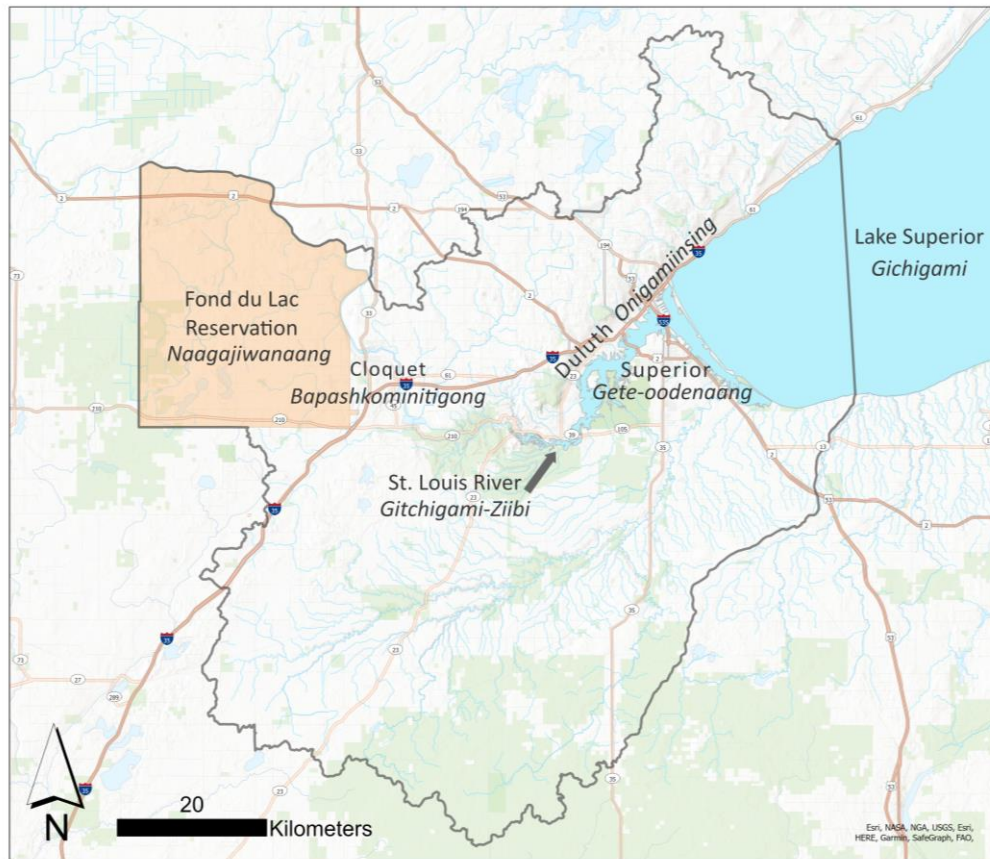


Figure 1.1 The study area is the St. Louis River estuary of Lake Superior and includes the communities of Duluth, and Cloquet, Minnesota, and Superior, Wisconsin. Ojibwe place names are shown in italics.

Our study was situated in an historical and contemporary context of fraught relationships between Indigenous communities and research institutions. Minnesota has 11 federally recognized tribes and eight non-recognized Indigenous communities (Bureau of Indian Affairs, 2022; Mendota Mdewakanton Dakota Community, 2023). UMN has a current initiative that aims to understand the history of its relationship with these communities (Faircloth, 2021). This includes unethical medical research on impetigo and nephritis conducted during the Cold War on children of the Red Lake Band of Lake Superior Chippewa Reservation in Minnesota. A recent controversy involves the study of manoomin, a plant sacred to the Ojibwe. UMN has been conducting research on manoomin since 1950, including developing domesticated varieties and, in 2000, mapping the genome (Raster and Hill, 2017). This research was done without consultation with,

compensation to, or acknowledgement of tribes who have for centuries been responsible for the stewardship and management of wild rice. The six bands of Minnesota Chippewa (Ojibwe) vehemently oppose this research because cross-contamination could change the genetic nature of natural manoomin stands, which could violate retained treaty rights to traditional, ceremonial, and subsistence relationships with the sacred plant (Raster and Hill, 2017; Walker and Doerfler, 2009). Chairman Goggeley Jr. of the Leech Lake Band explained it this way: “The Creator has given us many things. Every time we try to change [what we are given], it messes things up. I’m afraid this will happen to our wild rice beds. To [genetically engineer] wild rice would be disrespectful to the First People who inhabited this land . . . . It would be morally wrong.” (Walker and Doerfler, 2009, p. 504). Further, the ownership of genetic material, or claims to copyright in perpetuity, of a plant resource (especially by non-Indigenous peoples) is inconceivable to Ojibwe people. In a letter to the university, President Norman Deschampe of the Minnesota Chippewa Tribe asserted, “We object to the exploitation of our wild rice for pecuniary gain. We are of the opinion that the wild rice rights assured by treaty accrue not only to individual grains of rice, but to the very essence of the resource. We were not promised just any wild rice; that promise could be kept by delivering sacks of grain to our members each year. We were promised the rice that grew in the waters of our people, and all the value that rice holds.” (LaDuke, 2007). For these reasons, Minnesota Ojibwe governments called for a moratorium on the wild rice breeding program and for protection of their intellectual property rights to wild rice in 2003 (LaDuke, 2007). Despite this request, wild rice genetic research at UMN is ongoing. However, a recent collaboration between UMN researchers and regional tribes to study regional manoomin declines has sought to begin addressing some of these past harms (Bouayad, 2020; Matson et al., 2021).

Our study was subject to review by the Band’s tribal IRB because it would include data collection on the reservation from self-identified Native Americans (information about tribal affiliation or descent was not collected). Their tribal IRB was established in 2005 (Fond du Lac Human Services Division, 2020), and recommends approval or denial of all human subjects research to the main governing body, the Reservation Business Committee (RBC), which has the authority to make a final decision. All human subjects research conducted within the jurisdiction of the Band must be reviewed by the tribal IRB regardless of review by other IRBs (Ibid.). The guiding

principles for the tribal IRB policy are the Seven Grandfather Teachings of the Band and the *Belmont Report*, the 1978 report by the National Commission for the Protection of Human Subjects, which outlines the fundamental ethical principles to protect human subjects. All research dissemination materials must be reviewed and approved by the tribal IRB and the RBC. The Band “reserves the right to recommend edits, negotiate changes, and if needed, to deny publication or research dissemination regarding IRB-approved research that it considers to be harmful, or potentially harmful, to individuals, tribal communities, [Band] resources, or the Tribe.” (Ibid., p. 13) With respect to data ownership, the tribal IRB policy states that the Band “shall retain all ownership, property, trademark, copyright, and other rights to cultural, linguistic, and historic information that is not the intellectual property of the Researcher.” (Ibid., p. 14). The policy does not explicitly state that a formal research and data-sharing agreement between the tribe and researchers is required, but it is implied by the data ownership policy.

### **Research engagement with Indigenous communities**

To protect Indigenous communities, Indigenous scholars recommend decolonization of research practices, including employing community-engaged research, Indigenous epistemologies and methodologies, and leadership by Indigenous researchers (e.g., Smith, 2012; Wilson, 2008). In our case, funding and academic constraints required this research be led by university researchers. This study was designed as part of a university PhD degree program’s requirements consistent with the dominant practices and expectations of institutional science. Furthermore, the study included research objectives and encompassed a population larger than the Indigenous community.

The likelihood of research findings resulting in new knowledge that can benefit the Indigenous community ultimately depends on the community’s engagement and tribal oversight. The local Band’s Resource Management Division (RMD) expressed support for our study and provided feedback during the study design stage. The RMD water quality manager helped articulate to the tribal IRB and RBC the potential benefits of the research. We convened a community advisory group of 11 community representatives including Indigenous representatives to solicit input on the study design and participant recruitment. In response to the initial tribal IRB review described below, we also convened a second advisory group that consisted of five Ojibwe representatives to

provide input on the study design from an Indigenous perspective. In addition, individual consultation was done between the first author and many additional stakeholders representing community organizations and government agencies in one-on-one meetings.

We identified ways that the Band might benefit from this study through discussions with the Band's RMD and members of the Indigenous advisory group. This included that the research has the potential to help non-Indigenous natural resource managers understand how Indigenous members of the community experience cultural ecosystem services in the context of their identity, worldview, and culture, and which cultural ecosystem services are important to those who self-identify as Native American. The knowledge that comes from this research could be applied in the design and evaluation of projects to help remove beneficial use impairments in the St. Louis River AOC. Our research might help negotiations for Natural Resource Damage Assessment for a local Superfund site in a tribally important area, for the restoration and protection of culturally important manoomin beds, and for the design of climate adaptation projects. Further, our results could help inform the evaluation of the equitability of outcomes of restoration and protection efforts in the AOC.

We submitted the research protocol summarizing the study design and human subjects protections to the tribal IRB on August 30, 2021 (see Table 1.1 for a timeline of our protocol). The protocol was reviewed by the tribal IRB within a month of submission. During review, the Band requested protocol revisions including engagement of an Indigenous advisory group to review the survey and recruitment materials to ensure they would appropriately capture cultural ecosystem services for Indigenous people. The tribal IRB requested changes to the survey participant consent form. They also asked the university to sign a research and data-sharing agreement (RDA), for which the tribal IRB shared a template. After revisions were submitted in October 2021, the tribal IRB approved the protocol. At that time, university counsel in the UMN Office of the General Counsel reviewed the RDA template offered by the Band. Consistent with tribal IRB policy, the template stated that the Band would maintain sole ownership of all data collected on the reservation, or in this case, for any respondent who self-identified as Native American. Researchers and funders could use these data provided they maintained confidentiality and obtained approval from the tribal IRB prior to publication or research dissemination. The university's legal counsel

Table 1.1 Timeline of Tribal IRB Review and Approval Process

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8/30/2021	UMN researchers submitted protocol to tribal IRB.
9/3/2021	UMN submitted revisions to tribal IRB as requested by the tribal IRB specialist's review.
9/16/2021	UMN researcher Wick presented protocol to tribal IRB and answered IRB questions. Tribal IRB requested UMN sign a research and data-sharing agreement (RDA).
9/24/2021	Tribal IRB shared revisions requested for the project and the Band shared their RDA template.
10/3/2021	UMN submitted requested revisions to tribal IRB, except the RDA.
10/12/2021	UMN submitted the tribal RDA template to the university's Sponsored Projects Administration for review as an Unfunded Research Agreement.
10/19/2021	University counsel reviewed the template RDA.
10/21/2021	Tribal IRB voted to approve the protocol with some minor additional advice and under the condition of a signed RDA between the university and the Band. Final project approval generally comes from the Reservation Business Committee (RBC), the tribal governing body. This study would be brought before the RBC for approval only once an RDA was established.
11/2/2021	UMN researchers met with UMN legal counsel. Counsel raised the issue that the Band's template RDA did not meet UMN regent's policy for openness in research.
11/15/2021	UMN requested to meet with the Band to discuss the RDA and explained the university's openness in research policy to the tribal IRB specialist. The IRB specialist brought these concerns to the tribal IRB chair. The Band had not yet executed one of these agreements with UMN. The chair brought the issue to their legal affairs office, which did not respond immediately.
12/8/2021	The tribal IRB had not heard back from their legal office, so they suggested the university submit a proposed RDA to review.
12/22/2021	UMN researchers met with UMN legal counsel to agree on proposed changes to the template RDA that would meet the UMN openness in research policy.
1/5/2022	UMN researchers shared the proposed RDA with the tribal IRB. It included UMN legal counsel's comments and explanations. The proposed RDA specified that the university and the Band would have joint ownership of all data collected, except for any Traditional Indigenous Intellectual Property (TIIP), of which the Band would retain sole ownership (the collection of TIIP data was not planned, but TIIP could be collected incidentally in open-ended survey or interview questions). It also stated that "UMN will consider all

suggestions in good faith; however, UMN shall have the final authority to determine the scope and content of any publication [resulting from this research].”

- 2/1/2022 The Band’s legal affairs office reviewed the proposed RDA and responded that it was not consistent with tribal IRB policy.
- 3/29/2022 The tribal IRB, aware of the potential benefits to the Band of the research, decided to send UMN’s proposed RDA to the RBC for review even though the RDA did not meet the Band’s IRB policy. The protocol and the proposed RDA were reviewed by the Band’s Reservation Business Committee on 03/23/2022. The IRB argued to approve the research despite the RDA not allowing the tribe to maintain sole ownership of data collected. The RBC voted to not approve the protocol and RDA because the changes to the RDA did not meet the Band’s IRB policy.
- 4/15/2022 UMN researchers brought this issue to UMN’s senior advisor to the President on Native American Affairs, who raised the issue with the office of the vice president for research. The vice president for research granted an exception to the openness in research policy for this project.
- 6/8/2022 UMN vice president for research signed the Band’s template RDA.
- 6/30/2022 The tribal IRB reviewed the signed RDA and approved it and the research protocol.
- 7/15/2022 The Band’s RBC approved the research protocol and the signed RDA.
- 

interpreted these terms of the agreement as impinging on UMN’s “Openness in Research” policy, which states that the university “shall not accept restrictions on participation in University research or on the dissemination of the results of University research,” and that the university “reserves the right to publish and present research results, individually and in collaboration with other researchers.” (UMN, 2010).

To address this issue, we requested a meeting with the tribal IRB chair or Band’s legal affairs office to understand the Band’s concerns and attempt to find a solution. The Band was unable to accommodate this request in a timely manner and suggested that UMN submit an RDA proposal reflecting their requirements. Working with the university’s legal counsel, we drafted a proposed RDA specifying that the university and the Band would have joint ownership of all data collected, except for any Traditional Indigenous Intellectual Property (TIIP), of which the Band would retain sole ownership (the collection of TIIP data was not planned, but TIIP could be collected incidentally in open-ended survey or interview questions). The proposed RDA, consistent with

UMN's openness in research policy, stated that "UMN will consider all suggestions in good faith; however, UMN shall have the final authority to determine the scope and content of any publication [resulting from this research]."

We submitted this proposed RDA to the tribal IRB in January 2022. The Band's Legal Affairs office reviewed the proposed RDA and responded that it was not consistent with the Band's IRB policy (Fond du Lac Human Services Division, 2020). The tribal IRB, aware of the potential benefits to the Band of this research, argued to the RBC that the research should be approved despite the proposed RDA not allowing the Band to maintain sole ownership of data collected. However, the RBC disagreed and did not approve the university's RDA proposal.

At that time, we engaged the senior advisor to the university president on Native American Affairs. The university created this position in 2021 to "acknowledge the historic injustices against Native Americans in Minnesota." (Louden, 2021). The senior advisor brought the matter to the attention of the university's vice president for research, who indicated that his office could review specific circumstances and grant waivers to the openness in research policy. Through previous discussions regarding tribal sovereignty and partnerships, the vice president for research was familiar with concepts of tribal data sovereignty. After review of our proposed research and the tribal requirements, the vice president for research granted a waiver to the openness in research policy for this study and signed the tribe's template RDA. Thereafter, the tribal IRB and the RBC approved the RDA. From research protocol submission to final RBC approval, this process took 11.5 months.

## **Discussion**

Open research policies, Indigenous sovereignty, and human subjects protections must be integrated when designing and implementing research involving Indigenous communities, tribal nations, or their resources. Our experience in this case should reinforce for university researchers that university policies do not supersede tribal sovereignty over data, knowledge, or property. UMN and many other research universities' openness in research policies do not currently include considerations for tribal sovereignty (e.g., UMN, 2010; University of Wisconsin, 2015; Harvard University, 2014; Brown University, 2018). Based on our case analysis, we recommend

revising these policies to include explicit exceptions for research partnerships with sovereign tribal nations and Indigenous communities to facilitate research partnerships and protect Indigenous communities. UMN's openness in research policy is designed to protect research from corporate influence exerted through research funding. This is a serious concern. The fundamental purpose of universities, to promote the advancement of society through knowledge, depends on academic freedom, or the right to teach and conduct research without censorship (Robinson, 2013). However, as Brugge and Missaghian (2006) point out, concern for influence exerted through research funding is not generally applicable to Indigenous nations, who rarely fund university research.

Government funding agencies, which universities largely rely on for funding, increasingly have open science requirements to ensure publicly funded research samples, data, software, and publications are openly available, and for the purpose of supporting open research (e.g., see Nelson, 2022). These policies generally reflect the FAIR principles of Findability, Accessibility, Interoperability, and Reuse of digital assets (Wilkinson et al., 2016). The Global Indigenous Data Alliance developed the CARE principles to complement the FAIR principles and protect Indigenous data sovereignty. CARE stands for Collective benefit, Authority to control (data, resources, and research by Indigenous communities), Responsibility (of researchers working with Indigenous data), and Ethics (to prioritize Indigenous communities' rights and well-being; (Carroll et al., 2020). Although these principles have yet to be formally adopted in the U.S., federal funding agencies are increasingly acknowledging the need to protect Indigenous research sovereignty (e.g., NIH OSP, 2022; NSF, 2021; Nelson, 2022). Federal policies fall under the purview of the federal trust responsibility with federally recognized tribes, the obligation of the U.S. government to secure tribes' rights to self-governance (Tsosie, 2019). Therefore, explicit exceptions to open research policies for tribal sovereignty would be consistent with funding agency policies and federal trust responsibilities.

In this case, the local Band was unwilling to negotiate about data ownership, leaving UMN with two main options consistent with tribal sovereignty: to accept the Band's template RDA, or to abandon the aspects of the research involving the Band and its members and resources. Inefficient coordination between the university and tribal government, due to UMN's omission of rec-

ognition of Indigenous sovereignty in its openness in research policy, significantly delayed this PhD research project. Short of preventing the research, administrative delays resulting from protracted research policy negotiations among parties, or internally within the university, have been interpreted as infringing on academic freedom and can be a hindrance to postgraduate studies (e.g., Scott and Fonseca, 2013; Thomson et al., 2013; Tierney and Blumberg Corwin, 2007).

Preventing, halting, or interfering with research that stands to benefit Indigenous communities also contradicts recent interpretations of the Common Rule. Freeman argued that the principle of justice in the *Belmont Report*, which underpins the Common Rule, should be applied not just to individuals but also to communities (Freeman, 2004; NCPHS, 1979; Saunkeah et al., 2021). Such communities should not be asked to participate in research with little benefit to them, and conversely, should be included in research that is potentially of benefit to them. A 2021 recommendation from the Secretary’s Advisory Committee on Human Research Protections to the Secretary of Health and Human Services reiterated this, stating that due to the systemic exclusion of certain populations from research, justice was lacking in the Common Rule (Secretary’s Advisory Committee on Human Research Protections, 2021). This interpretation of the Common Rule implies an ethical obligation to include (and for universities to facilitate inclusion of) Indigenous communities in university research from which they would benefit. For example, the exclusion of Indigenous participants in this study would inhibit potential benefits like improving cross-cultural understanding of plural values associated with nature and increasing the equitability of the environmental restoration outcomes for Indigenous communities and individuals.

Under the terms of the RDA signed by the local Band and UMN, the Band retains the right to approve or not approve publication of research from study research “that it considers to be harmful, or potentially harmful, to individuals, tribal communities, [...] resources, or the Tribe.” This is prima facie inconsistent with university academic freedom doctrines, but it reflects the special case of a research partnership between the university and a sovereign nation. The practical implications of the RDA will depend on the specific research. In the case of our study, we think it unlikely that the Band would prevent all publication of our research findings because of the

relatively benign nature of the data collected (e.g., perceptions of cultural ecosystem services rather than medical information). Furthermore, we expect tribal review and comment on research results to contribute valuable perspective and context, while also providing a final check on inappropriate dissemination of tribal knowledge to prevent harms from occurring. However, the risk of tribal lack of approval of research products must be a consideration in the original conception and design of research. Tribal IRB review and input on research design, along with community input, such as what we received from the Indigenous advisory group, may also help diminish the risk of lack of approval.

The UMN IRB and the tribal IRB both reviewed the research protocol for this study. At the time of our proposed study, the UMN IRB had not previously worked with the local Band's IRB and was unfamiliar with their requirements and process. Navigating study review by multiple IRBs can be inefficient (Sahota, 2007), and IRBs are often reluctant to cede review to another IRB through reliance agreements (Klitzman, 2011a; Klitsman, 2011b). Improving cooperation between university and tribal IRBs with overlapping jurisdictions would reduce administrative burdens on researchers. This could include training university IRB staff on tribal IRB requirements so they could provide technical and legal guidance to researchers. Because tribal IRBs often require more information and may have different requirements than standard IRBs (Sahota, 2007), process flexibility by university IRBs would ultimately help support tribally engaged research. Such changes would be consistent with the flexibility of review requirements allowed by the Common Rule to accommodate local context (Byerly, 2009).

University compliance with tribal ethics review can help address researcher and systemic biases with respect to Indigenous communities or partners (e.g., Weaver, 1997; Higgins and Stark, 2020; Wilson, 2008; Drabiak-Syed, 2010). This is especially important in qualitative studies set in Indigenous communities and is a central tenant of rigorous social science research (e.g., Kovach, 2010). Like Angal et al. (2016), we found that the tribal IRB review was a mutually beneficial “mechanism of independent community oversight” rather than a “regulatory hurdle.” We received constructive feedback from the tribal IRB and from the Indigenous advisory group that the tribal IRB requested be convened, which improved our study design and the likelihood of collecting reliable data. The advisory group provided study design oversight that improved the cultural

sensitivity of survey and interview questions while maintaining scientific integrity. These changes, along with tribal IRB approval, which helps ensure study participants that the research has direct oversight from the Band, likely improved participant recruitment (Dukes et al., 2014).

Requiring us to have tribal review of manuscripts provides an additional level of oversight to ensure that results are interpreted appropriately in the context of Ojibwe culture and worldviews. Throughout our study, and despite university-driven efforts to “acknowledge the historic injustices” (Louden, 2021) and improve tribal-university relations, we found a lack of awareness and understanding within the university’s legal and sponsored program offices about tribal sovereignty or university relations with Indigenous communities or nations. We found that these high-level initiatives had not yet “trickled down” into university operations, and the university’s actions with respect to tribal affairs were not consistent across programs. This is not an isolated problem. Turpel-Lafond and Chondoma identified this as a significant barrier to partnerships, stating, “Institutions of learning must get their own houses in order in significant ways to engage with [Indigenous] individuals and Nations appropriately.” (Turpel-Lafond and Chondoma, 2019). Wong et al. called for researchers to obtain an understanding of not just the socio-political landscape around their research sites, but also of Indigenous peoples’ rights to and manifestations of self-determination (Wong et al., 2020). University-sponsored training for researchers and graduate students conducting or hoping to conduct research in partnership with Indigenous communities has been very limited (Northbird, 2022). However, to help address this need, the UMN Office of Native American Affairs recently established guidance for researchers wishing to conduct research with Indigenous communities (UMN Office of Native American Affairs, 2022). These efforts as well as the work of Indigenous scholars within universities may help shift university culture and cultivate political capital for changes in university policy that will support research partnerships with Indigenous communities in the future.

## **Conclusion**

This case analysis identified a major challenge with respect to university research partnerships with Indigenous communities, which is the lack of explicit considerations for Indigenous research and data sovereignty in university open research policies compounded by an incomplete understanding within the university of tribal sovereignty. In the case described herein, this

resulted in a significant delay in research progress and increased administrative burden on the part of the Band and the university. To support university research that is inclusive of and potentially beneficial to Indigenous communities, we recommend universities undertake efforts to educate and provide guidance for researchers and staff on tribal rights to self-determination and research sovereignty. Further, we recommend universities include explicit, proactive considerations for Indigenous research and data sovereignty in academic freedom and research policies. Policies should be developed in consultation with Indigenous governments and advisors. To facilitate this, resources need to be adequately allocated not only to university research and ethics review programs but also to tribal IRBs and research advisors. These changes will facilitate ethical collaboration among universities and Indigenous communities and ultimately lead to mutually beneficial outcomes consistent with Indigenous sovereignty.

## References

Adams, D.W., 1995. *Education for extinction: American Indians and the boarding school experience, 1875-1928*. Lawrence, KS: University Press of Kansas.

Advisory Council on Historic Preservation, 2018. Guide to working with non-federally recognized tribes in the Section 106 process. Accessed May 22, 2024:

<https://www.achp.gov/digital-library-section-106-landing/guide-working-non-federally-recognized-tribes-section-106>

Angal, J., Petersen, J.M., Tobacco, D., Elliott, A.J., and Prenatal Alcohol in SIDS and Stillbirth Network, 2016. Ethics review for a multi-site project involving tribal nations in the northern plains. *Journal of Empirical Research on Human Research Ethics*, 11(2), pp.91-96.

Angradi, T.R., Launspach, J.J., and Wick, M.J., 2022. Human well-being and natural capital indicators for Great Lakes waterfront revitalization. *Journal of Great Lakes Research*, 48(4), pp.1104-1120.

Angradi, T.R., Williams, K.C., Hoffman, J.C., and Bolgrien, D.W., 2019. Goals, beneficiaries, and indicators of waterfront revitalization in Great Lakes Areas of Concern and coastal communities. *Journal of Great Lakes Research*, 45(5), pp.851-863.

Bouayad, A., 2020. Wild rice protectors: An Ojibwe odyssey. *Environmental Law Review*, 22(1), pp.25-42.

Brown University, 2018. Brown University Openness in Research Policy. Accessed May 22, 2024:

<https://www.brown.edu/research/sites/research/files/policies/Openness%20in%20Research%20Policy.pdf>

Brugge, D., and Missaghian, M., 2006. Protecting the Navajo People through tribal regulation of research. *Science and Engineering Ethics*, 12(3), pp.491-507.

Burnette, C.E., and Sanders, S., 2014. Trust development in research with Indigenous communities in the United States. *Qualitative Report*, 19(22), pp.1-19.

Byerly, W.G., 2009. Working with the Institutional Review Board. *American Journal of Health-System Pharmacy*, 66(2), pp.176-184.

Carpio, M.V., 2004. The lost generation: American Indian women and sterilization abuse. *Social Justice*, 31(4), pp.40-53.

Carroll, S., Garba, I., Figueroa-Rodríguez, O., Holbrook, J., Lovett, R., Materechera, S., Parsons, M., Raseroka, K., Rodriguez-Lonebear, D., Rowe, R., and Sara, R., 2020. The CARE principles for Indigenous data governance. *Data Science Journal*, 19(43), pp.1-12.

Clinton, R.N., Goldberg, C.E., and Tsosie, R., 2007. American Indian law: Native nations and the Federal system: Cases and materials. Durham, NC: LexisNexis/Matthew Bender.

DeJong, D.H., 2007. 'Unless they are kept alive': Federal Indian schools and student health, 1878- 1918. *American Indian Quarterly*, 31(2), pp.256-282.

Díaz Ríos, C., Dion, M.L., and Leonard, K., 2020. Institutional logics and Indigenous research sovereignty in Canada, the United States, Australia, and New Zealand. *Studies in Higher Education*, 45(2), pp.403-415.

Drabiak-Syed, K., 2010. Lessons from Havasupai Tribe v. Arizona State University Board of Regents: Recognizing group, cultural, and dignity harms as legitimate risks warranting integration into research practice. *Journal of Health & Biomedical Law*, 6(2), pp.175-225.

Dukes, K.A., Burd, L., Elliott, A.J., Fifer, W.P., Folkerth, R.D., Hankins, G.D., Hereld, D., Hoffman, H.J., Myers, M.M., Odendaal, H.J., and Signore, C., 2014. The safe passage study: design, methods, recruitment, and follow-up approach. *Paediatric and Perinatal Epidemiology*, 28(5), pp.455-465.

FDL, MNDNR, MPCA, and WDNR, 2023. St. Louis River Area of Concern: 2022 Remedial Action Plan. Accessed May 22, 2024: <https://www.pca.state.mn.us/sites/default/files/wq-ws1-38.pdf>

- Faircloth, R., 2021. Land seizures, 'unethical' research: University of Minnesota confronts troubled history with tribal nations. *Indigenous Nations Want Reparations, Understanding over Land Seizure with U*, Star Tribune, April 3. Accessed May 22, 2024: <https://www.startribune.com/land-seizures-unethical-research-university-of-minnesota-confronts-troubled-history-with-tribal-nati/600041972/>
- Fish, R., Church, A., and Winter, M., 2016. Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. *Ecosystem Services*, 21, pp.208-217.
- Fond du Lac Reservation Human Services Division, 2020. Institutional review board policy and procedure manual 2020. June 25.
- Foulks, E.F., 1989. Misalliances in the Barrow alcohol study. *American Indian and Alaska Native Mental Health Research*, 2(3), pp.7-17.
- Freeman, W., 2004. The Protection of potential individual volunteers and tribal communities in research involving the Indian Health Service. In: *Guidelines for Researchers, manual for the Northwest Portland Area Indian Health Service Institutional Review Board*.
- Garcia, Helena, Logan Murphy, Briana Wendland, and Tiffany Wu., 2021. Assessing equity and environmental justice in the Great Lakes Restoration Initiative. Master's Thesis. University of Michigan.
- Great Lakes Restoration Initiative, 2022. Excel spreadsheet of all GLRI projects. Accessed May 22, 2024: <https://www.glri.us/projects>
- Gupta, A.K., 2004. WIPO-UNEP Study on the role of intellectual property rights in the sharing of benefits arising from the use of biological resources and associated traditional knowledge. Vol. 769. World Intellectual Property Organization and United Nations Environment Programme.
- Harding, A., Harper, B., Stone, D., O'Neill, C., Berger, P., Harris, S., and Donatuto, J., 2012. Conducting research with tribal communities: Sovereignty, ethics, and data-sharing issues. *Environmental Health Perspectives*, 120(1), pp.6-10.

Harvard University, 2014. Harvard University Research Policy: Openness in Research. Effective date September 2014. Accessed May 22, 2024: [https://bpb-us-e1.wpmucdn.com/websites.harvard.edu/dist/f/106/files/2022/10/openness\\_in\\_research\\_policy\\_2014.pdf](https://bpb-us-e1.wpmucdn.com/websites.harvard.edu/dist/f/106/files/2022/10/openness_in_research_policy_2014.pdf)

Higgins, M., and Stark, R.K., 2020. Mitigating implicit bias in reference service and literature searching. In: Bombaro, C. (ed.), *Diversity, Equity, and Inclusion in Action: Planning, Leadership, and Programming*. Chicago: ALA Editions, pp.59-72.

Ho-Chunk Nation, 2005. *Ho-Chunk Nation Tribal Research Code*. Black River Falls, WI: Ho-Chunk Nation.

Hodge, F.S., 2012. No meaningful apology for American Indian unethical research abuses. *Ethics & Behavior*, 22(6), pp.431-444.

Indian Affairs Bureau, 2022. Indian entities recognized by and eligible to receive services from the United States Bureau of Indian Affairs. *Federal Register*. Accessed May 22, 2024: <https://www.federalregister.gov/documents/2021/01/29/2021-01606/indian-entities-recognized-by-and-eligible-to-receive-services-from-the-united-states-bureau-of>

Indian Health Service, [n.d.]. Institutional Review Boards. Accessed January 26, 2024: <https://www.ihs.gov/dper/research/hsrp/instreviewboards/>

James, R., Tsosie, R., Sahota, P., Parker, M., Dillard, D., Sylvester, I., Lewis, J., Klejka, J., Muzquiz, L., Olsen, P., and Whitener, R., 2014. Exploring pathways to trust: A tribal perspective on data sharing. *Genetics in Medicine*, 16(11), pp.820-826.

Josephs, J.J., Hollenhorst, T.P., Wick, M.J., and Angradi, T.R., 2021. Environmental justice and Great Lakes Areas of Concern: Addressing the need for more research. *Environmental Justice*, 14(5), pp.315-321.

Klitzman, R., 2011. The ethics police? IRBs' views concerning their power. *PLoS One*, 6(12), p.e28773.

Klitzman, R., 2011. How local IRBs view central IRBs in the US. *BMC Medical Ethics*, 12(1), pp.1-14.

Koster, R., Baccar, K., and Lemeli, R.H., 2012. Moving from research ON, to research WITH and FOR Indigenous communities: A critical reflection on community-based participatory research. *Canadian Geographer*, 56(2), pp.195-210.

Kovach, M., 2010. *Indigenous methodologies: Characteristics, conversations, and contexts*. Toronto: University of Toronto Press.

LaDuke, W., 2007. Ricekeepers: A struggle to protect biodiversity and a Native American way of life. *Orion Magazine*. Accessed July 12, 2024: <https://orionmagazine.org/article/ricekeepers/>.

Louden, M., 2021. Karen Diver joins UMN as new senior leader for Native American affairs. *Minnesota Daily*, July 28. Accessed July 12, 2024: <https://mndaily.com/268506/news/karen-diver-joins-umn-as-new-senior-leader-for-native-american-affairs/>.

Mendota Mdewakanton Dakota Tribal Community, [n.d.]. How can the Mendota Mdewakanton Dakota community become a Federal Recognized Tribe, who can help us? Accessed July 12, 2024: <https://mendotadakota.com/mn/non-recognized-tribes-in-mn/>.

Methot, S., 2019. *Legacy: Trauma, story, and Indigenous healing*. Toronto, Canada: ECW Press.

NRCC (National Research Council Committee on Evaluation of 1950s Air Force Human Health Testing in Alaska Using Radioactive Iodine-131), 1996. *The Arctic Aeromedical Laboratory's thyroid function study: A radiological risk and ethical analysis*. Washington, DC: National Academies Press.

National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research (NCPHS), 1979. *The Belmont report: Ethical principles and guidelines for the protection of human subjects of research*. Washington, DC: Government Printing Office.

National Institutes of Health Office of Science Policy (NIH OSP), 2022. Supplemental information to the NIH policy for data management and sharing: Responsible management and

sharing of American Indian/Alaska Native participant data. Notice number NOT-OD-22-214, September 21. Accessed July 12, 2024: <https://grants.nih.gov/grants/guide/notice-files/not-od-22-214.html>.

National Science Foundation, 2021. Action plan of the National Science Foundation to enhance tribal consultation in response to presidential memorandum on tribal consultation and strengthening nation-to-nation relationships. April 26. Accessed July 12, 2024: <https://www.nsf.gov/geo/opp/arctic/ace/Tribal%20Engagement%20Action%20Plan.PDF>.

Nelson, A., 2022. Ensuring free, immediate, and equitable access to federally funded research. Memorandum from Office of Science and Technology Policy (OSTP), Executive Office of the President. Accessed July 12, 2024: <https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-access-Memo.pdf>.

Norris, C., Nigrelli, C., Newcomer-Johnson, T.A., White, D.P., Beaubien, G.B., Pelka, A., and Mills, M.A., 2022. Defining community revitalization in Great Lakes Areas of Concern and investigating how revitalization can be catalyzed through remediation and restoration. *Journal of Great Lakes Research*, 48(6), pp.1432-1443.

Northbird, A., 2022. Building tribal relationships while integrating Indigenous ways of knowing into land management and changing policies. Capstone Paper for Master of Tribal Resource and Environmental Stewardship, University of Minnesota Duluth.

Pacheco, C.M., Daley, S.M., Brown, T., Filippi, M., Greiner, K.A., and Daley, C.M., 2013. Moving forward: Breaking the cycle of mistrust between American Indians and researchers. *American Journal of Public Health*, 103(12), pp.2152-2159.

Rainie, S.C., Kukutai, T., Walter, M., Figueroa-Rodríguez, O.L., Walker, J., and Axelsson, P., 2019. Issues in open data—Indigenous data sovereignty. In: Davies, T. et al. (eds.), *The State of Open Data: Histories and Horizons*. Cape Town and Ottawa: African Minds and International Development Research Centre, pp.301.

Raster, A., and Hill, C. G., 2017. The dispute over wild rice: An investigation of treaty agreements and Ojibwe food sovereignty. *Agriculture and Human Values*, 34(2), pp.267-281.

Robinson, D., 2013. Corrupting research integrity: Corporate funding and academic independence. In: Pillay, N. (ed.), *Global Corruption Report: Education*. London: Routledge.

Roy, B. K., 2005. Intellectual property, traditional knowledge and related issues in access and benefit sharing contracts with Indigenous Peoples. Master thesis, Lund University.

Sahota, P. C., 2007. *Research regulation in American Indian/Alaska Native Communities: Policy and practice considerations*. Washington, DC: National Congress of American Indians Policy Research Center.

Saunkeah, B., Beans, J.A., Peercy, M.T., Hiratsuka, V.Y., and Spicer, P., 2021. Extending research protections to tribal communities. *American Journal of Bioethics*, 21(10), pp.5-12.

Scott, C. L., and Fonseca, L., 2013. Overstepping the mark: Ethics procedures, risky research, and education researchers. In: Sikes, P., and Piper, H. (eds.), *Ethics and Academic Freedom in Educational Research*. London: Routledge.

Secretary's Advisory Committee on Human Research Protections to the Secretary of Health and Human Services, 2021. Consideration of the principle of justice under 45 C.F.R. part 46. Office for Human Research Protections, July 22. Accessed July 12, 2024:

<https://www.hhs.gov/ohrp/sachrp-committee/recommendations/attachment-a-consideration-of-the-principle-of-justice-45-cfr-46.html>.

Smith, L. T., 2012. *Decolonizing methodologies: Research and Indigenous peoples* (2nd ed.). London: Zed Books.

Steinmetz, G., 2005. Positivism and its others in the social science. In: Steinmetz, G. (ed.), *The Politics of Method in the Human Sciences: Positivism and Its Epistemological Others*. Durham/London: Duke University Press.

Thomson, J.J., Elgin, C., Hyman, D.A., Schrag, Z., Knight, J., and Kreiser, B.R., 2013. Regulation of research on human subjects: Academic freedom and the Institutional Review Board. *Academe*, 99(4), pp.101-117.

Tierney, W. G., and Blumberg Corwin, Z., 2007. The tensions between academic freedom and Institutional Review Boards. *Qualitative Inquiry*, 13(3), pp.388-398.

Tsosie, R., 2019. Tribal data governance and informational privacy: Constructing Indigenous data sovereignty. *Montana Law Review*, 80(2), pp.229-268.

Tsosie, K. S., Yracheta, J. M., and Dickenson, D., 2019. overvaluing individual consent ignores risks to tribal participants. *Nature Reviews Genetics*, 20(9), pp.497-498.

Turpel-Lafond, M. E., and Chondoma, L., 2019. Building Indigenous-led engagement frameworks. Report on dialogue on Indigenous data, information, and records. University of British Columbia, p.9.

Twarog, S., and Kapoor, P., eds., 2004. Protecting and promoting traditional knowledge: Systems, national experiences, and international dimensions. New York and Geneva: United Nations.

U.S. and Chippewa Indians of Lake Superior and the Mississippi, 1854. *Treaty with the Chippewa*. September 30. 10 Stats., 1109. Accessed July 12, 2024: [https://files.dnr.state.mn.us/aboutdnr/laws\\_treaties/1854/treaty1854.pdf](https://files.dnr.state.mn.us/aboutdnr/laws_treaties/1854/treaty1854.pdf).

U.S. and Chippewa Indians of the Mississippi, and Lake Superior, 1842. *Treaty of La Pointe*. Oct. 4. 7 Stat., 591. Proclamation, Mar. 23, 1843. Accessed July 12, 2024: <https://www.1854treatyauthority.org/images/TREATY.TEXT.final.webpublish.pdf>.

U.S. Census Bureau, 2022. *QuickFacts*. Accessed July 12, 2024: <https://www.census.gov/quickfacts/fact/table/cloquetcityminnesota,superiorcitywisconsin,duluthcityminnesota#>.

U.S. Government Accountability Office, 2012. *Indian issues: Federal funding for non-federally recognized tribes*. April 12. Accessed July 12, 2024: <https://www.gao.gov/products/gao-12-348>.

United Nations General Assembly, 2007. *United Nations declaration on the rights of Indigenous Peoples*, Article 31. Accessed July 12, 2024:

[https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP\\_E\\_web.pdf](https://www.un.org/development/desa/indigenouspeoples/wp-content/uploads/sites/19/2018/11/UNDRIP_E_web.pdf), p. 22.

University of Minnesota, 2010. *Board of Regents policy: Openness in research*. Last amended February 12. Accessed July 12, 2024: [https://regents.umn.edu/sites/regents.umn.edu/files/2019-09/policy\\_openness\\_in\\_research.pdf](https://regents.umn.edu/sites/regents.umn.edu/files/2019-09/policy_openness_in_research.pdf).

University of Minnesota Office of Native American Affairs, 2022. *University of Minnesota guidelines for Indigenous research*. University of Minnesota. Accessed July 12, 2024: <https://docs.google.com/document/d/1wEVeTzrdTXUVem40PVditpCRYzdNhERa/edit?usp=sharing&oid=105584718521150523143&rtpof=true&sd=true>.

University of Wisconsin, 2015. *Open research and free interchange of information*. Policy number UW-4006, revised January 28. Accessed July 12, 2024: <https://policy.wisc.edu/library/UW-4006>.

Walker, R. D., and Doerfler, J., 2009. Wild Rice: The Minnesota legislature, distinctive crop, GMO, and Ojibwe perspectives. *Hamline Law Review*, 32(2), pp.499-528.

Weaver, H. N., 1997. The challenges of research in Native American communities: Incorporating principles of cultural competence. *Journal of Social Service Research*, 23(2), pp.1-15.

Wong, C., Ballegooyen, K., Ignace, L., Johnson, M.J., and Swanson, H., 2020. Towards reconciliation: 10 calls to action to natural scientists working in Canada. *Facets*, 5(1), pp.769-783.

Worcester v. Georgia, 1832. 31 U.S. 515.

## *Chapter 2 - Sociodemographic variation in human wellbeing benefits from a Great Lakes coastal ecosystem*

### **Abstract**

Blue spaces such as publicly accessible environments associated with oceans, lakes, rivers, and streams, can benefit human well-being by reducing stress, evoking positive emotions, and providing a venue for physical activity, leisure, and social engagement. The distribution of these benefits can vary across different sociodemographic groups, which makes it challenging to identify interventions for increasing equitability, yet few studies have assessed plural cultural ecosystem service (CES) experiences in a diverse community. To address this gap, we explored how sociodemographic identity, including gender, age, income, and race, influenced perceived benefits from and barriers to CES associated with blue spaces within the Great Lakes coastal community of Duluth, Minnesota, and Superior, Wisconsin, USA. Specifically, we used a qualitative and quantitative survey approach to assess the blue space experiences of participants across sociodemographic groups and identified barriers individuals faced in accessing these benefits. We found that men reported higher engagement in recreational activities, while women and nonbinary individuals experienced more inspiration, art, and mindfulness benefits. Younger participants more commonly reported social and physically demanding experiences, while older participants reported wildlife experiences more often, and reported an increasing awareness of environmental concerns. Overall, older participants reported fewer types of CES. Higher income groups reported more CES experiences, especially recreation experiences. Participants who were Native American alone derived more types of CES benefits and reported barriers at a lower rate than other racial/ethnic groups in the study. Our qualitative analysis of reported barriers illustrated how multiple barriers were linked with one another and were perceived based on the participant's identity and worldview. Our results are consistent with affordance theory which suggests both benefits and barriers are emergent properties that arise from an individual's perception of themselves relative to an environment. These perceptions, in turn, are rooted in sociodemographic identity. Our results study reaffirms the relational nature of CES and demonstrate that identity fundamentally structures the relational experiences of CES by individuals, including both the benefits from and barriers to CES.

## **Introduction**

Blue spaces (e.g., the publicly accessible environments associated with oceans, lakes, rivers, and streams), can benefit human well-being by reducing stress, evoking positive emotions, and providing a venue for physical activity, leisure, and social engagement. (Abraham et al., 2010; Smith et al., 2021; Völker and Kistemann, 2011; Gascon et al., 2017). Well-being benefits associated with blue spaces vary across sociodemographics and social groups (e.g., Pitt, 2019, Gascon et al., 2017). Coastal blue space investments and decision-making have the potential to both perpetuate and help reduce inequities in benefit distribution among community members. Assessments of human well-being benefits associated with nature have been proposed to support improved decision-making for equitability. Cultural ecosystem services (CES), defined as services co-produced by humans and nature that give rise to intangible benefits to human well-being (Chan et al., 2012; Fish et al., 2016), is one type of framework for assessment posited to support consideration of equitability of benefits (Gould et al., 2020a, b., Chan et al., 2016; Jones et al., 2022; Gould et al., 2019). However, this application for equitability is limited by a gap in understanding of how benefits from and barriers to CES vary with the identity of community members in diverse communities.

While many disciplines (e.g., human geography, environmental psychology, leisure studies, landscape and urban planning) have advanced frameworks for understanding how nature influences human well-being, the ecosystem services framework from ecological economics has been widely adopted by environmental decision-makers. Critiques of the ecosystem services framework contend that a utilitarian, service-based relationship between humans and nature derived from neoclassical economics is inaccurate and inconsistent with some cultural worldviews and ontologies, such as those of Indigenous peoples who may prioritize reciprocity between humans and nature or service to nature by humans (e.g., Comberti et al., 2015; Kirchhoff 2019; Winthrop, 2014; Díaz et al., 2018). Responses to these critiques point out that even acknowledging these drawbacks, CES may nonetheless inform decision-making when applied with adequate reflexivity, acknowledgement of its limitations, and explicit engagement with relational value frameworks for CES consistent with non-Western ontologies (Gould et al., 2020a, b). Furthermore, CES may facilitate informed decision-making by bridging traditional public, academic, and disciplinary boundaries, translating knowledge within and among groups,

advancing inclusive research processes, and challenging reductionist and objectivist approaches to ecosystem service studies. As an approach that has been widely adopted, CES assessment is supported by a robust literature and methodologies to support decision-making. Challenges in defining, measuring, and assessing CES mean there are relatively few examples to date of studies examining sociodemographic variation in CES experiences in diverse communities and its implications for environmental decision-making (e.g., Jones et al., 2022; Blicharska et al., 2017; Chan et al., 2012; Winthrop, 2014; Satz et al., 2013).

Conceptual models for CES take the form of traditional economic frameworks (e.g., the stock-and-flow model of Jones et al., 2022 or the cascade model of Blicharska et al., 2017) or relational models (e.g., Fish et al., 2016; Sangha et al., 2018; Mucioki et al., 2021) that may be better equipped to accommodate plural values, but are challenging to operationalize for measurement. Both types of models generally conceptualize CES experiences as services (and associated benefits) that flow to a beneficiary because of interaction between the beneficiary and the environment, dependent on potential ecosystem services available in nature, with little consideration of the many social, historical, cultural, or institutional factors that mediate benefits from nature (Jones et al., 2022; Blicharska et al., 2017). However, studies that have personal (traits, preferences, attitudes) and social (roles, groups, membership) identity (e.g., Walker et al., 2022) have shown them to be important to perceptions of and benefits attributed to CES (Daw et al 2011, Dawson & Martin 2015, Cuni-Sanchez et al., 2016; Dou et al., 2020; Sagie et al., 2013; Fish et al., 2016).

To address how social identity influences CES, we conducted a mixed methods case study assessment of perceived CES and barriers to CES within the Great Lakes coastal community of Duluth, Minnesota and Superior, Wisconsin, USA, across a range of sociodemographic groups including gender, age, income, and race. We addressed the following research question: How is sociodemographic identity associated with (a) blue space CES experiences and (b) barriers to blue space CES experiences? We hypothesized that marginalized sociodemographic groups would report fewer CES benefits from blue space and more barriers to blue space CES than other participants. We interpret our results in the context of social science literature on existing theories of access to, barriers to, and benefits from nature to human well-being, and summarize

implications of our results for CES assessment practice and application to equitable environmental decision-making.

### ***Study conceptualization***

Identity is defined here as the personal characteristics (qualities, beliefs, personality traits, appearance, expressions) and memberships of social groups of an individual, which are dynamic and can change through time (Walker et al., 2022). Here, we considered solely sociodemographic identity, because this well-established method presented a reasonable scope, facilitated quantitative analysis, and may have a primary influence on identity (Smith, 2007). We defined CES “delivery” as assessed perceptions of CES experiences, the point of interaction between a person and the blue space. Because quality of access can be just as important as quantity to users (e.g., Haeffner et al., 2017), barriers to CES were defined as any factors that reduce the ability of an individual to access blue space or reduce the quality of the experience. Access is defined broadly after Ribot and Peluso (2003), as the ability to benefit from blue space. We deployed a survey to facilitate engagement of participants from a range of sociodemographic backgrounds to collect quantitative and qualitative data about the range of common cultural ecosystem services in the area. The survey focused on CES experiences associated with blue space defined as the freshwater lakes, rivers, and streams in the study area.

### ***Case study area***

The study area includes the communities situated around the St. Louis River estuary, which is located at the western end of Lake Superior, known as Gichigami in the Ojibwe language (Fig. 2.1). The area includes the cities of Duluth and Cloquet Minnesota, Superior Wisconsin, and several rural townships. The area includes the lower 39 miles of the St. Louis River and the immediate estuary watershed downstream from there.

The Lake Superior basin has been home to Indigenous peoples for at least 13,000 years (Phillips, 1993; Gibbon, 2012). The Anishinaabeg<sup>2</sup> migrated from the eastern seaboard into the area over generations, finding the prophesied place where food, manoomin (wild rice), grows on the water (Whyte, 2018). In the mid-1600s when French explorers arrived, the study area was home to the Ojibwe, as well as the Dakota people, who subsequently migrated to the prairies and plains to the southwest (FDL, 2022). French fur traders established peaceful trade and the French and Ojibwe both embraced cultural exchange (FDL, 2022). In treaties between the Ojibwe and the U.S. government in 1842 & 1854, reservations were established, study area land was ceded to the U.S. Government, while rights to traditional lifeways such as hunting, fishing, and gathering were retained within treaty boundaries.<sup>3</sup> In the 1850's and 1860's, the area attracted prospectors, surveyors, land speculators, town promoters, and settlers. Superior was founded in 1854, Duluth in 1856. A railroad between St. Paul, Minnesota and Duluth arrived in 1870, and the expansion of lumber and mining industries resulted in exponential growth of the European population (Kaups, 1978; FDL, 2022).

As of 2022, the combined population of the cities of Duluth and Cloquet, Minnesota and Superior Wisconsin was 126,016 (US Census Bureau, 2022a). Additional sociodemographic data for the study area are shown in Table 2.1. The study area includes the entire reservation of an Ojibwe Tribal Nation. Duluth and Superior are a regional tourist destination attracting approximately 6.7 million visitors annually to enjoy museums, performance centers, festivals, arts and culture, and outdoor recreation opportunities along the waterfront and in area parks (Duluth Area Chamber of Commerce, 2024). The international port of Duluth-Superior is the largest on the Great Lakes by

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<sup>2</sup> The term Anishinaabe people or Anishinaabeg (noun) means “original people,” and refers to culturally related peoples of the Great Lakes region including Ojibwe, Odawa, Potawatomi, Mississauga, Nipissing, and Algonquin peoples.

<sup>3</sup> U.S. and Chippewa Indians of Lake Superior and the Mississippi. 1854 Treaty with the Chippewa. September 30, 1854. 10 Stats., 1109.

[https://files.dnr.state.mn.us/aboutdnr/laws\\_treaties/1854/treaty1854.pdf](https://files.dnr.state.mn.us/aboutdnr/laws_treaties/1854/treaty1854.pdf); U.S. and Chippewa Indians of the Mississippi, and Lake Superior. 1842 Treaty of La Pointe. Oct. 4, 1842. 7 Stat., 591. Proclamation, Mar. 23, 1843. <https://www.1854treatyauthority.org/images/TREATY.TEXT.final.webpublish.pdf>.

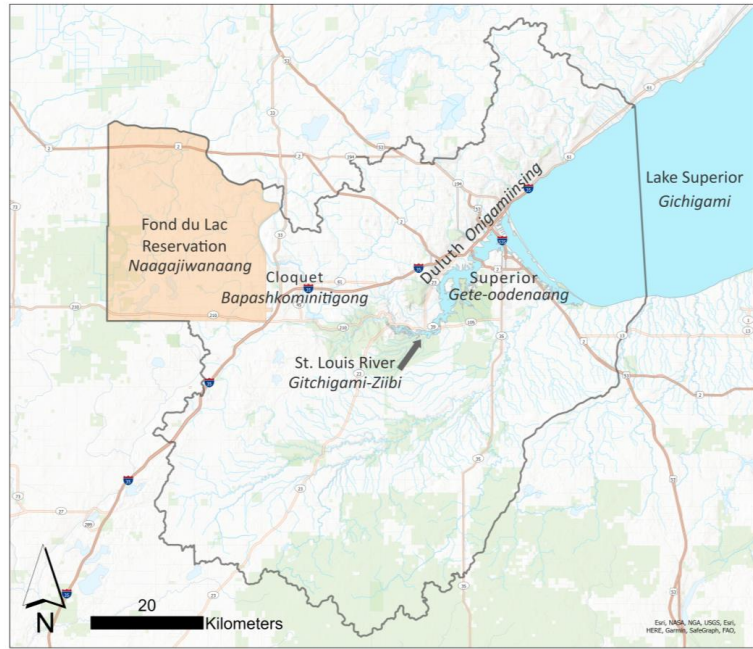


Figure 2.1 The study area includes the lower 39 miles of the St. Louis River and its estuary on Lake Superior, including the immediate watershed. It includes the communities of Duluth, and Cloquet, Minnesota, and Superior, Wisconsin. Anishinaabe place names are shown in italics.

Table 2.1 Sociodemographic attributes for combined cities of Duluth, MN, Cloquet, MN, and Superior, WI, the three major cities in the study area (US Census Bureau, 2022). The combined population as of April 1, 2020, was 126,016.

Demographic	%
Under 5 years	5.3%
Under 18 years	19.1%
Age 65 and over	15.7%
Female	51.2%
White alone	89.7%
Black or African American alone	2.2%
American Indian & Alaska Native alone	2.5%
Asian alone	1.6%
Two or More Races	3.7%
Hispanic or Latino	2.2%
White alone, not Hispanic or Latino	88.3%
In poverty	14.6%

tonnage and handles iron ore, coal, limestone, grain, and global cargo (Duluth Seaway Port Authority, 2024). Other major industries include healthcare, aviation, and manufacturing (Duluth Economic Development Authority, 2023). The study area is currently a focus of ongoing federal investments in environmental remediation and restoration under the Great Lakes Area of Concern program, which addresses beneficial use impairments associated with historical pollution and habitat loss (FDL et al., 2023).

## **Methods**

### ***Community engagement***

We convened two project advisory groups: a community advisory group consisting of representatives for local municipalities and local organizations, and an Indigenous advisory group consisting of Ojibwe representatives of the Tribal Nation, the local tribal community college, and two regional tribal natural resource management commissions. These groups provided input on the study design, helped recruit participants, provided feedback on interpretation of results, and are helping disseminate results to local and regional decision-makers. The Indigenous advisory group provided input to ensure the study captures CES of interest to Ojibwe participants.

### ***Survey development and recruitment***

We developed the Waterway Benefits survey tool (Appendix 2.1) to answer our research questions. Plain language (e.g., “benefits from waterways”) was used rather than jargon (e.g., “cultural ecosystem services”) to enhance comprehension by participants (e.g., Dean et al., 2022). Requirements to participate included being at least age 18 and a current resident of the study area. Following a consent form, the first section asked participants which of 48 cultural ecosystem service experiences they had experienced in the past year. These experiences were classified into categories that were adapted from existing CES frameworks (e.g., MA, 2005) for the study area based on local knowledge and feedback from the advisory groups. The CES categories included were cultural and traditional experiences; spiritual and emotional experiences; aesthetic, inspirational, and art experiences; educational and learning experiences; active experiences; shore-based recreation experiences; water-based recreation experiences; work and stewardship experiences; and wild food experiences (See Table 2.3 for the list and description of individual CES experiences within each category). These categories were selected to represent the most

common CES experiences known in the study area and offer brief and roughly equal subsets of CES experiences to evaluate for ease of the participant. For the wild foods category, we included questions about how wild foods contributed to the participants' diet, based on input from the Indigenous advisory group. A series of questions asked about what kinds of barriers participants faced in positive water-related experiences in the past year, including questions about negative experiences, environmental, social, and personal barriers to experiencing water. The last section included questions about the participant sociodemographic attributes, including gender, age, income, race, Hispanic ethnicity, education level, employment status, household size, and duration of time living in study area. The sociodemographic groups included in our analysis are shown in Table 2.2. The survey was available via hard copy and online and took around 20 minutes to complete. The online survey was hosted on ESRI's Survey123 platform to facilitate geospatial questions which are outside of the scope of this report. Prior to launching, the survey was reviewed or tested by approximately 18 community and Indigenous advisors and other individuals.

Our recruitment efforts were designed to ensure participation by adequate numbers of typically underrepresented age, race, and income groups to address our research question. We sent a single postcard to 10,000 households selected to maximize the age, race, and income diversity of survey respondents and include individuals in demographic groups that comprise relatively small proportions of the study area population. Mail routes for recruitment were selected based on sociodemographic data provided in the USPS's Every Door Direct Mail Online Tool (USPS, 2023). We included the 14 mail routes with the lowest average incomes, under \$35k/year in the study area. We included five mail routes with the highest percent of residents aged 70 and above. To increase racial diversity of respondents, we used the mail route data combined with American Community Survey (ACS) 5-year 2019 data for race by zip code (ACS, 2019). We randomly selected 4 additional routes within the zip codes with the lowest percent of non-white residents based on ACS data. We included all three mail routes within the Reservation boundaries. All targeted routes selected above were located within ZIP codes with average percent non-white population higher than study area average of approximately 10%. Finally, we added the two Superior, WI mail routes with the lowest average incomes (both under \$25k/year) to increase spatial coverage because all other mail routes were in Minnesota. A total of 23 mail routes were

Table 2.2 Sociodemographic attributes of respondents reported as number (N) and percent (%) of respondents. Race groups were established based on sample numbers. Race groups with low sample numbers, which included Asian or Pacific Islander, Black or African American, Other race, and mixed-race participants besides Native American/White, were combined into the group “Other or mixed-race.” NA indicates no response for the question.

	N	%		N	%
<b>Gender</b>			<b>Age</b>		
Woman	288	54.1	18 - 29 years	125	23.5
Man	217	40.8	30 - 39 years	121	22.7
Nonbinary or gender expansive	26	4.9	40 - 49 years	84	15.8
NA	1	0.2	50 - 59 years	78	14.7
<b>Income</b>			60 - 69 years	80	15.0
Less than \$25k/year	137	25.8	70 years or older	42	7.9
\$25k - \$50k/year	125	23.5	NA	2	0.4
\$50k - \$90k/year	143	26.9	<b>Employment</b>		
Greater than \$90k/year	114	21.4	Working	322	60.5
NA	13	2.4	Retired	86	16.2
<b>Race</b>			Student	55	10.3
Native American alone	38	7.1	Unable to work	27	5.1
Native American/White	28	5.3	Out of work	23	4.3
Other or mixed-race	30	5.6	Stay at home	14	2.6
White alone	434	81.6	NA	5	0.9
NA	2	0.4	<b>Education</b>		
<b>Hispanic ethnicity</b>			Eighth grade	2	0.4
Non-Hispanic	513	96.4	Some high school	10	1.9
Hispanic	11	2.1	Diploma or GED	46	8.6
NA	8	1.5	Some college	81	15.2
<b>Duration living in study area</b>			Trade or tech degree	75	14.1
Less than 2 years	68	12.8	Bachelor's	170	32.0
2 - 5 years	80	15.0	Advanced degree	145	27.3
5 - 10 years	58	10.9	NA	3	0.6
10 - 20 years	87	16.4	<b>Household size</b>		
20 - 30 years	72	13.5	1	145	27.3
30 - 40 years	51	9.6	2	215	40.4
40 - 50 years	32	6.0	3 to 4	129	24.2
50 - 60 years	18	3.4	5 to 6	40	7.5
60 - 70 years	20	3.8	NA	3	0.6
Greater than 70 years	23	4.3			
NA	23	4.3			

targeted and postcards were delivered to 10,740 residential addresses. Participants were invited to visit the website to take the survey or to request a hard copy of the survey be mailed to them.

In addition to mailings, participants were recruited through word of mouth and via social media networks. The invitation was shared to social media in place- and neighborhood-based, water-based, and recreation-based Facebook groups. Local non-profit environmental organizations such as the St. Louis River Alliance and Friends of the Lake Superior Reserve shared the survey invitation via their newsletters. In-person recruitment was conducted at one local event hosted by the Lake Superior National Estuarine Research Reserve. Survey participants were compensated for participating with a \$10 debit card. The survey was open from mid-October 2022 to mid-December 2022.

### *Data analysis*

After the survey was closed, data were reviewed for quality assurance. The online survey received scam responses, which were dropped from the dataset based on three QA questions in the survey, and responses that were nonsensical, or if the benefits reported were located outside of the study area (see Appendix 2.2 for detailed QA procedures). Following QA review, survey data were deidentified and any information that could allow participants to be identified through direct or indirect identifiers were replaced with non-specific or aggregated categories. Short answers about “other” CES experiences were reviewed for consistency with existing CES categories and grouped accordingly, and a list of other CES categories were identified and compiled.

We used an open coding approach (Ryan and Bernard, 2003) to inductively code short answer responses to seven questions that elicited responses regarding barriers to CES: (1) Describe any negative experiences. (2) Are there things you can't or don't do anymore? (3) Describe any site or environmental barriers. (4) Describe any social barriers. (5) Describe any personal barriers. (6) Describe any other barriers. (7) What should be done to increase access to water experiences? (for wording of survey questions, see Appendix 2.1). We chose this approach rather than applying an existing framework to reduce framing effects, suggestion bias, and potential to reinforce or reproduce the prevailing paradigms around CES. The barriers identified are more accurately

considered barrier themes, because often the actual barrier was unclear; for example, for a respondent that included, “safety” as a barrier, it is unclear what is the specific safety concern or barrier. For simplicity we use “barriers” and “barrier theme” interchangeably. We chose not to adopt an existing classification of barriers to preserve the locally specific context, but summarized results can be compared with existing schemes, as described in the discussion.

We used Fisher’s exact tests (because some groups and categories had small sample sizes) to test for independence between sociodemographic groups (gender, age group, race, income group, education, employment status, size, and duration of residence in study area) and the following: CES categories (e.g., active, art, culture), CES experiences (specific experiences that fall within each category, e.g., for active, this included walking, jogging, etc.), and barriers. We used nonparametric Kruskal-Wallis H-tests to test whether sociodemographic groups influenced the total counts of reported types of CES. For tests rejecting the null hypothesis, we conducted post hoc pairwise Wilcoxon rank sum tests to identify which levels within sociodemographic groups were different. We used the Bonferroni alpha correction for all tests (original alpha level of  $\alpha=0.05$  divided by number of comparisons; Sinclair et al., 2013).

To evaluate how sociodemographic identity influenced benefits and barriers to CES, we used distance-based redundancy analyses (dbRDA, Legendre and Anderson, 1999, McArdle and Anderson, 2001), which is a constrained ordination technique of a similarity matrix (here, CES experiences or barriers to CES) that evaluates the variation attributable to multiple, interdependent predictors (here, sociodemographic groups). This statistical technique allows us to account for non-independence for each respondent within the CES benefits, the CES barriers, and the demographic parameters. At the same time, it allows us to test for which demographics are influential predictors of CES experiences and barriers overall. We ran two dbRDA models; in the first model, the response was a presence-absence matrix of CES categories, whereas in the second model, the response was the presence-absence matrix of barriers to CES. For both dbRDA models, the response was based on Sorenson similarities of the presence-absence matrix, and the response was modeled as function of sociodemographic groups: gender (categorical), age group (continuous), income group (continuous), race (categorical), education level (continuous), employment (categorical), household size (continuous), and residence time (continuous). To

reduce the number of predictors, ordered categories (income group, age group, education, household size, duration of residence in study area) were assigned as continuous based on the mean of the range for each category (e.g., age 50-60 would be 55 for all ages). Hispanic ethnicity was excluded due to small sample size. Observations were excluded if they did not have complete demographic information. We interpret the dbRDA with the assumption that more CES experiences and fewer barriers resulted in increased benefits for human well-being. All analyses were conducted in R (R Core Team, 2021). The dbRDA was conducted using the ``vegan`` package (Okasanen et al., 2023). Figures were generated using the ``ggplot2`` and ``tidyverse`` packages (Wickham, 2016; Wickham et al., 2019).

## **Results**

The Waterway Benefits Survey received 1,354 online, and 13 hard copy responses. After QA review of the online surveys, the usable sample was 532. We attribute the large portion of surveys eliminated in QA review to attempts to obtain the \$10 debit card offered to participants without taking the survey, as an invalid participant, or both. At the time of the study, the Survey123 platform did not have a way to minimize scam responses in surveys open to the public. The response rate based on mailer recruitment was 5%, although we did not collect data on recruitment source. The survey was conducted in Fall 2022 during the COVID-19 pandemic. Most (67%) participants indicated that the pandemic did not affect their experiences with water in the study area, while 19% indicated the pandemic had a positive impact, 11% indicated it had a negative impact, and 3% indicated it had an impact but did not indicate if it was positive or negative. Three (<1%) participants indicated both positive and negative impacts.

### ***Response demographics***

Similar numbers of men and women responded to the survey; few NB/GE people responded (Table 2.2). Although participation dropped with increasing respondent age group, each age group had at least 42 participants. The number of participants in each income group was relatively consistent, ranging from 21 to 26%. Most respondents identified as White and non-Hispanic. Exceptions included 38 individuals (7%) who identified as Native American alone and 28 (5%) who identified as White and Native American. We use the term Native American because although this study was conducted in Ojibwe territory, we did not ask participants for

detailed information about their ethnicity, and Native American respondents may represent members and descendants of many different Tribal Nations. Most respondents were educated with a bachelor's degree or an advanced degree, and were employed or self-employed, retired, or students. Household sizes of two were most common. Most respondents reported residing in the study area for 10 to 20 years.

### ***Cultural ecosystem service experiences***

Cultural ecosystem services were ubiquitous among participants; 80% of all respondents reported experiencing at least seven of the ten categories. (Fig. 2.2a). At least 83% of respondents experienced most categories, except education/learning, work/stewardship, and wild food experiences, which included hunting, fishing, foraging, and trapping.

The four most cited CES experiences included walk/hike, appreciate aesthetics, socialize with others, and rest, relax or reflect (Table 2.3). In general, experiences that required physical or athletic abilities (e.g., jogging/running), specialized knowledge (e.g., foraging), or specialized gear (e.g., fishing from a boat), or all three (e.g., sailing) were less common than experiences without those requirements (e.g., picnicking). The two least common experiences included hunting and trapping, which have all three requirements. An exception was paddling, which nearly half of the population had experienced, despite its requirements. Other less frequently reported experiences include those that may only be relevant to certain populations, such as attending a faith-based service or gathering, paid work, or practicing traditional knowledge, which was considered water or land-based knowledge, skills, or practices passed on across generations.

In addition to the 48 experiences on the survey, respondents identified 41 other CES experiences. Fourteen were mentioned by multiple participants, (Table 2.4) for example, enjoying a home with a view of the water was mentioned by 9 respondents. Twenty-seven others were mentioned by only one participant (Appendix 2.3). If the survey had included these as an option, more respondents may have reported experiencing these, so they were not included in further analysis.

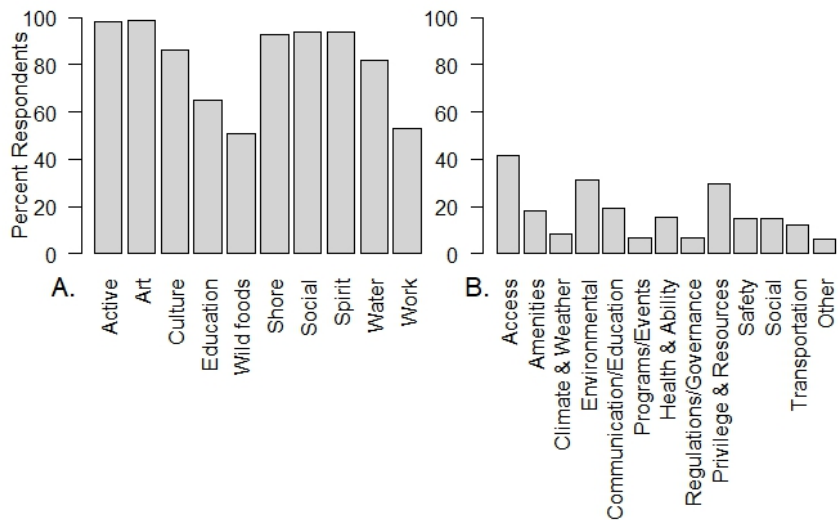


Figure 2.2 Percent respondents reporting experienced CES categories (A) and barrier themes (B) within the last year. See Table 2.3 for description of experiences included in each CES category; see Table 2.7 for description of barrier themes.

Table 2.3. Table of all CES categories and experiences along with their description and the percent of total response population (N = 532) reporting each. For a full description of each experience included in the survey, see Appendix 2.1.

CES	Description	%
<b>Active</b>		
Walked	Walked or hiked along or overlooking water	95.9
Biked	Bicycled along or overlooking water	40.2
Jogged/ran	Jogged or ran along or overlooking water	32.5
Skied	Cross country skied, skijored, or snowshoed	31.6
Skated	Ice skated or played hockey at or on a natural waterbody	17.7
Sports	Played team or individual sports at the water	12.2
Other	Other active experiences	1.5
<b>Art</b>		
Aesthetics	Appreciated the scenery, view, or beauty of water or shoreline	94.7
Art	Appreciated art associated with water in the study area	60.5
Materials	Searched for or harvested materials for making art or traditional use	51.3
Inspiration	Found artistic inspiration for work or a hobby from the water	42.9
Art	Made art from or associated with the water as a hobby or for profit	42.3
Named	Named something in your personal life or business after a water-related natural setting or feature in the study area	15.8
Other	Other art experiences	0.6
<b>Culture</b>		

History	Visited, learned, or taught about an historical, cultural, or family history site associated with water	70.7
Annual	Attended or participated in an annual or recurrent ceremony at or overlooking water	45.1
Milestone	Attended or participated in milestone ceremony or tradition at or overlooking water	32.9
Practiced TEK	Practiced traditional knowledge at or involving water	22.9
Other	Other cultural experiences	1.3
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Education		
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Hobby/skill	Learned, developed, shared a hobby/skill at or overlooking water	45.7
Shared TEK	Learned/shared traditional knowledge associated with water	28
Classes	Participated in formal education at or overlooking water	22.7
Learned	Participated in informal education at or overlooking water	21.4
Other	Other educational experiences	0.2
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Wild foods		
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Fish-shore	Fished from shore	26.9
Forage	Harvested or foraged for food or medicinal plants at or overlooking water	26.5
Fish-boat	Fished from a boat	26.3
Ice fished	Ice fished	14.7
Hunted	Hunted with a gun or bow for food at or overlooking water	8.5
Trapped	Trapped animals for fur or food at or overlooking water	1.7
Other	Other wild food experiences	0.2
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Shore		
<hr/>		
Picnicked	Picnicked at or overlooking water	63.5
Wildlife	Birdwatched or viewed wildlife at or overlooking water	57.9
Pets	Exercised a pet at or overlooking the water	46.8
Snow play	Played in snow at or overlooking water	38.5
Camped	Camped at or overlooking water	35.2
ATVed	Used a motorized recreational vehicle at or overlooking water	12.4
Other	Other shore experiences	0.9
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Social		
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Socialized	Socialized with friends or family at or overlooking water	90
Events	Attended a public gathering/event sponsored by a government, organization, or business at or overlooking water	48.7
Club/group	Attended an event sponsored by local club or group at or overlooking water	40.6
Other	Other social experiences	0.4
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Spirit		
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Relaxation	Rested, relaxed, reflected, or recuperated at or overlooking water	88
Mindfulness	Practiced meditation (still or moving) or mindful breathing at or overlooking water	46.6

Deceased	Remembered or honored deceased ancestors or loved ones at or overlooking water	39.5
Prayed	Prayed or connected to higher power at or overlooking water	37.2
Faith	Attended a faith-based service or community gathering at or overlooking water	17.9
Other	Other spiritual experiences	0.4
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Water		
Swam	Swam or soaked	65.8
Paddled	Paddled or rowed a boat	48.1
Boated	In a motorized boat or personal watercraft, waterskied, tubed, etc.	32
Sailed	Sailed or rode on a sailboat	12.8
Other	Other water experiences	1.1
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Work		
Caretaking	Caretaking for water not associated with a volunteer organization	36.5
Paid work	Worked/held a paid position associated with water or waterfront	19.2
Volunteer	Volunteered for an organization at or overlooking water	16.9
Stewardship	Took part in water or shore management or restoration activities	9.4
Other	Other work experiences	0.4
Other	Other experiences	6.4

Table 2.4 CES experience reported in short answer “other” questions in addition to multiple choice CES listed. This table includes categories with at least two respondents; see Appendix 2.3 for additional experiences listed by only one respondent.

CES experience reported	Example responses (Respondent ID number)	No. reported
Live on or in home with water view	"I overlook the lake from my 9th floor downtown apartment. I gaze out at it every single day and it fills me with awe and peace." (ID572); "I live next to the water and connect with it every day." (ID749)	9
Wading/creek walking	"Exploring creek beds" (ID1496); "Walked in shallow waters" (ID779); "Wade in the various creeks and beaches in this area" (ID226)	7
Driving	"I love seeing the marina as I drive through Superior." (ID449); " I rent cars and drive Hwy 23 & it is beauty-full!" (IDHC006)	4
Worked with view of water during work	"Had work meetings at parks along the Cloquet and St. Louis Rivers." (ID849); "Worked remotely while overlooking the water." (ID887)	3
Research or monitoring of environment	"Researching the {water} of the Great Lakes for my Graduate Thesis." (ID673); "Performing scientific research on Lake Superior." (ID482)	3
Teach kids about nature	"Activities related to children." (ID1494); "Teaching our kids about how the estuary works and making experiences with them around Lake Superior and the estuary a priority." (ID408)	3
Stargazing	"One of the best places to view the Northern lights is from the Wisconsin side of the St. Louis Bay" (ID395); "Because of Thee lake / Because No-body can live on it >It is dark @ night & I can see HEAVEN! :)" (IDHC006)	2
Rock climbing	"Rock climbed." (ID461, ID177)	2

Enjoy plants	"Enjoyed the rose garden" (ID520); "Try to ID plants near shore." (ID425)	2
Drinking water/water use	"Collecting drinking water from natural springs" (ID241); "Drink the water, use the water for washing" (ID398)	2
Political advocacy/resistance	"I am a water protector.....fought with migizi will fly line 3 resistance camp...was arrested defending water...have wrote political resolutions to state and tribal delegates. Many things to support keeping water ways clean" (ID432); "Strong participation in saving the Boundary Waters Canoe Area Wilderness from the harmful effects of sulfide ore copper mining." (ID638)	2
Sharing the water with visitors	"Bringing others (family and friends from out of town) to experience the water and wilderness" (ID868); "Take visitors to Wisconsin Point" (ID449)	2
Grew up in the study area	"I grew up in the area I've had lots of experience with this beautiful lake" (ID819); "I grew up right off Lake Superior and played daily on the shores and would swim in the water walk along the creeks and collect Lake Superior agates." (ID1495)	2
Listening to water	"Listening to the sound of water (waves, stream flow, rain on water, etc.) is important to me" (ID227)	2

#### *CES and sociodemographic groups*

The percent of respondents reporting specific CES experiences varied by sociodemographic group (Figs. 2.3 and 2.4; See Appendix 2.4 for p-values). Women more frequently reported making art inspired by the water, collecting natural materials for art, meditating, and relaxing. Men more frequently reported recreational experiences such as biking, playing sports, fishing from boat, shore, or on ice, hunting, trapping, ATVing, boating, sailing, and volunteering. Socializing with friends and family was reported by fewer older respondents. Likewise, jogging and swimming, both experiences with high physical requirements, were reported at a lower rate by older participants. Conversely, skiing and caretaking (stewardship or care for water or waterfronts) were reported more frequently by older age groups. Some CES were reported most frequently by middle age groups including ATVing and honoring a deceased loved one. Higher income groups reported biking, skiing, fishing by boat, exercising pets, playing in the snow, participating in clubs or groups, attending public events, boating, paddling, sailing, caretaking, stewardship activities, and paid work more frequently than lower income groups. Many CES were significantly associated with race, with more Native American alone, and Native American/White, participants reporting collecting materials for art, annual events, milestone events, practicing and sharing traditional ecological knowledge (TEK), formal and informal education, fishing from a boat, from shore, and on ice, foraging, hunting, trapping, ATVing,

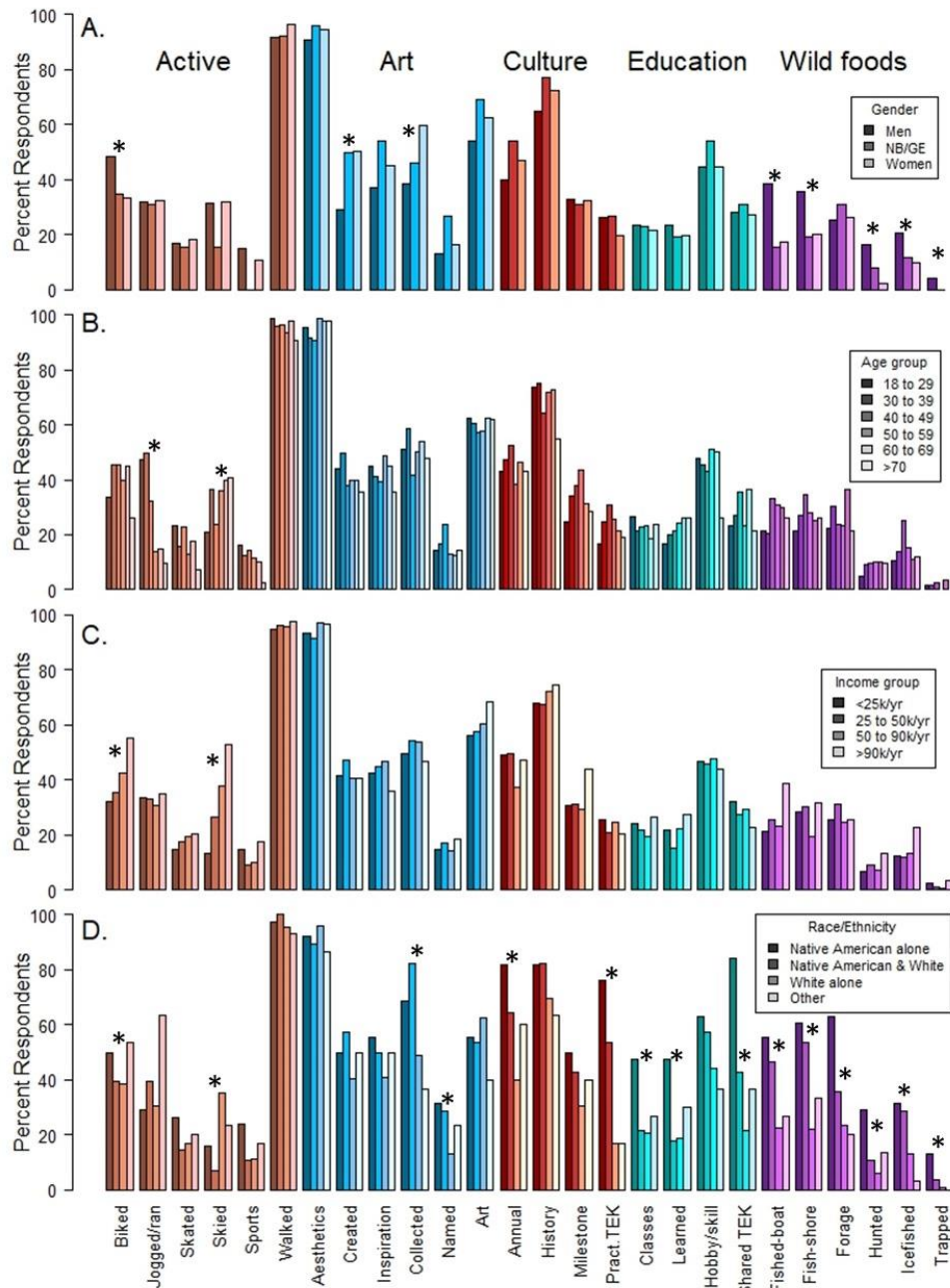


Figure 2.3 Percent respondents reporting individual CES experiences in the active, art, culture, education, and wild food categories, by A. gender, B. Age group, C. Income group, and D. race. CES with a star indicate that there was a significant association between the count reporting the CES and sociodemographic group based on a Fischer Exact Test (See Appendix 8 for p-values; see Table 2.3 for description of each CES). NB/GE indicates nonbinary and gender expansive participants. Darker colors for each category correlate with darker colors in the legend.

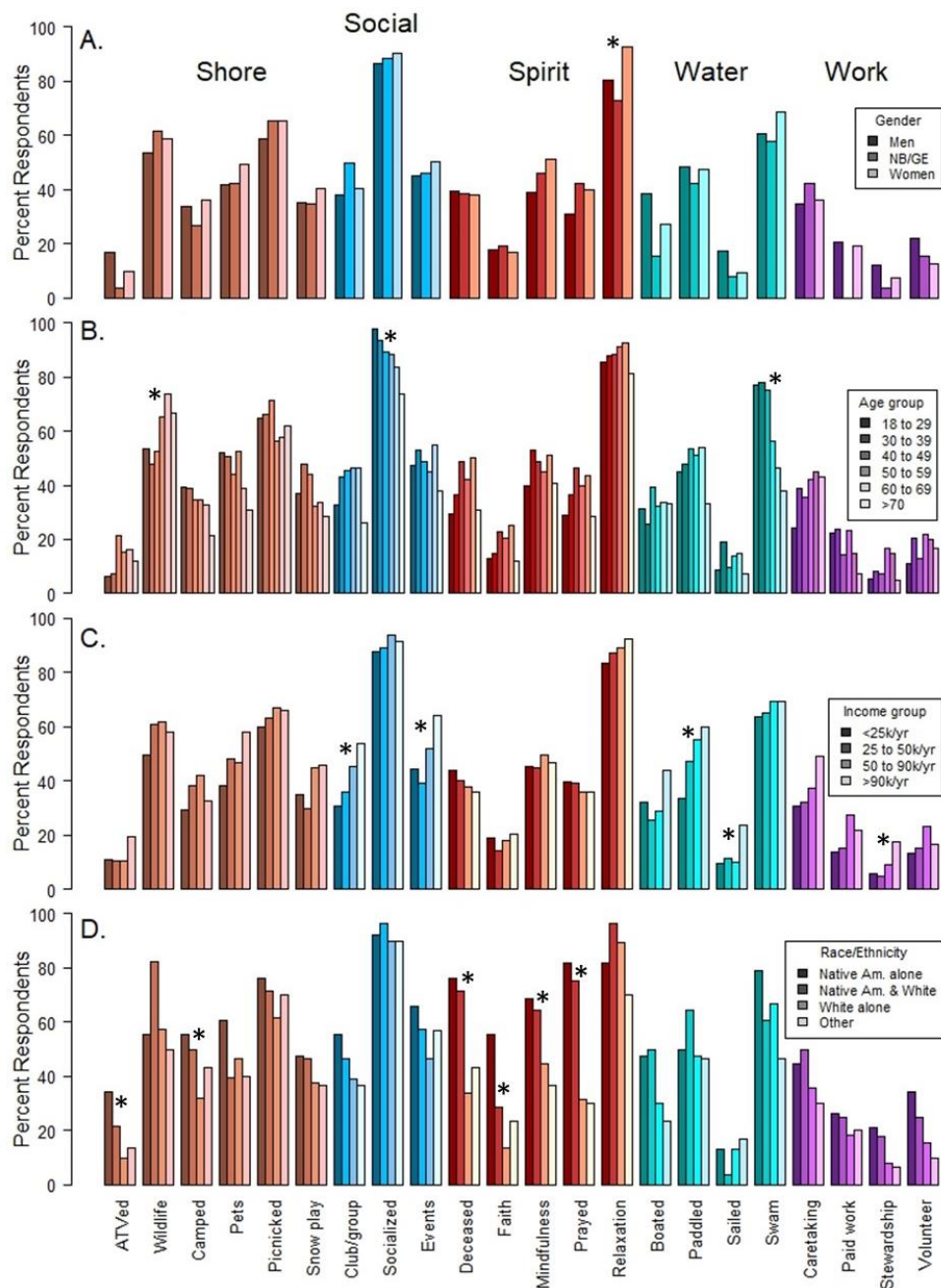


Figure 2.4 Percent respondents reporting individual CES experiences in the shore, social, spirit, water, and work categories, by A. gender, B. age group, C. income group, and D. race. CES experiences with a star indicate that there was a significant association between the count reporting the CES and that sociodemographic (See Appendix 2.4 for p-values; see Table 2.3 for description of each CES). NB/GE indicates nonbinary and gender expansive participants. Darker colors for each category correlate with darker colors in the legend.

camping, honoring deceased loved ones, faith-based services, practicing mindfulness and meditation, praying, boating, and volunteering. Only skiing and jogging were reported more often by White participants and Other or Mixed-race participants than by Native American alone and Native American/White participants, respectively.

In terms of the broader CES categories, gender was significantly associated with percent reporting spiritual experiences only (Fig. 2.5, Appendix 2.4). Age group was significantly associated with percent reporting water experiences, with generally fewer older age group participants reporting these. Income was significantly associated with percent reporting water and work experiences, with a higher proportion of higher income participants reporting these experiences. A higher proportion of Native American alone and Native American/White participants reported education and wild food experiences than White and Other or Mixed-race participants.

Race and duration of residency in the study area were significantly associated with both the total number of CES experiences reported and the number of CES categories reported (Table 2.5). The total number of CES reported and the total number of CES categories reported by Native American alone and White participants were different ( $p < 0.001$ , Bonferroni-corrected  $\alpha = 0.008$ ). The number of CES categories was different for a duration of residency of two years versus a residency of 10 to 20 years ( $p = 0.001$ ; Bonferroni corrected  $\alpha = 0.001$ ).

To evaluate how demographics influence CES categories and barriers to CES while accounting for non-independence of an individual's demographics and experiences, we conducted a dbRDA. The dbRDA only accounted for 11.0% of the variance for CES categories (Fig. 2.6, Table 2.6), demonstrating that demographics alone cannot account for much of the variation in how individuals experience CES. Even such, there are some meaningful trends worth noting. Some types of CES responded similarly by sociodemographic group. For example, culture, education (edu) and work experiences responded similarly, plotting together in the lower right quadrant, while active, wild food, and water experiences plotted together in the top right quadrant (Fig. 2.6). This group of CES experiences was negatively correlated with age while spiritual

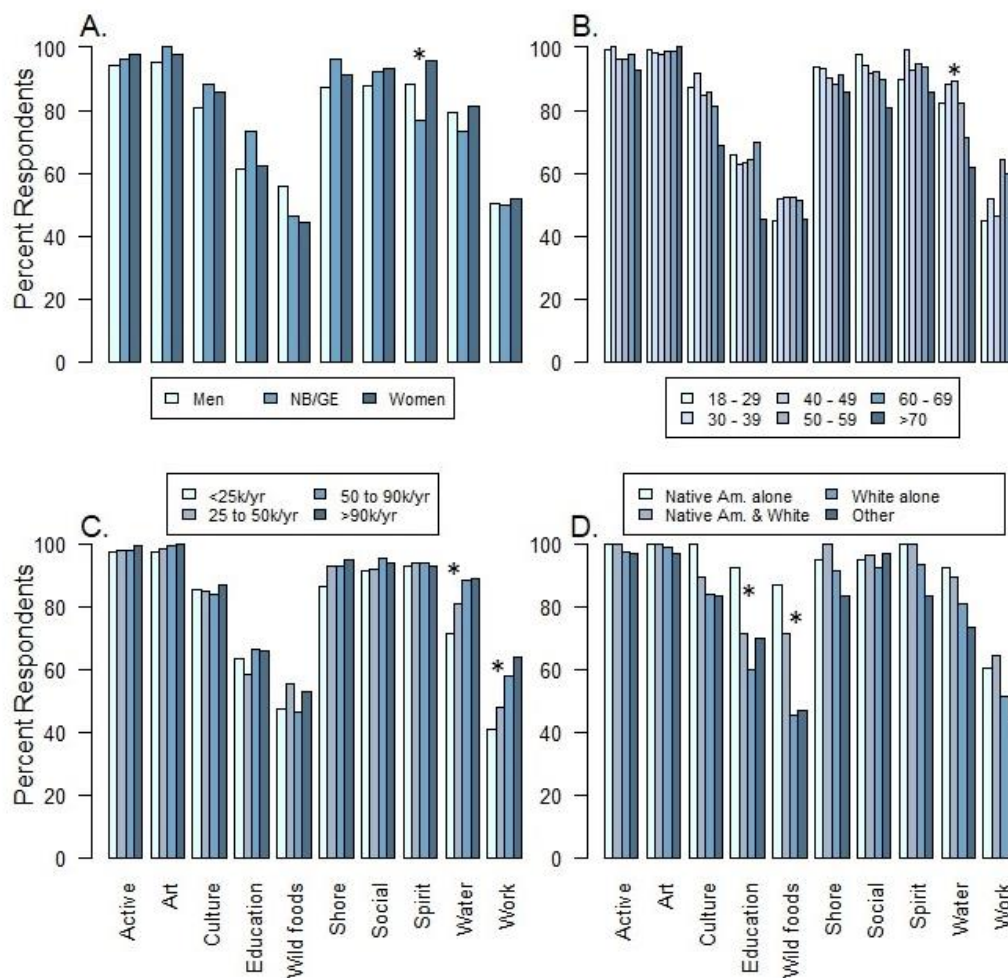


Figure 2.5 Percent of respondents reporting CES categories by A. gender, B. age group, C. income group, and D. race. CES categories with an star indicate that there was a significant association between the count reporting the CES and that sociodemographic (See Appendix 2.4 for p-values; see Table 2.3 for description of each CES category). NB/GE indicates nonbinary and gender expansive participants.

experiences were positively correlated. Education level (edu level) was positively correlated with cultural, educational, and work CES benefits. Race was also a significant factor with respect to CES experiences. The largest differences were between White and Native American alone race groups (Fig. 2.6b, their ellipses do not overlap). Native American alone participants plotted further right, indicating Native Americans reported more types of CES experiences than White participants. Native American/White respondents fell in between White and Native American

Table 2.5 Statistics of analyses for Kruskal-Wallis H-test of the effect of sociodemographic group on total number of CES experiences reported and total number of CES categories reported. P values significant at a Bonferroni-corrected  $\alpha \leq 0.05 / 9 = 0.006$  are shown in bold.

Sociodemographic	CES Experiences			CES Categories		
	df	$\chi^2$	p-value	df	$\chi^2$	p-value
Gender	2	0.579	0.748	2	0.144	0.930
Age group	5	4.389	0.495	5	6.931	0.226
Income	3	9.21	0.027	3	7.242	0.065
Race	5	29.046	<b>&lt;0.001</b>	5	30.826	<b>&lt;0.001</b>
Hispanic ethnicity	1	0.687	0.407	1	0.047	0.828
Education	6	16.365	0.012	6	13.484	0.036
Employment	5	15.419	0.009	5	10.675	0.009
Household size	3	2.476	0.480	3	2.781	0.480
Residency Duration	9	29.328	<b>0.001</b>	9	31.364	<b>0.001</b>

Table 2.6 Results of a distance-based redundancy analysis (dbRDA) evaluating how CES experiences change by sociodemographic groups. The CES experiences were grouped into ten categories, and the model's response was the presence or absence of each of these categories for each survey participant. P values significant at  $\alpha = 0.05$  are shown in bold.

Endpoint and Source of Variation	df	F	p
Cultural ecosystem services			
household size	1	0.370	0.717
age	1	5.411	<b>0.006</b>
income	1	2.503	0.067
education level	1	3.727	<b>0.022</b>
residence time	1	2.407	0.094
employment	5	2.316	<b>0.018</b>
gender	2	0.714	0.609
race	2	4.480	<b>0.006</b>
residual	389		

alone and were not different from either group, indicating that CES experiences for Native American/White individuals were intermediate between the two races. Lastly, the biggest differences for employment were between people working and unable to work. People unable to work reported fewer types of CES experiences than people working and students. Income was not significant in this analysis.

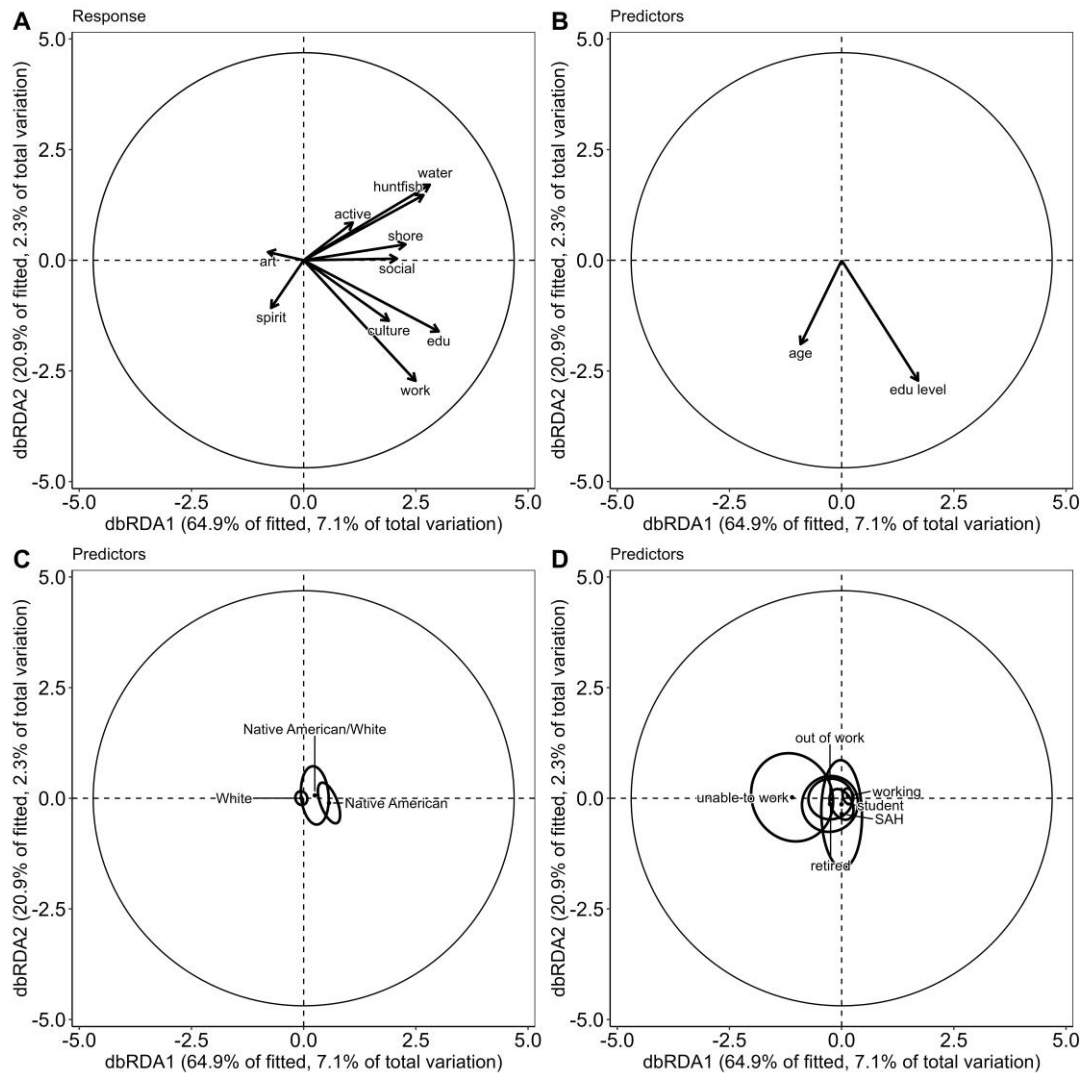


Figure 2.6 Results of dbRDA analysis for CES experiences and sociodemographic groups. (A) Plot of the model's response, the CES experience categories. (B), (C), and (D) Corresponding overlay plots of model's statistically significant predictors, showing the additive effects of demographics. Demographics are shown in separate panels for ease of visualization. In (C) and (D) points and ellipses are the centroids and 95% confidence intervals of correspondents' race and employment status. In all plots, the black circles correspond to vector lengths that would have a correlation coefficient of one with each axis. We show only the predictors which significantly influenced the response ( $\alpha = 0.05$ ). The entire dbRDA model explains 11.0% of the variance of benefits of CES. Additional statistical output for the model can be found in Table 2.5. The huntfish category shown here corresponds to the Wild foods category of CES experiences. For interpretation, arrows and points with ellipses in the same quadrant indicate that the variables are positively correlated.

### *CES Barriers*

We identified 13 barriers themes, and 132 specific barrier subthemes (Table 2.7). Eighty-nine percent of respondents reported at least one barrier to benefits from the water. The most reported theme was access, followed by environment, resources, and communication/education (Fig. 2.2b). Each theme included a diverse set of subthemes. Survey responses encompassed a wide range of topics ranging from site-scale issues like litter to societal-scale issues like housing insecurity and chronic illness.

Sociodemographic groups were rarely significantly associated with barriers; no barriers were significantly associated with gender, income, or race (Fig. 2.7, see Appendix 2.5 for p-values of Fisher exact tests). For age, the only significant association found was for older age groups reporting barriers associated with health/ability more frequently ( $p=0.006$  equal to the Bonferroni-corrected  $\alpha$  of 0.006; Appendix 2.5). Although not statistically significant, a higher proportion of NB/GE people reported barriers in most categories than women or men, and a higher proportion of women reported barriers than men (Fig. 2.7). These findings are consistent with a lower proportion of women and NB/GE individuals reporting recreational CES experiences, suggesting these respondents face greater barriers than men. A higher proportion of respondents in younger age groups reported barriers associated with resources. Native American/White participants reported barriers associated with the theme resources most frequently, and Native American alone respondents reported barriers associated with resources less frequently than other races. This theme included responses about having time, access to gear or equipment, financial resources, and appropriate knowledge and skills (Table 2.7).

Distance-based redundancy analysis accounted for only 6.4% of variation (Fig. 2.8, Table 2.8). Education level and gender are correlated with barriers to CES. With increased education, respondents reported more barriers associated with resources, communication/education, and access. There is separation in barriers to CES by gender. The largest difference is between NB/GE expansive participants and the other two genders, who were less likely to report barriers. Nonbinary and gender expansive people were more likely to report social, transportation, health, and environment barriers.

Table 2.7 Barrier themes and subthemes identified from short answer responses on the survey, along with percent of total response population (N = 532) reporting each theme and subtheme. Theme totals are shown in bold, with subtheme within each theme shown in plain text under theme totals.

<b>Barrier theme/subtheme</b>	<b>Percent respondents reporting</b>
<b>Access barriers (all)</b>	<b>41.5</b>
General access	13.7
Universal access (general)	6.6
Restrict shoreline development	5.8
Access in specific locations	5.5
Maintenance of waterfront (general)	4.7
Closures due to construction	3.0
Maintenance of waterfront: trails	2.8
Maintenance of waterfront: shoreline	2.1
Closures of access due to clean-ups	1.5
Equitability of access	1.3
General closures of access	1.1
Sustainable access/amenities	1.1
Maintenance of waterfront: vegetation	1.1
Universal access: ramps on beach	1.1
Balance access and wildness	0.9
Maintenance of waterfront: graffiti/vandalism	0.9
Maintenance of waterfront: infrastructure and amenities	0.9
Maintenance of waterfront: specific locations	0.8
Closures of former access points	0.6
Winter	0.6
Avoid/reduce gentrification	0.4
Open hours	0.4
<b>Environmental barriers (all)</b>	<b>31.2</b>
Pollution (general)	15.0
Litter/garbage (general)	9.4
Conservation/protection (general)	6.8
Litter/garbage: proper disposal	2.6
Litter/garbage: drug paraphernalia	2.1
Pollution: environmental threats	1.9
Conservation/protection: invasive species	1.7
Pollution: fish contamination	1.3
Litter/garbage: dumping	0.8
Pollution: runoff/storm sewer discharge	0.8
<b>Personal resource barriers (all)</b>	<b>29.7</b>
Time (general)	13.3

Time: work responsibilities	8.6
Gear/equipment	6.2
Financial resources	5.5
Time: family responsibilities	3.0
Knowledge/skills: where to go	1.9
Knowledge/skills: general	1.5
<b>Communication/education barriers (all)</b>	<b>19.2</b>
Communication and Education (general)	6.8
Communication/education: signage (general)	3.9
Communication/education: about how to access	3.8
Communication/education: about environment/nature	2.8
Communication/education: classes to learn skills	1.7
Communication/education: for youth	1.3
Communication/education: interpretive signage	0.8
Communication/education: about well-being benefits	0.6
Communication/education: about Indigenous culture	0.6
Communication/education: about water safety	0.6
<b>Amenity barriers (all)</b>	<b>18.2</b>
Bathrooms	5.6
Trails	3.9
Other amenities	2.3
Tables, benches, shelters	2.3
Canoe/kayak access	1.5
Boat launches	1.3
Safe swimming holes	1.3
Camping areas	1.1
Kid-friendly	1.1
Boat rentals	0.8
Docks, piers, jetties	0.8
Temporary docking/shore-based land access	0.6
<b>Health/ability barriers (all)</b>	<b>15.2</b>
Mental health (general)	3.4
Aging	2.4
Other medical/illness	2.1
Physical ability/fitness	2.1
Fatigue/energy	1.7
Health and ability (general)	1.7
Mobility	1.5
Chronic illness	1.1
Mental health: grief/loss	1.1

Disability	0.9
Surgery or injury	0.9
<b>Social barriers (all)</b>	<b>15.0</b>
Crowds	8.8
Lack of companionship/community	2.3
Housing insecurity	1.9
Partying	1.7
Tourists	1.3
Fires	0.9
Noise	0.9
Belonging	0.6
Being asked for money from others	0.4
<b>Safety barriers (all)</b>	<b>14.8</b>
Safety (general)	4.1
Violence/harassment/fear of others	3.0
Gender safety	1.9
Dogs	1.5
Safety amenities	1.5
Boat speed	1.5
Water/boat safety	1.5
Swim safety	1.3
Public health	1.1
Vehicle speed	1.1
Lighting	0.6
Racism	0.6
Crime/theft/break-ins	0.0
<b>Transportation barriers (all)</b>	<b>12.0</b>
Pedestrian access	2.8
Personal transportation	2.8
Public transportation	2.8
Parking (general)	2.6
Parking: availability	2.6
Cycling access/infrastructure	1.5
Travel time	1.5
<b>Climate/weather barriers (all)</b>	<b>8.3</b>
Weather (general)	5.1
Changing climate: flood/storm damages	1.3
Changing climate (general)	1.1
Weather: long winters	1.1
<b>Community programs/events barriers (all)</b>	<b>6.8</b>

Events and communities (general)	4.5
Volunteer opportunities	1.1
Events and communities: for marginalized groups	0.6
Events and communities: with easy access	0.4
Outdoor businesses	0.4
<b>Regulations/governance barriers (all)</b>	<b>6.6</b>
Enforcement of laws	1.5
Funding for protecting/providing access to environment	1.5
Public engagement in decision-making	1.1
Costs of permits	0.9
Harvest/permit regulations	0.9
Indigenous management/science	0.9
Environmental justice	0.8
Lack of government support	0.8
Rights of Nature	0.4
<b>Other (all)</b>	<b>6.0</b>

Table 2.8 Results of a distance-based redundancy analysis (dbRDA) evaluating how CES barrier themes change with demographics. The model's response was the presence or absence of each of 13 barrier themes for each survey participant.

Endpoint and Source of Variation	<i>df</i>	F	p
Barrier themes			
household size	1	0.917	0.502
age	1	1.564	0.182
income	1	2.026	0.068
education level	1	6.439	0.001
residence time	1	0.751	0.573
employment	5	1.167	0.257
gender	2	2.172	0.025
race	2	0.546	0.809
residual	389		

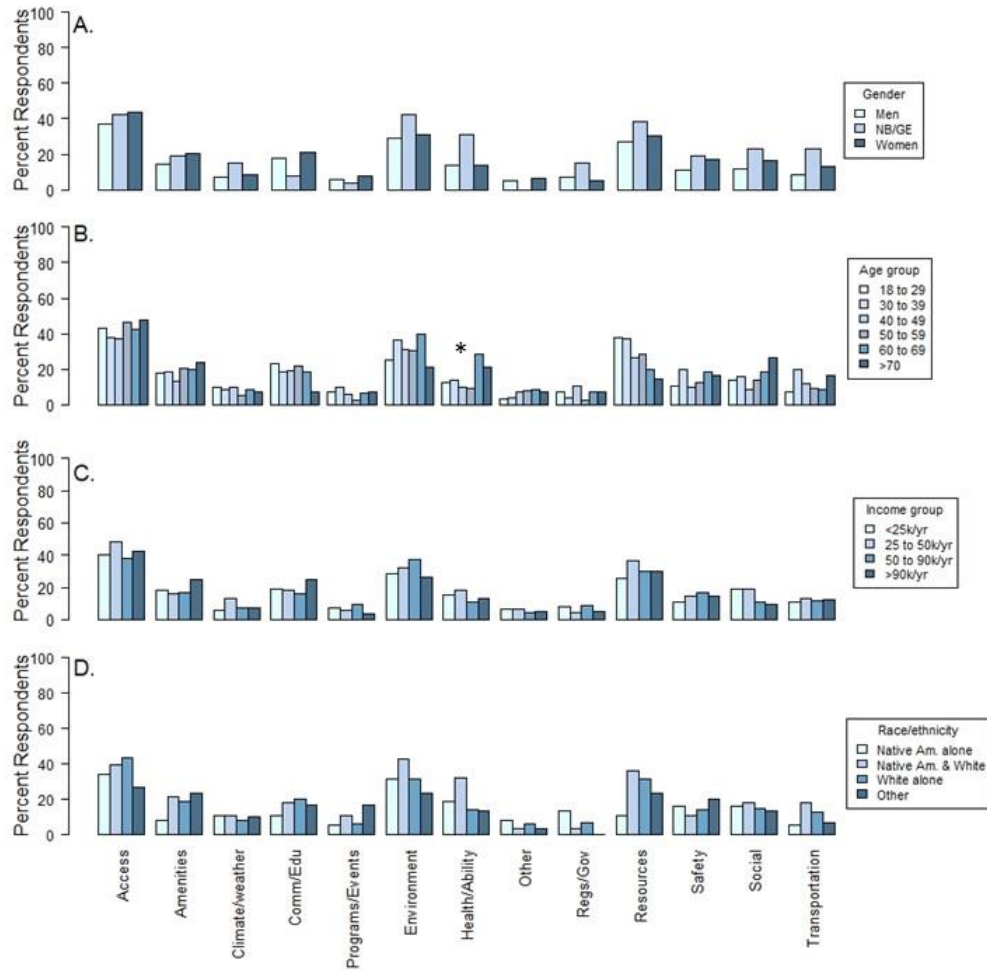


Figure 2.7 Percent respondents reporting barrier themes, by A. gender, B. age group, C. income group, and D. race. Barriers with a star indicate that there was a significant association between the count reporting the barrier and sociodemographic group. See Appendix 9 for p-values.

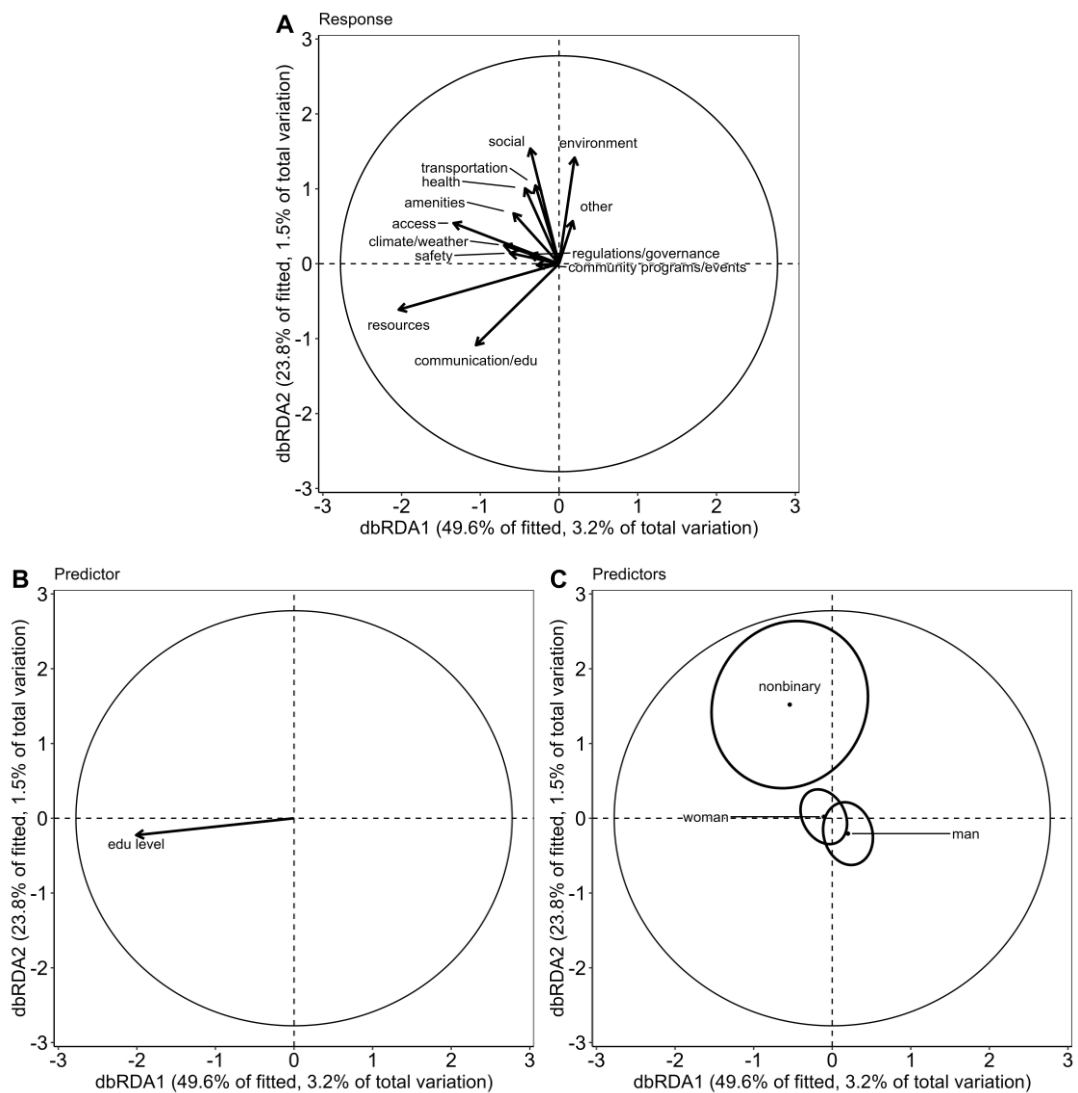


Figure 2.8 Results of dbRDA analysis for barriers to CES and sociodemographic groups. (A) Plot of the dbRDA model's response, the barriers to CES. (B) and (C) Corresponding overlay plots of model's statistically significant predictors, showing the additive effects of demographics. Demographics are shown in separate panels for ease of visualization. Arrows and points/ellipses in the same quadrant in the three plots indicate that the variables are positively correlated. In (C) points and ellipses are the centroids and 95% confidence intervals of correspondents' race. In all plots, the black circles correspond to vector lengths that would have a correlation coefficient of one with each axis. The entire dbRDA model explains 6.4% of the variance of benefits of CES. Additional statistical output for the model can be found in Table 7. Nonbinary group includes individuals who identified as nonbinary and gender expansive.

## **Discussion**

In the study area, CES benefits varied among sociodemographic groups, with some groups associated with higher reports of CES benefits and reduced barriers and vice versa. Our results showed how sociodemographic identity structures both barriers to and benefits of CES, and how both barriers and benefits can be understood as emergent properties of the relationship between an individual's perception of themselves relative to the environment. We discuss our results by sociodemographic group, followed by consideration of how the intersection of multiple sociodemographic identities is associated with CES experiences. We then evaluate the applied CES assessment method. Next, we discuss how the CES barriers identified can be considered according to affordance theory as emergent and dynamic properties of an individual's perceptions of their identity relative to the environment, rather than as stemming from one or the other. We conclude with how our findings about the fundamentally integrated nature of CES benefits, CES barriers, and identity might inform conceptualization and assessment of CES to inform more equitable environmental planning and decision-making.

### ***CES experiences and barriers by sociodemographic group***

#### *Gender*

A higher proportion of men than women reporting recreational activities is consistent with historic and current national patterns of lower participation and in some cases exclusion of women from recreation spaces (e.g., Bordelon, 2019; Huybers-Withers & Livingston, 2010; Burton, 2015; Carini and Webber, 2017; Heberlein et al., 2008; Crawley, 1998; Henderson and Gibson, 2013). It is also consistent with limited research on NB/GE individuals, but NB/GE participants are rarely included in statistical assessment due to low sample numbers, as is the case here (Colley et al., 2022). Conversely, women and NB/GE respondents reported higher rates of inspiration, art, and mindfulness, while women alone reported higher rates of relaxation. Bell and coauthors (2015) identified four dimensions of therapeutic experiences associated with coasts: immersive experiences, goal achieving experiences, social experiences, and symbolic experiences. They did not find a link between reports of these dimensions and gender, but in this study, a higher proportion of women experienced immersive and symbolic experiences such as making art, collecting natural materials, meditating, and relaxing, and while a higher proportion of men reported achieving experiences such as recreational experiences like biking, playing

sports, fishing, or sailing. White et al. (2020) frames similar patterns in terms of gender-based differences in energy expenditure with causes rooted in social constructions of masculinity that encourage men more than women to pursue athletic activities.

Women more frequently reported making art inspired by the water, collecting natural materials for art, meditating, and relaxing. Men more frequently reported recreational experiences such as biking, playing sports, fishing from boat, shore, or on ice, hunting, trapping, ATVing, boating, sailing, and volunteering.

The only barrier theme identified that was inherently linked to a sociodemographic group was gender safety, reported by 2% of respondents. This theme was assigned to comments that explicitly mentioned safety in relation to a participant's gender. This may partially explain our finding that men reported higher rates of recreational benefits than women and NB/GE. Women and NB/GE participants reported safety barriers more frequently than men (although this was not statistically significant), reflecting increased fear and concern about personal safety than men in green spaces (Sreetheran and van den Bosch 2014; Pitt, 2019; Kilgour and Parker, 2013).

#### *Age and employment*

Older age groups and those unable to work derived fewer CES than younger age groups able to work. This trend may be attributable to the finding that age was associated with health-related limitations, as has been reported elsewhere (Pitt, 2019; Ghimire et al., 2014). A notable exception was skiing, which was reported at a higher rate by older age groups. Cross-country skiing is a popular activity in the study area which experiences long winters. Although cross country skiing does have a health requirement, it is lower compared to other activities like jogging and swimming, which older age groups reported less frequently. However, it does have a knowledge and gear requirement, which may limit participation by younger participants with less experience and fewer financial resources for equipment. A significantly lower percent of older participants reported barriers associated with resources, likely because those of retirement age have more time, and wealth can accumulate with age.

Overall, our results suggest that patterns of CES experiences and benefits change throughout life, with younger participants more commonly reporting physically demanding and social experiences, and older participants appreciating slower-paced and nature-based activities. De Bell et al. (2017) found that older age groups found nature more important than younger groups and placed a lower value on socializing in nature. This shift in how nature is valued associated with age was consistent with our finding that older age groups reported wildlife and birding experiences more frequently than younger participants. In addition, our data also suggest an increasing awareness of environmental concerns with age. Older age group participants reported environmental barriers more often than younger participants, and caretaking for nature was reported more frequently by older age groups. Socializing with family or friends was also reported less frequently for older age groups, suggesting older populations may seek out nature experiences rather than social ones consistent with de Bell et al., (2017). Alternatively, older age groups may have experienced more barriers to socializing. Older age groups reported more social barriers, but the finding was not significant. This could have been because the social barrier theme included both in-group barriers like having companionship and belonging, and out-group barriers like crowding and anti-social behavior.

### *Income*

Although income group was associated with proportion of respondents reporting individual CES experiences, especially recreation experiences, income was not significantly associated with barriers. This finding was surprising because the importance of income in predicting both benefits and barriers is well established in the literature (White et al., 2020; Ghimire, 2014). Our survey methods may be the cause of this difference in result. Because barrier themes were identified inductively based on responses received, rather than through multiple-option questions like in our CES assessment, associations may be harder to detect due to higher variability. This approach resulted in barriers that are linked and, in some cases, interdependent, which is discussed below. Furthermore, while income was not, education was significantly associated with barriers. This result could also be because respondents with higher educational attainment were more likely to be aware of and able to articulate barriers or were more responsive to the short answer question format due higher understanding of or trust in the research and researchers. Because education is

correlated with income, this correlation likely reduced our ability to detect real associations between income and barriers, should they exist for this population.

### *Race*

Native American alone participants derived more unique CES benefits and reported barriers less frequently than the other racial groups evaluated in this study. This result is at odds with studies that have found racial minorities face increased barriers to and fewer benefits from CES (e.g., Morris et al., 2011; Dean et al., 2022; Ghimire et al., 2014; Byrne, 2012, White et al., 2020). Although data on specific ethnicities were not collected, many Native American alone participants were likely of Ojibwe descent. The Ojibwe continue to have deep, multi-generational connections with the land and water in the study area, despite federal policies designed and implemented over the last 200 years to abolish and terminate Indigenous culture (e.g., Clinton et al., 2007). Furthermore, this study was framed to include CES that span cultural conceptions of relationships with nature and thus revealed many diverse benefits experienced especially by Indigenous individuals. These findings corroborate examples from Maori and Hawaiian contexts (Mansfield et al., 2020), and push decision-makers to consider CES benefits beyond the typical framework of recreation and leisure, especially in assessments that include plural values, cultures, and worldviews (see also: Wheaton et al., 2020; Gould et al., 2017; Gould et al., 2014).

Participants experienced CES benefits even if barriers existed, particularly Native American/White participants, who reported resource barriers more frequently than other racial groups. Even so, this group also reported many CES experiences more frequently than White and other and mixed-race participants. While Dean et al. (2022) suggests these trends could indicate that personal motivations have *overcome* barriers, our data suggest that because of the high personal or cultural value placed on CES, motivations persist *despite the reduced quality* of CES due to barriers. For example, one participant stated, “We do not eat the fish we catch due to pollution,” (ID408) suggesting that although fishing is still possible, some benefits (ability to eat the catch) are reduced due to fish consumption advisories in the area.

### *Intersectionality*

Morris et al. (2011) highlight that an individual's identity includes many intersectional social categories and caution against using a single predominant social characteristic to categorize individuals. Intersectionality is a conceptual framework defined by Crenshaw (1990) and further developed through the critical work of Black feminist scholars (Brah, 1996; Hill Collins, 1990; hooks, 1989; Yuval-Davis, 2006) to expose various simultaneous processes of exclusion and discrimination resulting from the overlapping gender, race, and class-based power relations. An intersectional framework allows us to acknowledge that experiences of CES occur within this set of overlapping power relations. Our dbRDA analysis might reveal some intersectional patterns in both CES benefits and barriers because it tests for the effects of multiple demographic variables while accounting for their interdependence (Fig. 2.6). However, while the dbRDA can test for additive effects of sociodemographic variables, it does not test for synergistic or antagonistic effects of these variables. For instance, these results suggest older, non-Indigenous participants unable to work with lower education might report fewer types of CES. Morris (2011) found that that disabled people are disproportionately affected by access issues. We did not include an explicit sociodemographic measure of disability, but our results suggest a potential intersection of disability (which partly overlaps with inability to work), age, and employment associated with fewer types of CES benefits.

The dbRDA accounted for a relatively small proportion of variance for both CES and barriers. The dbRDA for barriers to CES explained less variation than the dbRDA for CES experiences, likely due to the data collection method applied. CES experience data were from multiple answer questions, whereas barriers were coded post-hoc based on short answers, so every participant was not introduced to the same pre-set list of barriers. While this method facilitated identification of a more comprehensive set of barriers, it also introduced more variability than the multiple answer approach used for CES experiences. Regardless, the small proportion of variance explained by both models suggests that while important, the sociodemographic groups evaluated here are only part of how identity is associated with CES benefits and barriers. Additional sociodemographic groups not included here, such as religion, political affiliation, occupation, or sexual orientation, could account for additional variance. Interview results, discussed in Chapter 3, suggest that high variance is also due to individual characteristics stemming from childhood and ongoing personal

experiences, education, and relationships, including preferences, affinities, and fears. These personal and social factors influence environmental attitudes, so it is likely that they also affect subsequent experiences with nature (e.g., blue space) and their well-being benefits (e.g., Gifford and Nilsson, 2014). Future research is needed to better understand how these less-easily grouped components of identity might predict CES experiences and their well-being benefits.

### ***CES assessment***

Participants identified 41 experiences that were not offered in the survey. Some of these were excluded to reduce survey length (e.g., rock climbing, known to be limited in waterfront locations the study area), but others (e.g., creek walking, home views of water, etc.) were overlooked by the authors, advisory group, and survey testers. Some of these which were mentioned by multiple respondents and in other survey questions, suggesting they may be important in the study area and possibly elsewhere and should be considered for inclusion in future assessments. Several individuals reported experiences that did not involve active interaction with the blue space, like going for a drive or enjoying views of the water from home. One survey respondent reported “Learning about the progress to restore the estuary through online resources” (ID1133). Indirect experiences can be associated with general and mental health (Dempsey et al., 2018; Garrett et al., 2019; Helbich et al., 2019). Virtual access has been proposed as a specific type of access associated with benefits (Weldon, Baily, and O’Brien, 2007), and development of remote technologies (e.g., video feeds or virtual reality experiences) may support benefits for individuals who cannot access the waterfront physically (Pistola et al., 2021; Coleman and Kearns, 2015; White et al., 2020). The variety of experiences reported by respondents highlights challenges associated with truly holistic CES assessment tools transferrable to multiple communities, and the importance of vetting and testing survey tools prior to deployment.

For CES assessment, we used a standard CES typology reflecting the type of the experience (e.g., active, recreation, social, spirituality, cultural, etc.). However, these categories are often experienced together (e.g., recreational activities may also be social, provide physical and emotional benefits, may involve cultural components, etc.). Furthermore, single categories included highly accessible experiences (e.g., walking) with experiences that have substantial requirements in terms of gear, finances, physical ability, skills, and knowledge (e.g., bicycling,

jogging, skiing), which is likely why few CES categories were significantly associated with sociodemographic identity. Our results suggest that CES experiences and benefits exist along a spectrum of accessibility that reflect requirements of the experience itself relative to the resources and abilities of the participant. Further research including the development of alternative CES typologies based on these factors should be explored in the future to better elucidate connections among CES benefits, barriers, and identity.

### ***Barrier themes***

Our thematic analysis of barriers based on survey short answers had limitations in terms of statistical analysis, but nonetheless provides insight into the challenges faced by respondents in accessing blue space CES benefits. Barriers to CES were not experienced in isolation but rather in concert with both other barriers and an individual's identity and perceptions. One example is transportation. Some participants framed transportation as a reflection of their own circumstances (e.g., "I don't drive so it's hard to get around." ID840); others framed transportation barriers as a reflection of services offered (e.g., "[we need] safe and accessible ways to commute that are not personal vehicles." ID415). Others posed the issue as a combination, "My husband being in fire school and working has cut our free time, also because I don't drive. [...] Price of gas has made it hard to travel away from our home." (ID859). Another example is that of age, health, and employment status discussed above, where physical ability barriers (disability, mobility, health, fitness) can be framed as personal circumstances, or as a reflection of environments that do not meet the needs of a population (Ladau, 2021).

Participants' perceptions of barriers can differ from those of researchers, decision-makers, and one another. For example, pollution was the most frequently reported environmental barrier. The St. Louis River has been the focus of significant environmental remediation in the past decade, so for many locations and experiences within the study area, pollution does not represent an immediate health risk. However, the perception of pollution likely *is* preventing or degrading respondents' experience if they reported it as a barrier (Macintyre, Macdonald and Ellaway, 2008, Poulsen et al., 2022). Perceptions of environmental barriers may be associated with a lack of knowledge or understanding, which was another barrier identified (communication/education) most frequently by those with higher education (bachelor's or advanced degrees). Adequate

communication and education are important for ensuring accurate perception of pollution risk, establishing positive narratives around belonging, and for logistically enabling blue space experiences (Cohen et al., 2010; Pitt et al., 2019; Roberts-Gregory and Hawthorne, 2016).

The safety barrier, reported by 15% of respondents, also has complex interactions with perception. Perceptions of safety may not match actual risk, especially regarding crime (Tolia-Kelly 2006, Spicer 2008, Byrne 2012, Hale, 1996). However regardless of actual risk, perceptions of safety affect visitation (e.g., Lapham et al., 2016) and wellbeing benefits, because not only is safety a requirement for positive experiences (e.g., Garrett et al., 2019; Fisher et al., 2021), fear, and especially fear of crime, can cause detriments to well-being (e.g., Ross, 1993, Whitley and Prince, 2005). Perceptions of safety intersect with gender as discussed above. Familiarity with a place may help diminish safety concerns so addressing communication and education barriers could reduce safety concerns (Sreetheran & van den Bosch, 2014). Maintenance status of parks and amenities including the presence of litter, vandalism, graffiti, or sightline-obscuring vegetation, all identified as barriers here, can influence perceptions of safety and social control (e.g., Sreetheran & van den Bosch, 2014, O'Brien, 2006). Perceptions of safety also depend on the number of facilities and features (included here in the amenities theme), number of organized activities (community programs/events theme), and neighborhood walkability (transportation theme), as well as view distance and social cohesion or mutual trust among community members (e.g., Foster, 2010, Lapham et al., 2016, Sreetheran & van den Bosch, 2014, Cohen et al., 2016). Also related to perceptions of safety are anti-social behaviors including drinking, illegal fires, noise, crowding, panhandling, and the presence of unhoused people, which were included in the social theme.

Community members may benefit from blue spaces in diverse ways that can conflict with one another, and reported barriers related to civility such as panhandling and perceived presence of unhoused people highlight an inherent power dynamic between those using spaces for recreation or restoration and those benefiting through the fulfillment of basic living requirements (Mokos, 2016; Speer and Goldfischer, 2020). While safety is necessary for well-being benefits, perceptions of safety alone do not facilitate benefits (Cohen et al., 2010), further highlighting the need to address barriers to CES in an integrated fashion.

Recent work has attempted to classify barriers to CES. White et al. (2020) proposed that factors influencing CES fall into categories of either individual (e.g., sociodemographic groups) or situational (environmental/access) effect modifiers, while Smith et al. (2022) proposed the hierarchical scheme of personal, inter-social, built environment, and natural environment factors. Dean et al. (2022) applied leisure constraints theory to interpreting use patterns of blue space (Crawford and Goodbey, 1987). Leisure constraints theory defines constraints (barriers) to leisure, in this case blue space recreation, as each falling into the hierarchical categories of intrapersonal (individual psychological states), interpersonal (social), and structural. Although these categories are defined as interrelated and not necessarily experienced hierarchically by the individual (Godbey et al., 2010), these approaches do not easily explain our results. For example, as discussed above, transportation barriers can be framed as individual or situational or both. Further, leisure constraint theory was developed to predict behavior or participation in an experience rather than to predict the associated benefit or reward (Godbey et al., 2010). Therefore, this theory is inconsistent with our definition of barrier as preventing or reducing the *quality* of an experience and limits the inference of well-being benefits. These barrier frameworks are based on a model of “use,” and focus on recreation benefits, reflecting a specific cultural conception of the human-nature relationship that may be inappropriate for Indigenous participants in this study and multi-cultural societies generally. By simplifying barriers into categories that inherently represent responsibility (e.g., personal category implying individual responsibility versus environmental category implying communal responsibility), we risk failing to identify the agency that decision-makers possess to implement communal interventions that result in increasingly equitable distribution of benefits from nature. For example, if physical ability barriers are framed solely as individual responsibility, decision-makers may miss opportunities to establish shoreline trails or beach access points that are fully accessible to a broad range of physical abilities.

A more nuanced understanding of barriers is needed. Both identity and place, including the built environment and the natural environments they offer access to, are socially constructed, and continually renegotiated (Tolia-Kelly 2006, Spicer 2008, Byrne 2012; Armstrong & Greene 2022). Cultural ecosystem services, defined as interactions between a person and the

environment, represent a social-cultural nexus, defined by Aitchison (2005:423) as a “site and process of construction, legitimation, reproduction, and reworking of” relations between identities that “often serves to perpetuate both structural and cultural inequality.” Barriers are the product of structural factors including, as summarized by Szaboova et al. (2020), habitus, or the system of cognitive processes “through which the objective material structures of a given context become internalized, often sub-consciously, in the subjective tastes, preferences and embodied experiences of people belonging to that context.” (Bourdieu 1977; Holt 2008). Habitus serves to perpetuate the disadvantage through iterative cycles of internalized dispositions dictating externalized structures further influencing internalized dispositions and so on. For example, Armstrong & Greene (2022) found People of Color were less comfortable using trails than White people. They concluded that this pattern of social-psychological barriers may be linked to a history of systemic race-based exclusion from outdoor spaces due to institutional racism, forced removal of Indigenous peoples from homelands, segregation of spaces within or exclusion from parks, multi-generational trauma, and ongoing harassment while in nature. Conversely, our data illustrate how habitus, at least for Native American alone participants, may have resulted in an increased diversity of CES benefits, while also serving to deteriorate benefits for women, NB/GE people, and certain age groups in distinct ways.

Bell et al (2015) describes the interplay between barriers and benefits of therapeutic landscapes as an emergent phenomenon in which places are not inherently therapeutic but may be experienced as therapeutic through various personally relevant phenomena in the setting. Gibson’s (1979) affordance theory offers a theoretical framework for this concept. Affordance is based on the idea that perception, an embodied and dynamic experience for the individual, is the mechanism for the emergence of “affordance,” defined as opportunities or constraints for benefits, within an environment and relative to the individual’s identity. This relational ontology is consistent with the relational values approach widely accepted for CES (Fish et. Al., 2016; Chan et al., 2018). It posits that affordances are as real as they are perceivable but are not properties of the individual or the environment themselves, but rather emergent properties of both (Chemero, 2003). Lastly, this approach represents barriers as fully integrated with opportunities for benefits themselves, which is consistent with our observation that reported CES benefits reflect an individual’s physical, financial, and knowledge resources relative to the requirements for a CES experience.

Applying affordance theory to green space, Lennon et al. (2017) identified six interdependent and dynamic dimensions that produce relations between opportunity and constraint: space, scale, time, objects, actions, and the physical or psychological state of the individual, with specific links between space, scale, and time; and objects, actions, and individuals. The barriers derived from our survey data can be considered themes associated with affordances. For example, the transportation theme discussed above includes negotiations between the individual and the interrelated dimensions of space (is the location accessible via a given form of transportation?); scale (how far is the location from the individual's home?); and time (how do possible modes of transportation differ in time requirements relative to time available?); as well as objects (does the individual own a car/bike/type of transportation?) and actions (is the individual capable of operating or taking a given type of transportation?). Thus, this approach offers decision-makers a framework for assessing how individuals with various identities might experience barriers and benefits from an environment (Lennon et al., 2017).

### ***Limitations***

This study has several features that may constrain the application of findings. Most importantly, we applied targeted recruitment to ensure the ability to assess across sociodemographic groups. Because of this targeted approach, the sample also has geographic bias with more responses from residents of neighborhoods where postcards were sent. A full discussion of the geographic patterns associated with responses will be published elsewhere. The sampled population has low racial diversity (89% White, US Census Bureau, 2022), which made reaching non-White populations in the study area population a challenge. Only one respondent identified as Black and eleven identified as Asian American. These respondents were lumped into the “other and mixed race” category for analysis. Although most respondents were White, the survey engaged a greater proportion of Native American alone or Native American/White participants (12% of sample) than expected based on a representative sample (6.2%). Self-selection of respondents to nature-related surveys can result in a sample biased towards ecocentrism or nature-connectedness (e.g., McGinlay et al., 2018; Jones et al., 2022), although residents of coastal neighborhoods may generally have higher nature-connectedness than those living inland (Alock et al., 2020).

Another caveat is that rather than measuring CES benefits or barriers directly, we measured perceptions of CES experiences and barriers to those experiences. We assumed that reported positive CES experiences conferred benefits to participants, while barriers reduced or precluded benefits. It is unclear if perception and attribution of meaning to a CES experience is required for benefits to human well-being, or if human well-being benefits may be conferred without perception, resulting in CES benefits remaining unidentified with the approach applied here. This topic is an important research avenue for future studies. Lastly, this study was conducted in Fall 2022, during the second year of the COVID-19 pandemic, which likely had some effect on CES experiences (Jo et al., 2022; Grima et al., 2020), although most respondents (67%) reported that the pandemic did not affect their CES experiences.

## **Conclusion**

Our results affirm the inherently relational nature of CES and demonstrate how identity fundamentally structures individuals' experiences of barriers to and benefits from CES. As such, CES assessments should include evaluation of not only benefits but also the integrated dimensions of identity and barriers to CES to avoid reproducing existing inequities in distribution of CES benefits. Detailed recommendations to address the barriers identified here are outside the scope of this paper. A broad recommendation towards addressing the barriers is for decision-makers to broaden compensated engagement and decisional power sharing with diverse social and community group members as well as across the disciplinary fields related to the barriers identified here including health care, public health, urban planning, transportation, education, housing, and social services. These recommendations represent a significant shift towards transdisciplinary work that will necessitate institutional and systemic changes towards increased funding and capacity for community engagement and participatory decision making, increased cultural competency within the environmental field, and extended grant cycles that afford broad participation and trust building among diverse constituencies. However, these investments and changes are critical for addressing inequities in human well-being benefits associated with blue spaces.

## References

- Abraham, A., Sommerhalder, K., and Abel, T., 2010. Landscape and well-being: a scoping study on the health-promoting impact of outdoor environments. *International journal of public health*, 55, pp.59-69.
- Alejandre, J.C., Chastin, S., Irvine, K.N., Georgiou, M., Khanna, P., Tiegies, Z., Smith, N., Chong, Y.Y., Onagan, F.C., Price, L., and Pflieger, S., 2023. Contextual factors and programme theories associated with implementing blue prescription programmes: a systematic realist review. *Health & Social Care in the Community*, 2023.
- American Community Survey 5-year 2019 data for race by zip code (ACS, 2019).
- Angradi, T.R., Williams, K.C., Hoffman, J.C., and Bolgrien, D.W., 2019. Goals, beneficiaries, and indicators of waterfront revitalization in Great Lakes Areas of Concern and coastal communities. *Journal of Great Lakes Research*, 45(5), pp.851-863.
- Armstrong, A., and Greene, B.T., 2022. Sense of inclusion and race in a public, outdoor recreation setting: Do place meanings matter? *Society & Natural Resources*, 35(4), pp.391-409.
- Bell, S.L., Phoenix, C., Lovell, R., and Wheeler, B.W., 2015. Seeking everyday wellbeing: The coast as a therapeutic landscape. *Social Science & Medicine*, 142, pp.56-67.
- Blicharska, M., Smithers, R.J., Hedblom, M., Hedenås, H., Mikusiński, G., Pedersen, E., Sandström, P., and Svensson, J., 2017. Shades of grey challenge practical application of the cultural ecosystem services concept. *Ecosystem services*, 23, pp.55-70.
- Bordelon, L., 2019. Women and barriers to participation in mountain biking: The impossible climb. In: Cherrington, J (ed.), *Mountain Biking, Culture and Society* (pp. 173-187). Routledge.
- Brah, A. 1996. *Cartographies of diaspora: Contesting identities*. London: Routledge.
- Burton, L.J., 2015. Underrepresentation of women in sport leadership: A review of research. *Sport management review*, 18(2), pp.155-165.

Byrne, J., and Wolch, J., 2009. Nature, race, and parks: Past research and future directions for geographic research. *Progress in human geography*, 33(6), pp.743-765.

Byrne, J., 2012. When green is White: The cultural politics of race, nature, and social exclusion in a Los Angeles urban national park. *Geoforum*, 43(3), pp.595-611.

Carini, R.M., and Weber, J.D., 2017. Female anglers in a predominantly male sport: Portrayals in five popular fishing-related magazines. *International Review for the Sociology of Sport*, 52(1), pp.45-60.

Chawla, L., 2015. Benefits of nature contact for children. *Journal of planning literature*, 30(4), pp.433-452.

Chan, K.M., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., Gould, R., Hannahs, N., Jax, K., Klain, S., and Luck, G.W., 2016. Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of the national academy of sciences*, 113(6), pp.1462-1465.

Chan, K.M., Gould, R.K., and Pascual, U., 2018. Editorial overview: relational values: what are they, and what's the fuss about? *Current opinion in environmental sustainability*, 35, pp.A1-A7.

Chan, K.M., Guerry, A.D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., Bostrom, A., Chuenpagdee, R., Gould, R., Halpern, B.S., and Hannahs, N., 2012. Where are cultural and social in ecosystem services? A framework for constructive engagement. *BioScience*, 62(8), pp.744-756.

Clinton, R.N., Goldberg, C.E., and Tsosie, R., 2007. American Indian law: Native nations and the Federal system: Cases and materials. Durham, NC: LexisNexis/Matthew Bender.

Cohen, D.A., Marsh, T., Williamson, S., Derose, K.P., Martinez, H., Setodji, C., and McKenzie, T.L., 2010. Parks and physical activity: why are some parks used more than others? *Preventive medicine*, 50, pp.S9-S12.

Cohen, D.A., Han, B., Derose, K.P., Williamson, S., Marsh, T., Raaen, L., and McKenzie, T.L., 2016. The paradox of parks in low-income areas: Park use and perceived threats. *Environment and Behavior*, 48(1), pp.230-245.

Coleman, T., and Kearns, R., 2015. The role of bluespaces in experiencing place, aging, and wellbeing: Insights from Waiheke Island, New Zealand. *Health & Place*, 35, pp.206-217.

Colley, K., Irvine, K.N., and Currie, M., 2022. Who benefits from nature? A quantitative intersectional perspective on inequalities in contact with nature and the gender gap outdoors. *Landscape and Urban Planning*, 223, p.104420.

Comberti, C., Thornton, T.F., de Echeverria, V.W., and Patterson, T., 2015. Ecosystem services or services to ecosystems? Valuing cultivation and reciprocal relationships between humans and ecosystems. *Global Environmental Change*, 34, pp. 247-262.

Conaway, J.D., and Leoso, E.S., 2024. Ganawendan Ginibiiminaan (Take care of our Water!): mobilizing for Watersheds-at-risk with the Bad River Ojibwe. *Ecology and Society*, 29(2).

Crawley, S.L., 1998. Gender, class, and the construction of masculinity in professional sailing: A case study of the America3 Women's Team. *International Review for the Sociology of Sport*, 33(1), pp.33-42.

Crenshaw, K. (1991). Mapping the margins: Intersectionality, identity politics, and violence against women of color. *Stanford Law Review*, 43(6), 1241–1299

Cuni-Sanchez, A., Pfeifer, M., Marchant, R., and Burgess, N.D., 2016. Ethnic and locational differences in ecosystem service values: Insights from the communities in forest islands in the desert. *Ecosystem Services*, 19, pp.42-50.

Daw, T.I.M., Brown, K., Rosendo, S., and Pomeroy, R., 2011. Applying the ecosystem services concept to poverty alleviation: the need to disaggregate human well-being. *Environmental Conservation*, 38(4), pp.370-379.

- Dawson, N., and Martin, A., 2015. Assessing the contribution of ecosystem services to human wellbeing: a disaggregated study in western Rwanda. *Ecological Economics*, 117, pp.62-72.
- De Bell, S., Graham, H., Jarvis, S., and White, P., 2017. The importance of nature in mediating social and psychological benefits associated with visits to freshwater blue space. *Landscape and Urban Planning*, 167, pp.118-127.
- Dean, A.J., Ross, H., Roiko, A., Fielding, K.S., Saeck, E., Johnston, K., Beatson, A., Udy, J., and Maxwell, P., 2022. Beyond proximity: How subjective perceptions of enablers and constraints influence patterns of blue space recreation. *Landscape and Urban Planning*, 228, p.104557.
- Dempsey, S., Devine, M.T., Gillespie, T., Lyons, S., and Nolan, A., 2018. Coastal blue space and depression in older adults. *Health & place*, 54, pp.110-117.
- DeVile, N.V., Tomasso, L.P., Stoddard, O.P., Wilt, G.E., Horton, T.H., Wolf, K.L., Brymer, E., Kahn Jr, P.H., and James, P., 2021. Time spent in nature is associated with increased pro-environmental attitudes and behaviors. *International journal of environmental research and public health*, 18(14), p.7498.
- Dou, Y., Yu, X., Bakker, M., De Groot, R., Carsjens, G.J., Duan, H., and Huang, C., 2020. Analysis of the relationship between cross-cultural perceptions of landscapes and cultural ecosystem services in Genheyuan region, Northeast China. *Ecosystem Services*, 43, p.101112.
- Duluth Area Chamber of Commerce, 2024. Visitors: Planning your visit? Accessed July 10, 2024. <https://duluthchamber.com/resources/visitors>
- Duluth Economic Development Authority, 2023. Key industries. Accessed July 10, 2024. <https://dulutheda.org/key-industries/>
- Duluth Seaway Port Authority, 2024. Port statistics. Accessed July 10, 2024. <https://duluthport.com/about-us/port-statistics/>
- FDL (Fond du Lac Band of Lake Superior Chippewa). (2022) Onigamiinsing Dibaajimowinan-Duluth's Stories. Accessed April 29, 2024: <http://www.duluthstories.net/index.html>.

FDL, MNDNR, MPCA, and WDNR (Fond du Lac Band of Lake Superior Chippewa, Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, and Wisconsin Department of Natural Resources), “St. Louis River Area of Concern: 2022 Remedial Action Plan,” February 2023, <https://www.pca.state.mn.us/sites/default/files/wq-ws1-38.pdf>.

Felipe-Lucia, M.R., Martín-López, B., Lavorel, S., Berraquero-Díaz, L., Escalera-Reyes, J., and Comín, F.A., 2015. Ecosystem services flows: why stakeholders’ power relationships matter. *PloS one*, 10(7), p.e0132232.

Finlay, J., Franke, T., McKay, H., and Sims-Gould, J., 2015. Therapeutic landscapes and wellbeing in later life: Impacts of blue and green spaces for older adults. *Health & place*, 34, pp.97-106.

Fish, R., Church, A., and Winter, M., 2016. Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. *Ecosystem Services*, 21, pp.208-217.

Fisher, J.C., Irvine, K.N., Bicknell, J.E., Hayes, W.M., Fernandes, D., Mistry, J., and Davies, Z.G., 2021. Perceived biodiversity, sound, naturalness, and safety enhance the restorative quality and wellbeing benefits of green and blue space in a neotropical city. *Science of the Total Environment*, 755, p.143095.

Fortnam, M., Brown, K., Chaigneau, T., Crona, B., Daw, T.M., Gonçalves, D., Hicks, C., Revmatas, M., Sandbrook, C., and Schulte-Herbruggen, B., 2019. The gendered nature of ecosystem services. *Ecological economics*, 159, pp.312-325.

Foster, S., Giles-Corti, B., and Knuiaman, M., 2010. Neighbourhood design and fear of crime: A social-ecological examination of the correlates of residents’ fear in new suburban housing developments. *Health & place*, 16(6), pp.1156-1165.

Garcia, S.F., and Hahn, E.A., 2015. Environmental barriers and supports to everyday participation: a qualitative insider perspective from people with disabilities. *Archives of physical medicine and rehabilitation*, 96(4), pp.578-588.

Garrett, J.K., White, M.P., Huang, J., Ng, S., Hui, Z., Leung, C., Tse, L.A., Fung, F., Elliott, L.R., Depledge, M.H., and Wong, M.C., 2019. Urban blue space and health and wellbeing in Hong Kong: Results from a survey of older adults. *Health & place*, 55, pp.100-110.

Gascon, M., Zijlema, W., Vert, C., White, M.P., and Nieuwenhuijsen, M.J., 2017. Outdoor blue spaces, human health, and well-being: A systematic review of quantitative studies. *International journal of hygiene and environmental health*, 220(8), pp.1207-1221.

Ghimire, R., Green, G.T., Poudyal, N.C., and Cordell, H.K., 2014. An analysis of perceived constraints to outdoor recreation. *Journal of Park and Recreation Administration*, 32(4).

Gibbon, G., 2012. Archaeology of Minnesota: the prehistory of the upper Mississippi River region. University of Minnesota Press.

Gibson, J.J., 1979. *The ecological approach to visual perception*: classic edition. Psychology press.

Gifford, R., and Nilsson, A., 2014. Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology*, 49(3), pp.141-

157. Gillespie, T., 2022. President Biden, EPA \$1 Billion Investment from the Bipartisan Infrastructure Law Will Accelerate Cleanup Efforts and Benefit Michigan. USEPA News Release: Region 5. February 17, 2022. Accessed March 3, 2022:

<https://www.epa.gov/newsreleases/president-biden-epa-1-billion-investment-bipartisan-infrastructure-law-will-1>

Gould, R.K., Adams, A., and Vivanco, L., 2020b. Looking into the dragons of cultural ecosystem services. *Ecosystems and People*, 16(1), pp.257-272.

Gould, R.K., Ardoin, N.M., Woodside, U., Satterfield, T., Hannahs, N., and Daily, G.C., 2014. The forest has a story: cultural ecosystem services in Kona, Hawai'i. *Ecology and Society*, 19(3).

Gould, R.K., Bremer, L.L., Pascua, P.A., and Meza-Prado, K., 2020a. Frontiers in cultural ecosystem services: Toward greater equity and justice in ecosystem services research and practice. *BioScience*, 70(12), pp.1093-1107.

Gould, R.K., and Lincoln, N.K., 2017. Expanding the suite of Cultural Ecosystem Services to include ingenuity, perspective, and life teaching. *Ecosystem services*, 25, pp.117-127.

Grima, N., Corcoran, W., Hill-James, C., Langton, B., Sommer, H., and Fisher, B., 2020. The importance of urban natural areas and urban ecosystem services during the COVID-19 pandemic. *Plos one*, 15(12), p.e0243344.

Hale, C., 1996. Fear of crime: A review of the literature. *International review of Victimology*, 4(2), pp.79-150.

Haeffner, M., Jackson-Smith, D., Buchert, M., and Risley, J., 2017. Accessing blue spaces: Social and geographic factors structuring familiarity with, use of, and appreciation of urban waterways. *Landscape and Urban Planning*, 167, pp.136-146.

Heberlein, T.A., Serup, B., and Ericsson, G., 2008. Female hunting participation in North America and Europe. *Human Dimensions of Wildlife*, 13(6), pp.443-458.

Helbich, M., Yao, Y., Liu, Y., Zhang, J., Liu, P., and Wang, R., 2019. Using deep learning to examine street view green and blue spaces and their associations with geriatric depression in Beijing, China. *Environment international*, 126, pp.107-117.

Henderson, K.A., and Gibson, H.J., 2013. An integrative review of women, gender, and leisure: Increasing complexities. *Journal of Leisure Research*, 45(2), pp.115-135.

Hill Collins, P. 1990. Black feminist thought: Knowledge, consciousness, and the politics of empowerment. New York, NY: Routledge.

Hooks, B. 1989. Talking back: Thinking feminist, thinking black. Boston, MA: Sheba Feminist.

Huybers-Withers, S.M., and Livingston, L.A., 2010. Mountain biking is for men: Consumption practices and identity portrayed by a niche magazine. *Sport in Society*, 13(7-8), pp.1204-1222.

Jennings, V., Larson, L., and Yun, J., 2016. Advancing sustainability through urban green space: Cultural ecosystem services, equity, and social determinants of health. *International Journal of environmental research and public health*, 13(2), p.196.

Jennings, V., Browning, M.H., Rigolon, A., Jennings, V., Browning, M.H., and Rigolon, A., 2019. Cultural ecosystem services meet broader frameworks in public health. *Urban Green Spaces: Public Health and Sustainability in the United States*, pp.31-46.

Jo, T., Sato, M., Minamoto, T., and Ushimaru, A., 2022. Valuing the cultural services from urban blue-space ecosystems in Japanese megacities during the COVID-19 pandemic. *People and Nature*, 4(5), pp.1176-1189.

Jones, L., Boeri, M., Christie, M., Durance, I., Evans, K.L., Fletcher, D., Harrison, L., Jorgensen, A., Masante, D., McGinlay, J., and Paterson, D.M., 2022. Can we model cultural ecosystem services, and are we measuring the right things? *People and Nature*, 4. Pp.166-179.

Kaups, M., 1978. North Shore commercial fishing, 1849-1870. *Minnesota History*, 46(2), pp.42-58.

Kilgour, L., and Parker, A., 2013. Gender, physical activity, and fear: Women, exercise and the great outdoors. *Qualitative Research in Sport, Exercise and Health*, 5(1), pp.43-57.

Kirchhoff, T., 2019. Abandoning the concept of cultural ecosystem services, or against natural-scientific imperialism. *BioScience*, 69(3), pp.220-227.

Ladau, E., 2021. *Demystifying disability: What to know, what to say, and how to be an ally*. Ten Speed Press.

Lapham, S.C., Cohen, D.A., Han, B., Williamson, S., Evenson, K.R., McKenzie, T.L., Hillier, A., and Ward, P., 2016. How important is perception of safety to park use? A four-city survey. *Urban Studies*, 53(12), pp.2624-2636.

Legendre, P., and Anderson, M.J., 1999. Distance-based redundancy analysis: testing multispecies responses in multifactorial ecological experiments. *Ecological monographs*, 69(1), pp.1-24.

Lennon, M., Douglas, O., and Scott, M., 2017. Urban green space for health and well-being: developing an 'affordances' framework for planning and design. *Journal of urban design*, 22(6), pp.778-795.

Mansfield, L., Daykin, N., and Kay, T., 2020. Leisure and wellbeing. *Leisure Studies*, 39(1), pp.1-10.

Millennium Ecosystem Assessment (MA), 2005. Ecosystems and human well-being. 563 p.

Mokos, J.T., 2017. Stigmatized places as therapeutic landscapes. *Medicine Anthropology Theory*, 4(1).

McGinlay, J., Parsons, D.J., Morris, J., Graves, A., Hubatova, M., Bradbury, R.B., and Bullock, J.M., 2018. Leisure activities and social factors influence the generation of cultural ecosystem service benefits. *Ecosystem services*, 31, pp.468-480.

Morris, J., and O'Brien, E., 2011. Encouraging healthy outdoor activity amongst under-represented groups: An evaluation of the Active England woodland projects. *Urban Forestry & Urban Greening*, 10(4), pp.323-333.

Morris, J., O'Brien, E., Ambrose-Oji, B., Lawrence, A., Carter, C., and Peace, A., 2011. Access for all? Barriers to accessing woodlands and forests in Britain. *Local Environment*, 16(4), pp.375-396.

Macintyre, S., Macdonald, L., and Ellaway, A., 2008. Lack of agreement between measured and self-reported distance from public green parks in Glasgow, Scotland. *International Journal of Behavioral Nutrition and Physical Activity*, 5, pp.1-8.

McArdle, B.H., and Anderson, M.J., 2001. Fitting multivariate models to community data: a comment on distance-based redundancy analysis. *Ecology*, 82(1), pp.290-297.

Mucioki, M., Sowerwine, J., Sarna-Wojcicki, D., Lake, F.K., and Bourque, S., 2021. Conceptualizing Indigenous Cultural Ecosystem Services (ICES) and Benefits under Changing

Climate Conditions in the Klamath River Basin and Their Implications for Land Management and Governance. *Journal of Ethnobiology*, 41(3), pp.313-330.

National Oceanic and Atmospheric Administration (NOAA). 2013. National Coastal Population Report: Population Trends from 1970 to 2020. Accessed March 2, 2022:  
<https://aambpublicoceanservice.blob.core.windows.net/oceanserviceprod/facts/coastal-population-report.pdf>

O'Brien, L., and Tabbush, P.M., 2005. Accessibility of woodlands and natural spaces: addressing crime and safety issues. *Forest Research*.

O'Brien, E., 2006. Social housing and green space: A case study in Inner London. *Forestry*, 79(5), pp.535-551.

Oksanen, J., Simpson, G., Blanchet, F., Kindt, R., Legendre, P., Minchin, P., O'hara, R., Solymos, P., Stevens, M., Szoecs, E., and Wagner, H., 2023. *vegan: Community Ecology Package*. R package version 2.6-4. 2022.

Parks, S., and Gowdy, J., 2013. What have economists learned about valuing nature? A review essay. *Ecosystem Services*, 3, pp.e1-e10.

Phillips, B.A., 1993. A time-space model for the distribution of shoreline archaeological sites in the Lake Superior Basin. *Geoarchaeology*, 8(2), pp.87-107.

Pistola, T., Diplaris, S., Stentoumis, C., Stathopoulos, E.A., Loupas, G., Mandilaras, T., Kalantzis, G., Kalisperakis, I., Tellios, A., Zavraka, D., and Koulali, P., 2021, May. Creating immersive experiences based on intangible cultural heritage. In *2021 IEEE International Conference on Intelligent Reality (ICIR)* (pp. 17-24). IEEE.

Pitt, H., 2019. What prevents people accessing urban bluespaces? A qualitative study. *Urban Forestry & Urban Greening*, 39, pp.89-97.

- Poe, M.R., Donatuto, J., and Satterfield, T., 2016. "Sense of Place": Human wellbeing considerations for ecological restoration in Puget Sound. *Coastal Management*, 44(5), pp.409-426.
- Poulsen, M.N., Nordberg, C.M., Fiedler, A., DeWalle, J., Mercer, D., and Schwartz, B.S., 2022. Factors associated with visiting freshwater blue space: The role of restoration and relations with mental health and well-being. *Landscape and Urban Planning*, 217, p.104282.
- R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.
- Riechers, M., Strack, M., Barkmann, J., and Tschardtke, T., 2019. Cultural ecosystem services provided by urban green change along an urban-periurban gradient. *Sustainability*, 11(3), p.645.
- Rodrigues, J.G., Conides, A.J., Rivero Rodriguez, S., Raicevich, S., Pita, P., Kleisner, K.M., Pita, C., Lopes, P.F., Alonso Roldáni, V., Ramos, S.S., and Klaoudatos, D., 2017. Marine and coastal cultural ecosystem services: knowledge gaps and research priorities. *One Ecosystem* 2 (2017) p.e12290.
- Ross, C.E., 1993. Fear of victimization and health. *Journal of Quantitative Criminology*, 9, pp.159-175.
- Ryan, G.W., and Bernard, H.R., 2003. Techniques to identify themes. *Field methods*, 15(1), pp.85-109.
- Sangha, K.K., Preece, L., Villarreal-Rosas, J., Kegamba, J.J., Paudyal, K., Warmenhoven, T., and RamaKrishnan, P.S., 2018. An ecosystem services framework to evaluate Indigenous and local peoples' connections with nature. *Ecosystem services*, 31, pp.111-125.
- Sagie, H., Morris, A., Rofè, Y., Orenstein, D.E., and Groner, E., 2013. Cross-cultural perceptions of ecosystem services: A social inquiry on both sides of the Israeli–Jordanian border of the Southern Arava Valley Desert. *Journal of Arid Environments*, 97, pp.38-48.

- Satz, D., Gould, R.K., Chan, K.M., Guerry, A., Norton, B., Satterfield, T., Halpern, B.S., Levine, J., Woodside, U., Hannahs, N., and Basurto, X., 2013. The challenges of incorporating cultural ecosystem services into environmental assessment. *Ambio*, 42, pp. 675-684.
- Sinclair, J., Taylor, P.J., and Hobbs, S.J., 2013. Alpha level adjustments for multiple dependent variable analyses and their applicability—a review. *International Journal of Sports Science and Engineering*, 7(1), pp.17-20.
- Smith, T.W., 2007. Social identity and socio-demographic structure. *International Journal of Public Opinion Research*, 19(3), pp.380-390.
- Smith, N., Georgiou, M., King, A.C., Tiegies, Z., Webb, S., and Chastin, S., 2021. Urban blue spaces and human health: A systematic review and meta-analysis of quantitative studies. *Cities*, 119, p.103413.
- Smith, N., Georgiou, M., King, A.C., Tiegies, Z., and Chastin, S., 2022. Factors influencing usage of urban blue spaces: A systems-based approach to identify leverage points. *Health & Place*, 73, p.102735.
- Speer, J., and Goldfischer, E., 2020. The city is not innocent: Homelessness and the value of urban parks. *Capitalism Nature Socialism*, 31(3), pp.24-41.
- Spicer, N., 2008. Places of exclusion and inclusion: Asylum-seeker and refugee experiences of neighbourhoods in the UK. *Journal of ethnic and migration studies*, 34(3), pp.491-510.
- Sreetheran, M., and Van Den Bosch, C.C.K., 2014. A socio-ecological exploration of fear of crime in urban green spaces—A systematic review. *Urban Forestry & Urban Greening*, 13(1), pp.1-18.
- Szaboova, L., Brown, K., and Fisher, J.A., 2020. Access to ecosystem benefits: more than proximity. *Society & natural resources*, 33(2), pp.244-260.
- Tolia-Kelly, D.P., 2006. Mobility/stability: British Asian cultures of ‘landscape and Englishness’. *Environment and planning A*, 38(2), pp.341-358.

US Census Bureau, 2022. QuickFacts, 2020 Decennial Census. Accessed February 28, 2022: <https://www.census.gov/quickfacts/fact/table/cloquetcityminnesota,superiorcitywisconsin,duluthcityminnesota#>

USPS, 2023. Every Door Direct Mail Online Tool. Accessed March 10, 2024: <https://eddm.usps.com/eddm/select-routes.htm>

Völker, S., and Kistemann, T., 2011. The impact of blue space on human health and well-being—Salutogenetic health effects of inland surface waters: A review. *International journal of hygiene and environmental health*, 214(6), pp.449-460.

Walker, B.W., 2022. A dynamic reframing of the social/personal identity dichotomy. *Organizational Psychology Review*, 12(1), pp.73-104.

Watson, B., and Scraton, S.J., 2013. Leisure studies and intersectionality. *Leisure Studies*, 32(1), pp.35-47.

Weldon, S., Bailey, C., and O'Brien, E., 2007. New pathways for health and well-being in Scotland: Research to understand and overcome barriers to accessing woodlands. *Report to Forestry Commission Scotland, Edinburgh*.

Wheaton, B., Waiti, J., Cosgriff, M., and Burrows, L., 2020. Coastal blue space and wellbeing research: Looking beyond western tides. *Leisure Studies*, 39(1), pp.83-95.

White, M.P., Elliott, L.R., Gascon, M., Roberts, B., and Fleming, L.E., 2020. Blue space, health, and well-being: A narrative overview and synthesis of potential benefits. *Environmental research*, 191, p.110169.

Whitley, R., and Prince, M., 2005. Fear of crime, mobility and mental health in inner-city London, UK. *Social science & medicine*, 61(8), pp.1678-1688.

Wickham, H., Averick, M., Bryan, J., Chang, W., McGowan, L.D.A., François, R., Golemund, G., Hayes, A., Henry, L., Hester, J., and Kuhn, M., 2019. Welcome to the Tidyverse. *Journal of open source software*, 4(43), p.1686.

Wickham, H. 2016. *ggplot2: Elegant Graphics for Data Analysis*. Springer-Verlag New York. ISBN 978-3-319-24277-4, <https://ggplot2.tidyverse.org>.

Williams, T.G., Logan, T.M., Zuo, C.T., Liberman, K.D., and Guikema, S.D., 2020. Parks and safety: A comparative study of green space access and inequity in five US cities. *Landscape and urban planning*, 201, p.103841.

Winthrop, R.H., 2014. The strange case of cultural services: Limits of the ecosystem services paradigm. *Ecological Economics*, 108, pp.208-214.

Whyte, K., 2018. Settler colonialism, ecology, and environmental injustice. *Environment and Society*, 9, pp. 125-144.

Yuval-Davis, N., 2006. Intersectionality and feminist politics. *European journal of women's studies*, 13(3), pp.193-209.

### *Chapter 3 - The multi-faceted nature of human connections to blue spaces for diverse identities in a Great Lakes coastal community*

#### **Abstract**

Relationships between humans and blue spaces, or publicly accessible environments centered around streams, rivers, lakes, and coasts, confer significant benefits to human well-being.

However, these benefits are not distributed equitably. Cultural ecosystem services (CES), which are the intangible benefits to human wellbeing from nature, have been proposed as a framework to conceptualize the human-nature relationship and measure its benefits for well-being, as well as to identify and reduce inequities in these benefits. However, current conceptual models are limited in their ability to effectively represent, measure, or communicate CES because they do not recognize the plurality of human-nature relationships in diverse communities. This understanding is necessary to develop local-scale recommendations or broader policy guidance to increase equitability of benefits in these communities. To address this challenge, we conducted qualitative interviews with 42 participants with diverse sociodemographic identities to explore how participants' relationships with blue spaces related to their self-identity in the Twin Ports of Duluth, Minnesota, and Superior, Wisconsin, USA. Based on thematic analysis, we identified 13 interconnected themes associated with participants' connection with water. Most of these themes were mentioned by at least three-quarters of participants, including enjoyment, exploration or learning, spirituality and emotions, time and traditions, place meaning, social and community, health, aesthetics and sensory, care for nature, fear and safety, and wild food and water. Human-water relationships were closely linked to stage of life and age, and for some participants, linked to their recreation group identity (e.g., being a paddler), Ojibwe identity, health status, occupation, religion, and affinity for nature. Some themes had potentially negative or self-limiting effects, such as fear and safety, and wild foods in the context of existing fish consumption advisories. We interpret our results in the context of sense of place and therapeutic landscape theory to identify patterns in how individuals' relationships with blue space (sense of place) and experiences in blue space (therapeutic landscapes) relate to identity. The study identified unique ways that Ojibwe participants relate with water, underscoring the importance of transdisciplinary and community-engaged CES assessment methodologies in pluralistic communities, and co-management and power-sharing approaches in decision-making processes.

## Introduction

The relationship between people and nature confers wellbeing benefits to individuals and communities. Understanding the sources of variation in human-nature relationships is critically important for environmental decision-making to support public health and wellbeing (e.g., Bratman et al., 2021; Markevych et al., 2017; Seymour, 2016). The human-nature relationship can also influence individuals' pro-environmental behavior, which has societal-level relevance for conservation and sustainability (Whitburn et al., 2020; Soga and Gaston, 2016). Over half the world's population resides within 3km of fresh waterbodies (Kummu et al., 2011). Blue spaces, publicly accessible environments in and around streams, rivers, lakes, and coasts, are important for human well-being benefits (Gascon et al., 2017; Georgiou et al., 2021). However, well-being benefits of blue spaces are generally not equitably distributed among populations, whether defined geographically, culturally, or socioeconomically (e.g., Pitt, 2019, Gascon et al., 2017). Disparate distribution of benefits, access to decision-making processes, and inadequate recognition of distinct histories, identities, and needs has resulted in environmental injustices for specific racial, cultural, and economic groups (Langemeyer and Connolly, 2020).

Cultural ecosystem services (CES), or the services that give rise to intangible benefits for human well-being (Chan et al., 2012; Fish et al., 2016), is the leading framework for assessing place-based human-nature relationships to inform policy and decision-making. A major critique of CES is that its utilitarian, service-based conceptualization of the human-nature relationship is often inconsistent with Indigenous and non-Western ontologies, resulting in assessments that fail to identify inequities (e.g., Combetti et al., 2015; Kirchhoff 2019; Winthrop, 2014; Díaz et al., 2018; Normyle et al., 2023).<sup>4</sup> Since their original conception in the Millennium Ecosystem Assessment (MA, 2005), CES have been reconceived as services and benefits co-produced by people and nature (Fisher and Eastwood, 2016), and reflecting relational values, or the “preferences, principles and virtues about human-nature relationships” (Chan et al., 2018 p. A1; Chan et al., 2016; Himes and Muraca, 2018). These framings are more consistent with non-Western

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<sup>4</sup> Another response to these criticisms has been a re-framing ecosystem services broadly as nature's contributions to people (Díaz et al., 2018; Pascual et al., 2017), but as most primary literature still adopts the frame of CES, that is what we use here.

ontologies and include multiple worldviews. When paired with adequate reflexivity and acknowledgement of the framework's limitations, CES assessments have pragmatic value for equitable decision-making (Gould et al., 2020a, b).

Although there has been increased interest in identifying ways to address inequities in ecosystem service benefits (e.g., Gould et al., 2020a, b; Edwards et al., 2022), decision-makers are still challenged by a lack of understanding of CES and human-nature relationships broadly in diverse (e.g., multi-cultural, multiracial, socioeconomically diverse) communities (e.g., Jones et al., 2022; Blicharska et al., 2017; Chan et al., 2012; Winthrop, 2014; Satz et al., 2013). This may stem from inadequacy or inflexibility in existing CES models in accounting for the complexity in how CES are experienced by different populations. An improved approach could enhance equitability of local-scale recommendations and broader policy (Ives et al. 2017; Restall & Conrad 2015).

To help address this knowledge gap for blue spaces, we conducted a qualitative study to explore how the human-nature connection related to self-identity in a waterfront case study location in the Great Lakes community of Duluth, Minnesota and Superior, Wisconsin, USA (also known as the "Twin Ports"). By human-nature connection, we mean the complex experiences, cognitions, emotions, behaviors, and collective identities that describe the relationship between a person and blue spaces and that are associated with CES, which give rise to human well-being benefits (e.g., Ives et al., 2017; Zylstra et al., 2018). We report data collected as part of a mixed methods study that included a community survey (Chapter 2) and follow-up interviews. We report the results from thematic analysis of 42 semi-structured interviews with participants representing a range of diverse identities in which we explored the following research questions: What are the ways that participants connect with water? How do those connections relate to participants' sense of identity?

Interdisciplinary and qualitative social science methodologies are needed in CES research to achieve a deeper understanding of CES distribution and benefits (Gould et al., 2019; Mandle et al., 2021; Langemeyer and Connolly, 2020). Many social science disciplines have explored the human-nature relationship and have put forth concepts and frameworks to understand them. We use grounded theory methods to explore the nature of participants' connections with blue spaces

based on their relationship with water in the study area and their self-identity as revealed in interviews. We considered self-identity (hereafter, identity) to be the components of sense of self, including personal characteristics and memberships of social groups, that a participant described as relevant to their relationship with blue space (Twigger-Ross et al., 2003; Oyserman, 2001; Walker et al., 2022). We interpreted our results in the context of a CES framework as well as in the context of leading theories of human-nature relationships from the social sciences.

### **Study area**

This research included on the communities situated on the St. Louis River estuary located at the eastern end of Lake Superior, or Gichigami in Ojibwe (Fig. 3.1). The area includes the cities of Duluth and Cloquet Minnesota, Superior Wisconsin, and several additional townships. The area includes the lower 39 miles of the St. Louis River and the immediate estuary watershed downstream from there. All participants were current residents of this study area, with their duration of residence ranging from less than a year to their entire life.

For 13,000 years, the study area has been home to humans (Phillips, 1993; Gibbon, 2012). The Ojibwe migrated into the area from the eastern seaboard over generations, finding the prophesied place where food, manoomin (wild rice), grows on water (Whyte, 2018). Ojibwe identity is deeply rooted in local waters (Conaway and Leoso, 2024). In the mid-1600s, when French explorers arrived, the study area was home to the Ojibwe as well as the Dakota, who subsequently migrated to the prairies and plains to the southwest (FDL, 2022). In treaties between the Ojibwe and the U.S. government in 1842 and 1854, reservations were established and land within the study area was ceded to the U.S. government. In these treaties, Ojibwe people's rights to

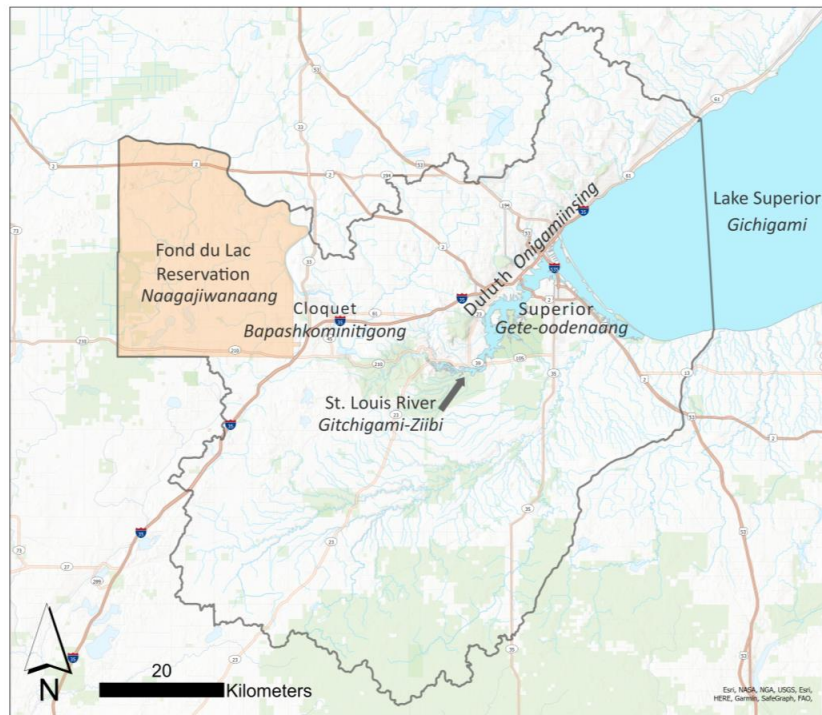


Figure 3.1 The study area is the St. Louis River estuary of Lake Superior and includes the communities of Duluth, and Cloquet, Minnesota, and Superior, Wisconsin. Ojibwe place names are shown in italics.

traditional lifeways including hunting, fishing, and foraging were retained within treaty boundaries.<sup>5</sup> Shortly thereafter, the states of Wisconsin (1848) and Minnesota (1858) were established. In the 1850's and 60's, many prospectors, surveyors, land speculators, town promoters, and settlers of European descent arrived. The railroad arrived in 1870, and the expansion of lumber and mining industries resulted in exponential growth of White settlers in the two communities (Kaups, 1978; FDL, 2022). As of 2022, the population of the cities of Duluth and Cloquet, Minnesota and Superior WI was 126,016 with 89.7% White, 3.7% Two or more races, 2.5% American Indian & Alaskan Native, and 2.2% Black or African American residents

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<sup>5</sup> U.S. and Chippewa Indians of Lake Superior and the Mississippi. 1854 Treaty with the Chippewa. September 30, 1854. 10 Stats., 1109.

[https://files.dnr.state.mn.us/aboutdnr/laws\\_treaties/1854/treaty1854.pdf](https://files.dnr.state.mn.us/aboutdnr/laws_treaties/1854/treaty1854.pdf); U.S. and Chippewa Indians of the Mississippi, and Lake Superior. 1842 Treaty of La Pointe. Oct. 4, 1842. 7 Stat., 591. Proclamation, Mar. 23, 1843. <https://www.1854treatyauthority.org/images/TREATY.TEXT.final.webpublish.pdf>.

(US Census Bureau, 2022). The study area includes the entire reservation of an Ojibwe (which was anglicized as “Chippewa”) Tribal Nation and is also home to residents with other Indigenous ethnicities. We use the terms “Indigenous” herein interchangeably to describe individuals who identify as members and descendants of American Indian (also known as Native American) and Alaskan Native tribes.

### **Positionality**

Authors Wick, Erickson, Hoffman, and Johnson are researchers and educators of European descent with training and nearly 100 cumulative years of work experience in institutional settings established based on Western<sup>6</sup> philosophies. They are all residents of the study area. Michele Beeksma is a Grand Portage Band of Lake Superior Chippewa enrollee and works at the 1854 Treaty Authority. She lives in Onigamiinsing (Duluth) and gives Ojibwe cultural presentations. Nisogaabokwe Melonee Montano is a member of the Red Cliff Band of Lake Superior Chippewa and is Traditional Ecological Knowledge Outreach Specialist for Great Lakes Indian Fish & Wildlife Commission. Arianna Northbird is a member of Fond du Lac Band of Lake Superior Chippewa and Environmental Program Manager for Fond du Lac Band of Lake Superior Chippewa. Jennifer Ballinger Saagajiwe-Gaabawiik, MPH, is a descendant of the Grand Portage Band of Lake Superior Chippewa and a Tribal Relations Specialist for the US Forest Service. This research was framed and carried out within the paradigm of institutional science and co-authors and cultural advisors Northbird, Ballinger, Beeksma, and Montano contributed Ojibwe cultural knowledge. Where a co-author’s Indigenous cultural knowledge is applied to interpret results, we note the co-author source (e.g., “Author Beeksma confirms...”).

### **Methods**

This study design was advised by two advisory groups: a community advisory group consisted of representatives of local municipalities and organizations, and an Indigenous advisory group consisted of co-authors Northbird, Ballinger, Beeksma, and Montano. These groups provided input on the study design, helped recruit participants, provided feedback on interpretation of

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<sup>6</sup> Western is used herein to construe Euro-centric cultural and philosophical traditions rooted in Enlightenment thinking and Judeo-Christian values.

results, are helping disseminate study results, and in the case of the Indigenous advisory board, supported the cultural relevance and interpretation of the study, and are co-authors on this report.

This study focused on experiences associated with blue space, which was defined as the freshwater lakes, rivers, and streams in the study area. Semi-structured interviews were conducted with a subset of 42 participants of the Waterway Benefits Survey (Chapter 2). Individuals voluntarily sharing their contact information to be mailed a \$10 debit card for survey participation were asked if they were interested in participating in a follow-up interview. Interviewees were selected based on their availability, with an effort to engage participants from diverse gender, race, and income groups. Participants were compensated for interviewing with a second \$25 debit card.

Interviews focused on elucidating the nature of participants' connection with blue space. We asked participants questions based on an interview guide (Appendix 3.1), while prioritizing open questioning and active listening. The questions prompted participants to share memories, experiences, and connections with "water," defined for participants as the lake, rivers, and streams in the study area. As such, we use this terminology ("water," rather than "blue space") in our results and discussion below. The open-ended up questions prompted participants to share their connections with waterbodies outside the study area that influenced their relationship to blue spaces in the study area. So, our results represent an integrated understanding of participants relationship to water in the study area as well as water broadly.

Interviews were conducted by a single researcher (Wick) between May 25 and July 28, 2023 (Table 3.1). Interviews were 19 to 78 minutes in length, with an average length of 46 minutes. They were held at a library, a community center, a nature center, or on Zoom, based on the participant preference. The interview included a study area map that participants could refer to throughout each interview. All but one interview was recorded. Interviews were then transcribed by a third-party contractor, deidentified by Wick, and reviewed for transcription errors which were corrected by reviewing audio. All participants were assigned pseudonyms, used here, to protect their privacy.

Table 3.1 Demographic attributes of interview participants. For time in area, a G denotes the participant grew up in the study area. For gender, men are denoted with M, women with W, and gender nonbinary with NB. Self-identified race was categorized according to the following: Those who those who identified as Caucasian or of European descent are listed as "White." Those who identified as American Indian, Native American, Indigenous, or a specific Indigenous ethnicity are listed as "Indigenous." In some cases, the participant indicated they identify as one race but also descend from another that they do not identify with or identify less with. For those individuals, the race or ethnicity that was less important to the individual is listed in parentheses with "also"; for example, "(also, Indigenous)." Two participants who identified primarily as White were not sure of their specific Indigenous ethnicity, one participant identified as Sioux (Oceti Sakowin), and the rest of the participants who identified as Indigenous reported Ojibwe ethnicity. These ethnicities are not listed in the table to protect participant identities.

Pseudo-nym	Age	Time in area (yrs)	Highest education	Marriage status	Children	Gender	Race and ethnicity
Erik	22	2	Bachelors in progress	No	No	M	White
Marcy	23	5	Bachelors	Yes	No	W	White (also Indigenous)
Avery	23	4	Bachelors	No	No	NB	White
Clarissa	24	6	Masters in progress	Engaged	No	W	White
Danielle	24	G	PhD in progress	Engaged	No	W	White
Brian	26	0.8	Masters	No	No	M	White
Victor	27	1	Bachelors	No	No	M	Hispanic
Joslyn	29	11	Bachelors	No	No	W	White
Isabel	30	11	Masters	No	Young	W	White
Russ	30	1	Bachelors	No	No	M	White, Indigenous
Stella	31	7	Bachelors	No	No	W	White
Fiona	34	9	Masters in progress	No	No	W	White
Mila	35	G	Bachelors	Yes	Young	W	White
Ravena	38	12	Masters	Yes	No	W	White
Brandon	38	G	Bachelors	No	No	M	White
Joey	38	9	Masters	Yes	Young	M	White
Melissa	39	G	High school	Yes	No	W	White
Jared	39	20	Masters	Yes	Young	M	White
Monica	39	NA >3	Masters	Yes	Young	W	White
Tyler	39	G	Bachelors	No (partner)	Young	M	White
Melody	39	G	GED	No (partner)	Young & grown	W	Indigenous

Kent	41	10	Bachelors	No (partner)	Young & grown	M	Indigenous (also White)
Daphne	41	G	Associates in progress	No	Young	W	Indigenous
Amanda	42	G	Bachelors in progress	Divorced	Young	W	White
Lindsay	44	30+	Masters	Yes	Young & grown	W	Indigenous (also White)
Colette	49	NA >3	Masters	Yes	Young & grown	W	Indigenous
Leroy	51	G	Bachelors	Yes	No	M	White
Anthony	54	2.5	Bachelors	Yes	Young	M	White
Connie	54	14	Bachelors	Yes	Grown	W	Indigenous (also White)
Anita	57	25	Associates	No	No	W	White (also Indigenous)
Calvin	57	35	Bachelors	Divorced (partner)	Grown	M	White
Cynthia	60	3	Tech degree	Divorced	Grown	W	White
Susan	61	G	Bachelors	No	Grown	W	White
Henry	61	G	Tech degree	Yes	Grown	M	White, Indigenous
Sheri	62	25	Some grad. coursework	Yes	No	W	White
Felicity	63	21	PhD	Yes	Grown	W	White
Robin	64	39	Associates	No (partner)	Grown	NB	White
Hugh	65	25.5	Masters	No	No	M	White
Paula	68	G	Bachelors	No	No	W	White
Lorelai	70	20	Masters	Yes	Grown	W	White
Linus	74	34	PhD	Yes	Grown	M	White
Evelyn	81	47	PhD	No	No	W	White

We used open coding to identify themes in interview transcripts (Ryan & Bernard, 2003). Themes are defined as conceptual labels assigned to similar expressions of activities, events, emotions, or instances of phenomena described in an interview (Strauss and Corbin, 1990). A single sentence or quote could be coded to multiple themes as appropriate. To address intercoder reliability and consistency, the first author (Wick) and author (Northbird) coded four interviews and reviewed them together, while Wick coded the rest of the interviews with input on interpretation from

Northbird. Following coding, themes and examples were shared with authors Northbird, Beeksma, Ballinger, and Montano (of the Indigenous advisory group) to validate coding and interpretation and iteratively adjust themes and coding as needed.

## **Results**

We identified thirteen themes associated with participants' connection with water (Table 3.2), the four most common of which were mentioned by every participant. Most participants ( $\geq 32$ ) discussed most (11/13) themes. Consistent with most studies of human well-being benefits of blue spaces, these themes were highly interrelated (e.g., Bell et al., 2015; Mansfield et al., 2020; Wright et al., 2024). We discuss these themes in the context of their relation to one another, starting with exploration/learning, which was often linked with time/traditions, enjoyment, and social/community; followed by spirituality/emotions, which was often linked with place meaning/attachment, health, aesthetics/sensory, and care for nature. We conclude with a discussion of the themes of fear/safety, wild food/water, work/economics, and art/inspiration. Participants shared several forms of identity as being associated with their connection with water, which are discussed below in the context of each theme. These included formal or informal membership in a recreation group, Ojibwe or Indigenous ethnicity, health status, occupation, religion, and affinity for nature (e.g., "outdoorsiness" or environmentalism). Following our discussion of themes, we highlight how age, lifestage, and parental status were especially important to participants' relationship with water. In the second half of this section, we explore how our results highlight the limitations of existing CES models in explaining the complexity of barriers to and benefits from CES for diverse constituents of a community and apply sense of place and therapeutic landscape theory to interpret our results. We conclude with a summary of the implications of our results for applying CES assessment to improve equity of human well-being benefits of blue space.

### ***Study limitations***

We reached thematic saturation with 42 interviews but were still identifying subthemes with the last interview coded (Weller et al., 2018). This study was not designed to represent the study area population, but rather include participants with a range of sociodemographic identities. For example, although we interviewed one participant who identified as homeless, this study is

Table 3.2 Overview of themes and subthemes related to participants' connection to water, along with the number of participants (Interviews) and number of cumulative references in transcripts for each theme.

Subtheme	Interviews	References
Enjoyment	42	572
Joy, happiness, enjoyment, fun	41	100
Recreation, fun, play	41	465
Connection when not present	5	7
Exploration/learning	42	449
Learning, knowledge	41	159
Teaching, sharing	31	147
Exploration, discovery, adventure	23	56
Building skills, independence, confidence, empowering	14	24
Excitement, thrill, pushing oneself	14	24
Learning, sharing across cultures	13	27
Formative experiences, finding yourself, personal growth	10	12
Spiritual/emotional	42	526
Gratitude	28	77
Awe, reverence	27	55
Respect	25	61
One with nature, water connects us	19	43
Solitude	17	33
Lifegiving	15	32
Generally spiritual	13	19
Mindfulness	10	28
Autonomy of water	10	33
Sacred, holy	10	15
Reciprocity	8	12
Refuge	7	13
Healing, medicine	6	15
Religion	6	7
Water as cleansing	6	9
Creation (Christianity)	5	5
Grief	5	8
Prayer	5	8
Asemaa, tobacco offering (Ojibwe)	4	7
Indigenous Water Protectors (Ojibwe)	4	6
Ancestral connection, blood memory	4	5
Dreams	3	3
Astrology, cosmos	3	5
Stories	3	6
Ceremony (Ojibwe)	2	8
Some things aren't for sharing (Ojibwe)	2	5
Water spirits (Ojibwe)	2	10
Spiritual journey	2	3
Time/traditions	42	370
Memories, nostalgia	35	119
Intention, desire for future	26	52
Changes with stage of life	16	36
History, heritage	15	28
Traditions for friends or family	13	18
Future generations	12	23

Personal ritual, habits	11	14
Evolving relationship	8	14
Tradition for culture or community	6	8
Treaty rights, tribal sovereignty	3	7
<b>Attachment</b>	<b>41</b>	<b>277</b>
Exposure	33	90
Special place	29	73
Reason for living here	23	52
Spend time	16	25
Generally positive connection to water	15	26
Pride, proud of this place	4	4
<b>Social/community</b>	<b>41</b>	<b>261</b>
With friends and family	38	139
Water as a connecting point, social in general	16	27
Events, tours	14	20
Community, organizations	13	26
Volunteering	9	17
For dogs	8	14
Milestones, marriage, engagement	3	8
Gifts from nature to others	2	3
<b>Health</b>	<b>40</b>	<b>214</b>
Mental health, peacefulness, calm	39	165
Physical health	22	34
Health and wellbeing, general	5	5
Technology-free environment	5	8
<b>Aesthetics/sensory</b>	<b>37</b>	<b>226</b>
Beauty, aesthetics, views	31	89
Sensory connection	25	48
Temperature	14	33
Nature connection	13	31
Always changing	9	12
Clean, pristine	5	7
<b>Care for nature</b>	<b>34</b>	<b>294</b>
Importance of protection, sense of responsibility	27	70
Emotions	24	105
Climate change	12	19
Actions taken	8	18
Observed degradation	4	8
<b>Fear/safety</b>	<b>34</b>	<b>200</b>
Fear, danger, safety, caution	28	94
For children	12	22
Negative experiences	24	57
Neighborhood safety, incivility	5	12
Perception of dangerous uses	2	5
Tragedy, trauma	5	10
<b>Wild food/clean water</b>	<b>32</b>	<b>247</b>
Fishing	27	119
Clean water, drinking water	20	35
Food, sustenance	18	28
Fish consumption advisories	10	18

Food culture, special dishes	7	10
Responsibility in harvesting, knowing where food comes from	6	13
Foraging	5	7
Sport fishing, catch and release fishing	5	7
Hunting	3	5
Subsistence in past or previous generations	2	3
<b>Work/economics</b>	<b>21</b>	<b>92</b>
Career influence	11	22
Economic benefits (personal or societal)	8	9
Jobs, work	16	61
<b>Art/inspiration</b>	<b>14</b>	<b>74</b>
Arts or craft type	12	38
Art or craft motivation	7	23
Influenced by writers about water or nature	4	13

unlikely to include a full representation of the nature of connections to water of the unhoused individuals staying in waterfront parks in the study area (Mokos, 2017). Interviews were not able to engage every population living in the study area, and does not include Black Americans or immigrants, who represented small proportions of the population. All participants expressed an existing relationship with water, revealing an affinity of participants for nature.

## ***Themes***

### *Exploration and learning*

Every participant mentioned exploration and/or learning, with 41 mentioning learning and knowledge pursuit, and 31 mentioning teaching and sharing knowledge. Two-thirds of participants (28) described learning about the water with family and elders, and seven mentioned learning from friends. Many participants explained how childhood family traditions influenced their present-day connection with water. Fiona shared, “*Growing up, starting at the age of four, I’d always do a sailing trip with my grandparents for about two weeks every summer until I was about eighteen. [...] So, I suppose just growing up with it in my life has given me confidence to be able to go out and find a boat to sail on.*” Many participants learned recreational knowledge and skills from family. Some, like Anita, also learned mental health coping skills. She described a tumultuous time as a young adult when she relied on the water, “*Mom always took us swimming. So, you know, it was just a given. [...] I just remembered mom had already planted those seeds and it was like, I knew it was there, so let’s go.*”

Nearly as many participants learned from teachers and in formal settings (26), as those who learned from family members and elders (28), highlighting the potentially life-long impact of nature-based education. Furthermore, some mentioned early educational experiences so formative they influenced the participant's career path. Isabel said, *"I think having that opportunity in high school to do that [stream] monitoring was really what sparked this continuous interest in water and management."* Many participants also mentioned classes and programs for adults. These were important for individuals who did not grow up with water-based experiences. Victor, who grew up in Houston, Texas, discovered a local conservation organization and decided to become a member. *"I started going to their events like river cleanups, things like that. And I actually went to one of their paddling events where they had a whole bunch of us. They provided all the equipment and all the kayaks and everything. And we went out with this botanist to do plant identification. [...] That was really cool for someone like me [...] who grew up in like the mainland or in a landlocked place [and] doesn't really know about that world."*

Many participants took joy in sharing water experiences with others, including their children or families (21), with others in general (15), and as formal guides or teachers (10). Most parents expressed joy in sharing water experiences with their kids. Robin highlighted their joy in sharing something they loved with their kids, *"It was very wonderful to introduce them to something that I loved so much. And to see them with their fresh look on the world, and the way they experienced it."* Many parents also expressed desires and intentions to share water with their kids, with various motivations. Amanda expressed the desire to keep her child safe. *"My daughter, I had her in the swimming lessons from a young age just because I didn't want her to be in the water and accidentally fall in and have something happen."* Some discussions connected to discussions of traditions, which is discussed more below. Tyler talked about his desire to pass down a family tradition, *"I think the tradition end of it, especially passing down the things that I've learned from my parents, and they learned from their parents, and so on and so forth – I think it's important that I pass some of those things down to my kids and just at least let them experience it."* Colette shared a sense of responsibility associated with her Ojibwe culture, *"There's a special responsibility and relationship that Indigenous women have with water and also a responsibility to teach others especially kids and grandkids about the importance and sacredness of water."*

Outside of teaching and sharing, participants also commonly discussed exploration, discovery, and adventure (23), building skills and confidence (14), excitement and thrill (14), and formative experiences (10). These themes suggest the importance of the water in supporting personal growth and evolution. For example, Victor shared his discovery of Park Point, a unique bay-mouth sandbar separating the harbor and estuary from Lake Superior, which has a 7-mile-long public beach and a state natural area. *“It was such a pleasant surprise. [...] Imagine moving to a place and then later finding out that there's a beach there. So that was awesome.”* Participants also shared how water experiences helped them build skills, test their independence, and build confidence. Stella said, *“I think part of my enjoyment and the peak experiences that I had around learning these skills was just feeling very accomplished. Because I was a pretty timid kid and was nervous about certain things and I didn't want to take risks. So, when I was able to build those skills and do those things, I felt very accomplished.”* Erik discussed the first time he rolled his kayak out of necessity, on a trip to North Carolina, *“I got to the end, and I flipped, and I was about to exit [the kayak]. And I distinctly remember this moment thinking, ‘No, I'm going to roll here.’ It would have been so devastating if I had exited. So, I did it for the first time, in this real scenario. And I felt really good. [...] But since then, I've really made a lot of progress with [rolling].”*

The water experiences shared were often formative. Robin shared how water *“was incredibly important to me as a like a vehicle for exploration when I was a teenager. A way to explore the world, and myself. And myself in relationship to the world.”* These formative experiences sometimes connected to the present day. Hugh said, *“I like to explore the lakes in the watershed like I did with my dad in our boat. I just have to throw a kayak on top of my old Toyota [...] and go to area lakes and like to explore.”* Jared explained, *“I was comfortable on the water because of those formative teenage years or whatever, and the [Boy] Scouts and doing those activities. It was fun to be able to continue those things, but in an area that I had yet to explore. Lake Superior was new for paddling for me and in some of the lakes that we went to as well.”* Formative experiences also informed participants' desires to share the water and water experiences with others. Joey described, *“The water or the lakes can inspire the sense of awe and adventure and that's magnetic to a kid like me,”* He continued later, *“So that kind of adventure, that's still there,*

*[the kids] just come along and it's changed in that it's satisfying to bring kids along and see them excited about it, share the love."*

Exploration and learning were often tied to the themes of enjoyment, time/traditions, social social/community, which are discussed below. Participants involved in adventure recreation described how these experiences offered opportunities for personal growth, fulfillment, friendships, connection to community, and happy memories, consistent with Houge Mackenzie and Hodge's (2020) framework for how adventure recreation supports eudemonic well-being. That framework included autonomy and competence (self-expression), relatedness and beneficence (self-transcendence), and contact with nature, which our participants also discussed in the context of aesthetic, sensory, spiritual, and emotional connections, described below.

Thirteen participants talked specifically about learning and sharing across cultures. Three participants expressed interest in preservation or understanding of other cultures broadly, while 11 non-Indigenous participants expressed an interest in or appreciation for understanding Indigenous connections to the water. Anthony shared, *"I saw something on PBS about harvesting wild rice in canoes like where they paddle through and whack it and get these big baskets. [...] I had no idea that that's how it happened or how they did it. When I see on the map it says, 'Wild rice restoration are. Stay away,' it's like, oh."* He also suggested the value in opportunities to understand Ojibwe culture and its connection with water, *"I think that'd be a fun learning opportunity and a way to connect with nature in maybe a slightly different way."* These comments suggest that there is a lack of understanding by non-Indigenous participants about connections between Ojibwe culture and water, and possibly about Ojibwe culture and history broadly. This could be a result of federal policies like the boarding school system which forced assimilation and resulted in the loss of Ojibwe culture and language, despite ongoing Indigenous resistance (Adams, 1995; DeJong, 2007). It is also likely due to a lack of Indigenous history presented in educational systems today (NCAI, 2019). Co-author Beeksma asserts that sharing knowledge across cultures can lead to increased understanding and respect. Similarly, two Indigenous participants discussed sharing Ojibwe culture with others. Lindsay said, *"I help spread the word and if somebody has a question and they don't know anything about*

*Anishinaabe, and they're like, "Yeah, what is this all about?" I'll try to educate them because I can talk both talks."*

### *Time and traditions*

The concepts of time and/or traditions came up in all interviews and included discussions relating to the past and the future and water traditions through time. Memories and nostalgia came up in 35 interviews, and included many early memories, "first time" memories, memories of summer camp, childhood family memories, formative memories of early adulthood, and recent memories. Amanda remembered childhood memories of playing in the creek near her home, *"So we used to play in that little creek all the time. We used to think it was a real lake or something. We'd dive and make little dams."* Not all associated memories mentioned were outdoor based. Leroy, a self-proclaimed boat nerd, that is, someone who watches ships coming and going in the harbor, recalled, *"I remember one day, my mom and dad told me, now, don't check out any books when you go [to the library]. Well, I discovered this one book that had pictures and listing of any of the ships that were on the Great Lakes as of 1980. [...] I get this book, I sit down, I'm looking through it. I must have spent two hours on it. This book is fascinating. I've got to take it home with me. [...] I now own every volume in that book series."*

Traditions were important to many participants, including family traditions (13), personal rituals (11), and cultural traditions (6). Cultural traditions included fishing and trapping traditions. Cynthia said, *"My father is an avid fisherman. We grew up with it too, so just tradition moving along."* Joey mentioned that as a ferry captain on Lake Erie, *"I felt like I was part of this tradition or something of sailing. You talked to the other captains. They had all these stories and they'd been doing it for so long and it felt like you were really linked to the history of the area."* Family traditions mentioned varied widely: a nightly walk, an anniversary boat excursion, summer boat rides, monthly dips in the lake, annual cold plunges, annual trips to favorite campgrounds or lakes, and annual attendance at events. Avery described how important summer boat rides were for their family. *"Boat rides are a very important tradition for us. We all load up with all our snacks and we go out on a lake for the day. We go up on some beautiful chain of lakes and just be together and talk. That's when we really have our heart-to-heart family conversations."*

Others shared personal rituals centered around daily walks, weekly meditations, and regular artistic practices along the shore. Avery described her daily walks, *“Sometimes I’ll bring friends with me, but a lot of the times I go by myself. I’ll walk down to Leif Erikson and then walk all the way down to Canal. There are a couple little spots where you can go down to the water from there.”* Avery uses this ritual to journal, calm themselves, and hunt for sea glass and agates. Fiona shared, *“Every full moon I try to get out and see it on the lake, and I ask myself where was I during the last full moon? And it just gives me a moment to question what I’m doing, how I’m doing, and give thanks for how far or little I’ve come, regardless of what’s happened.”*

Twenty-six participants also brought up intentions and desires for the future. Daphne shared her desire to try fishing on the St. Louis River, after having moved nearby. *“We drive by the St. Louis River all the time, and I’m starting to see posts about people fishing, or there’s different stories, and [...] I really want to learn how to fish.”* Although a thorough analysis of challenges raised was outside the scope of this study, Daphne shared that not knowing where to start was a big challenge to her.

Fifteen participants mentioned a connection with water through history or heritage. While several participants mentioned boat watching and the area’s historical and current significance as a shipping and industrial port city, two participants identified as “boat nerds.” Melissa, a music teacher, described how she became interested in boat watching. Late one night, she heard an obnoxious boat horn. *“And in the morning, I figured out it was this vessel called the James R. Barker. [...] And I started to identify it, and then I started to pay attention more to the comings and goings of boats, [...] and it’s all because Captain Newland just about blew my ears off last May, at 1:20 in the morning.”* Leroy, mentioned above, has written and published a book about the history of one laker, attends annual ship enthusiast events, and is an active shipping photographer.

Some Indigenous participants expressed how their family history has informed their relationship with water. For example, Kent shared a story about his grandmother’s removal to boarding school as a child, *“She came back at night, it was dark out, couldn’t see anything. She went to bed and woke up in the morning, walked out her front door, and there was nothing left. It was just stumps*

*for miles and miles and miles and miles. You couldn't even see a single tree.*” To Kent, the communities who have endured despite these kinds of “*life changing, turn your life upside down traumas*” have much to share about resilience and how to live with nature: “*Let it be. Stop disturbing and stop turning. [...] Otherwise, we're not giving the earth time to heal and regenerate and reproduce.*” Twelve participants expressed the importance of legacy and protecting our water for future generations. As Lindsay put it, “*Whatever we do now will absolutely affect our kids and our grandkids in the future. And I don't want them to look back and say, grandma wasn't a good ancestor, she didn't do anything, and she just let it happen.*” Over half of participants who identified as Indigenous mentioned considering future generations. Although this value is not unique to Indigenous participants, it is a common theme in many Indigenous cultures including Ojibwe culture (e.g., Ratima et al., 2019). Author Beeksma shared the cross-generational, matrilineal connection to water of the Ojibwe: Anishinaabeg women are the caretakers of the water. We are formed in water in our mother’s wombs. We all need water to survive. Water cleanses and fosters growth. The Grandmothers of our communities instill this knowledge in the younger generations. We are taught to sing and pray for the water. We are taught that the water has memory. Water allows things to be dissolved into it, and flowing water picks things up along its journey. Water is powerful, even changing the form of rock. It is to be respected.

Lastly, three participants reported connections to water through tribal sovereignty or treaty rights. As mentioned above, the study area included not only the reservation lands and waters of an Ojibwe Tribal Nation, but also falls entirely within the area where treaties preserved rights to practice traditional lifeways. As Russ said, “*How can we as a country uphold treaties that were made in the 1800s [...] but then continue to do these things [that degrade the land and water]. [...] It's at the expense of generations of people and their ancestors; people that have already been relocated and put down.*” Coauthor Northbird reiterated how treaty rights are a fundamental component of the rights to self-determination and sovereignty and an important connection for Indigenous residents to both their cultural heritage, current identity, and future as a people.

### *Enjoyment*

All participants mentioned sentiments of happiness, fun, or joy associated with their connection with water. These sentiments were often associated with recreational experiences, including walking/hiking (35), swimming and beach-going (29), paddling or floating (25), play (16), boating (15), time at a cabin (11), camping (11), biking (9), watching boats/ships (7), and sailing (6). Happy experiences were also often related to positive memories and nostalgia. For example, Lorelai shared, *“When we could, my dad, we would go fishing. And we had just bamboo poles. [...] And one time, he rented two rowboats, and we had four in each boat. And these bamboo poles sticking out each side and just catching a whole bunch of bluegills. And, of course, he spent a lot of time untangling poles and things. That was fun.”* For some participants, these fun or joyful childhood experiences were tied to current experiences. For example, Mila discussed how her childhood memories connected with her desire to create those experiences for her kids. *“I had such fun experiences playing [in the stream] behind my house when I was growing up that I would love for them to do that. And actually, they sometimes will go play by a creek. In Norton Park [...] they can actually access the creek on the lower side. And they have built a fort back there. And it reminds me of when I was a kid.”*

### *Social and community*

Forty-one participants mentioned the importance of friends and family in their relationship with water, and 16 mentioned water as explicitly being a vehicle for connection with others. As Stella put it, *“A lot of my friendships are built around [water] recreation.”* Danielle described, *“My fiancé is also very big into everything that my parents are into, like fishing, all that. The first time that my parents took my fiancé out on the boat with us on Lake Superior to go fishing sticks out a lot in my mind because I was like, wow. We all have something really big in common.”* Henry shared how water has always been associated with family for him, *“Back in the old days, we used to go smelt. [...] The whole family would get together with other families and go to the, say like Lester or Chester Creek and those area's there and get smelt.”* As for today, he said, *“I'll go out with family and friends, on different rivers, and different lakes, and it's just more enjoyable going with people.”*

Three participants mentioned that water was important in the context of memorable life experiences. Monica described, *“My husband and I got married out by the water too at [a resort] in Two Harbors. And my parents also have a timeshare there, so it's kind of fun, we bring the girls there when they are there in their timeshare and we can be outside with them and share with them, ‘this is where we got married.’”* Calvin shared a meaningful memory of bringing his niece, who had recently moved in with his family, to a local state park for a walk: *“Perhaps [it was] her first time ever out in the woods. And we were walking along, and I was wondering if she was loving this or hating this, and she stopped and she said, ‘Uncle Calvin, thank you for bringing me here. This is the most beautiful thing I've ever seen.’ And of course, we were standing there right along the shore of the St. Louis River. That was a great affirmation for me to just keep doing what I'm doing and keep bringing the kids out there.”*

For 13 participants, specific communities and organizations were important and often tied to learning and sharing experiences. Stella said, *“We've got the Duluth-Superior Sailing Association, a great organization, that has really accessible and affordable sailing. I learned through them originally, and then got connected with people who race on Wednesday nights.”* Conversely, Erik described the challenges of needing mentors who want to help grow the kayaking community, which has a high barrier to entry: *“I think it's a big issue of people not wanting to teach. Like even myself, I get burnt out on teaching people.”* Nine participants mentioned volunteering in various capacities associated with the water, including participating in youth organizations, garbage clean-ups, environmental advocacy organizations, recreation organizations, leading and participating in community science, waterfront historical museums, and disability access organizations. Hugh, who has been involved in many local environmental organizations and efforts over the years put it, *“Some of my most valuable connections with people are through that work.”*

### *Spirituality and emotions*

All participants discussed their spirituality and emotional connections to water. Spiritual connections were difficult to distinguish from emotional connections to water. Some participants did not consider themselves spiritual or religious, but still acknowledged what they considered a spiritual connection. For example, Russ shared, *“It's just something that affects me so positively*

*that I can't really think of it as anything more than I guess what you would consider spiritual."*

Other participants framed their connection as emotional, especially linked to gratitude (28 participants), awe/reverence (27), or respect for the water (25). For example, Susan expressed her awe, *"I'm not really spiritual, in the conventional sense, I suppose. But I've always had an awe of water. It's a mind-blowing substance. It just really blows my mind. I can't even articulate [it]."* Others, however, evoked these same emotions to convey connections they framed as spiritual. For example, Jared shared, *"I'm a Catholic, and just what a profound gift creation is. And [I am] grateful for it."* Kent associated his respect and honor for the water with his spiritual relationship with Ojibwe water spirits: *"The way we were taught is that those water spirits, they don't necessarily like us, they tolerate us. So, there was this underlying respect and honor for those water spirits as a child hearing those stories."*

Most secondary spiritual/emotional themes spanned cultural or religious identities (21), suggesting that religion or spirituality potentially serves as an underlying vehicle for certain types of emotional connection with water. However, we did identify five secondary themes that were culturally specific to Indigenous spirituality, and one specific to Christianity (Table 3.2). Other participants also mentioned Buddhism and Wicca in relation to concepts of mindfulness associated with water, which spanned cultural or religious identities.

Seventeen participants identified solitude as being an important part of their relationship with water, and many connected this to a spiritual or emotional practice because of the connection to peacefulness, quiet, and mindfulness. For example, Avery said, *"Right now, my relationship with water is very solitary. I find a lot peace with water. A lot of my mental clarity and meditation practice is surrounded by water. I still do like go to the beach with my friends, but now it's much more of a solitary relationship than it was [in the past]."* Calvin shared how, in regular life, he can feel pressure to *"to buy more things, go on more trips, look different than I do, feel different than I do. [...] And when I'm near the water, that disappears."* Other participants connected their desire for solitude to a personality trait. Brandon shared, *"I am not a crowd person. You're more likely to see me at one of the small, little, tiny beaches that are hiding around than popping into Brighton."*

The spirituality/emotions theme was highly connected to place meaning/attachment, health, and aesthetic/sensory themes, and for some, care for nature, all discussed below. It was particularly connected with mental health. For example, Fiona said, *“There have been a lot of times that I go down to the lake and just be there. Cry. Pray. Just like it’s a place of ... I don’t know, just being, I guess.”* These sentiments, along with many expressed by other participants, evoke the well-documented concept of restorative environments, which arose from Attention Restoration Theory (ART) and describes places that facilitate rest for the mind and provide measurable benefits to psychological states and health. (Herzog et al., 1997; Joye and van den Berg, 2018; Collado et al., 2016).

#### *Place meaning and attachment*

Ideas about place meaning and attachment to place arose in 41 of the interviews. Most participants (33) mentioned how exposure to water was important in their connection with water. Participants shared that water was part of the backdrop of life, they grew up with it, or that it was part of the local culture. As Hugh put it: *“I had a Minnesota childhood.”* Participants who grew up elsewhere often mentioned the water they grew up with. Colette explained, *“The lakes were such a formative part of my life. Especially on Lake Michigan, where I actually lived on the lake, I spent probably five months out of every year in the water.”* Joey, said of his hometown, Sandusky, *“It’s just centered around the water. There’s the amusement park, big, beautiful beaches, great fishing. I can’t point to exactly how but [there were] just a lot of good times spent as a kid down at the water messing around and being on my own.”* Participants who grew up in the area also shared the ubiquity of water in their lives. Tyler shared, *“I see [the St. Louis River Estuary] every day. My parents live just up the hill from it, so every day I’m coming into town, whether it be for school or sports or whatever, it’s something that I see every day. I grew up on it. [...] And now I spend a lot of time on it fishing.”*

Others talked about how their gender intersected with their exposure. Stella described how even though she only had sisters, her dad was involved with the Boy Scouts. *“You know, those were very gender separated at that time. [...] So, my sister and I didn’t go to the Boundary Waters, and he went every year.”* She went on to say, *“I’ve often sailed on a boat where I’m the only female.”*

*[...] But I have been on [...] trips where the recreation that's happening on the water is all women. For me, I feel like that gender norms in the recreation industry are equalizing."*

While some participants talked about how their attachment was rooted in exposure, a few participants talked about not growing up with water, but still having a connection with it. For example, Victor said, *"From everything that I've said and from my life, it doesn't really seem like I would be so drawn to a large body water, but that was just where I was in my life and where I am now, where it's one of the priorities for me."*

Twenty-nine participants mentioned favorite or special places to them associated with the water. Some places were linked to meaningful memories, like where Marcy got married, the memorial bench for Monica's mom, or Clough Island, which Anthony described circumnavigating with his son. Other locations were special because of their peacefulness, beauty, or natural features. Over half of participants (23), including both those who grew up here and transplants, reported that water was at least part of why they lived in the study area. Ravena shared, *"Duluth is our chosen home. We moved here for jobs, but we stay here because of the recreation and having access to the water and to the trails that overlook the water."* It is also what motivated some participants to move here. Joslyn said simply, *"The lake brought me up here."* Victor described visiting the area and *"when that trip was over, I just remember coming back to the cities and deciding that I would try to move here."* After growing up on Lake Superior in Michigan, Colette shared, *"I'm back home, I feel like, on Lake Superior."*

Ravena shared how her attachment to water was linked to the memories she has, *"It is a presence in a lot of memories, like almost in the backdrop, in a lot of memories. And good memories."* Others felt that the attachment was linked to what was normal in the area. Russ said, *"of the 20 people I work with, half of them have to have some sort of water connection."* Amanda shared, *"I guess when I've lived other places, the water hasn't been as prominent as it is here. It's such a part of the culture in Duluth."* Sixteen participants shared how their attachment was rooted in how they chose to spend their time. Joslyn shared, *"Anytime I'm [considering] anything I want to do, it usually involves water."* Some participants connected this to an identity as an outdoorsperson or nature-lover. Marcy explained, *"In my family I was always kind of the fish in*

*the family. So, it was very difficult to get me out of the water.” Brian said, “I identify as somebody who’s outdoorsy, who likes nature, who is like a camper, hiker person.”*

### *Health*

Most participants (40) commented on impact water had on their health and well-being. Participants found water to be relaxing, calming, or peaceful. Many participants mentioned specific times when the water helped resolve moments of crisis. Anita described one such instance at Brighton Beach: *“I took the bus there and I literally laid on a rock in the sunshine till I felt better.”* For some, the lake represented a place of refuge. Colette, who grew up on Lake Michigan and Lake Superior, remembered, *“And [the Lake] was always there, consistent, stable, nurturing, so I definitely was in relationship with the water when I was young. And it did lessen some of the severity of a difficult childhood.”* Joey described dealing with a period of depression and an argument with his wife, after which he drove to the waterfront, *“I took a walk from Endion Station to the North Pier, and it was like flipping a switch. By the time I got to the light on the end of North Pier, things had dissolved. It was absolutely incredible.”*

Avery described the role the lake played for them in coping with diagnosed mental illnesses. They shared, *“It’s a good place for me to ground myself and find my center and just be really in tune with what’s going on in my head.”* They go on to describe how searching for sea glass has helped them, *“I used to pick at my skin super bad. I used to have problems with self-harming and [picking for sea glass and agates] has completely replaced all my bad habits. [...] It’s very good for my mental health and it gives me something to focus on that has a rewarding outcome.”* For Avery, the lake also represents a place of social connection in moments of distress. They described walking on the Lakewalk during a manic episode when they were unable to sleep, *“We all know that we’re going through some shit. There’s this sense of camaraderie where you see somebody, and you’re like, ‘Yep, you’re going through it. It’s 3:00 AM. Why are you out here?’ It’s a sense of togetherness.”*

Isabel, meanwhile, described spending time at Lake Superior while coping with cancer and the associated medical trauma as a young adult. After she was healthy again, she got a tattoo of the lake, which she said *“reminded me of where there was peace and where I found a place to call*

*home. So, I would just look at the lake [tattoo] and think about sitting on the shore and looking at the waves. And that would help me to calm my nerves and put myself back into place versus dwelling on the cycle of anxiety.”*

Physical health was only mentioned by about half of participants, and even from those, not very frequently (just 34 references of 3674). Most mentioned it in passing. Monica said, *“I think the big benefit for me is the exercise component and how I really appreciate it.”* Some participants talked about health more broadly, without distinguishing between mental and physical. Clarissa’s comment suggested the inherent connections between mental and physical benefits *“I’m [visiting the water] intentionally to relax, as a stress reliever, to exercise.”* The binary distinction between mental and physical health represents is rooted in Cartesian philosophy and is a fundamental characteristic of Western medicine (e.g., Gendle, 2016), but our data suggest it may not be the way participants experience health benefits of water. Author Beeksma shares how in the Ojibwe culture of some participants, the medicine wheel represents, among other things, the importance of maintaining ones mental, physical, emotional, and spiritual health to keep them all in balance. Biimaadiziwin (living the good life) is living that out daily in our lives.

Fourteen participants discussed the importance of temperature in their connection with water, including the cooler air temperatures associated with waterbodies (10) and the benefits of living in the region considering projected climate futures (2). Melissa said, *“I don't like warm weather. So going to the piers to watch a boat, when it's 80 degrees at my house, and 64 degrees at the pier, that's a nice relief.”* Eight participants discussed submersion or swimming in cold water. Felicity acknowledged cold water’s physical healing benefits, *“I had some real bad back issues a while back and it was nerve-based. So, there was a lot of inflammation and I used water as a cure. I would dive in that water, cold as it was, two days a week and it seemed to help.”*

#### *Aesthetics and sensory*

A total of 37 participants expressed the importance of aesthetic, views, or beauty (31), or sensory experiences (25) with water. Sensory experiences included things like the sound of waves or birds, the sound of boat horns, smells of pine trees and the water, or sensations of sand on the feet or cold lake water, or as Fiona put it, *“feeling the lake hug you”* while smelting in waders along

the shore. Ravena described the unique sound of the waves on the ice along the shore in the winter: *“You know those fish water pitchers that glug when you pour them? It sounds like that, [...] there’s something that sounds like those water pitchers. And I just love it, it’s just such a cool unique experience.”* Thirteen participants mentioned observing wildlife, identifying plants, or appreciating a window into nature.

These sensory experiences were often associated with stillness, quiet, and mindfulness, evoking a possibly spiritual connection. Calvin described canoe trips with his partner, *“We spend most of the day, not specifically in silence, but it’s pretty quiet, and oftentimes when something needs to be said, it often ends up getting said almost in a whisper, because what would be considered a normal human conversation is just feels like too much of a disturbance to the tranquility of the environment.”* Isabel’s comments illustrated how stillness was associated with healing for some participants, *“I just need to sit on the shore, listen to the water, just to be there. There’s something healing and refreshing, to just be around water.”*

Discussions about aesthetics and beauty were often related to the views possible in Duluth due to the topography. Jared talked about his daily commute, *“I’ll take Skyline and that way I’m just overlooking the sunrise over Lake Superior. [...] Beauty, just being able to take in beauty.”* Daphne shared how the views were related to her attachment to the water. *“I grew up on the top of the hill. I’m the firstborn, so I got whatever room I wanted, and I picked the room to grow up in that when I looked out my window, and my windows were big, the lake was just right there. So, I grew up attached to it that way.”*

#### *Care for nature*

Many participants expressed their connection with water in terms of stewardship or care for nature (34). Twenty-four participants expressed the importance of reducing impacts to or protecting water or feeling a sense of responsibility to do so. Participants shared a range of emotions associated with their care for the water, including hope/optimism (10), feeling upset or disturbed (13), worrying about how pollution will affect people (10), worrying about how nature has suffered from people (10), and grief for the loss of nature (8). While a range of environmental challenges came up, including twelve participants mentioned climate change specifically, and

often in the context of worry for the future. Colette shared, *“I was surprised when we moved to Duluth how many air quality alerts there have been. [...] And it seems like it’s only increasing so of course, global warming is a big issue.”*

Protecting water was particularly important to the participants who identified as Indigenous. It was mentioned by eight of nine Indigenous participants. Lindsay shared how she does what she sees is her part, *“My personal duty, I conserve it as much as I can. [...] Minnesota is full of drinkable water right now. We need to make sure that we keep it that way.”* Henry said, *“You have to take care of the water. If you don’t, it all gets polluted and everybody in the end disappears. [...] It’s a European way of thinking. We can go in there, we can cut it, we can mine it, and we can do this. [...] [There] needs to be a change in the way people think.”* He also connected this sentiment to the threat of pollution to treaty rights and suggested that the tribes in the treaty area should share decision-making power about permitting industrial polluters. Kent shared, *“I’m ready to fight if I have to. I wasn’t so much when I was younger. I just kind of enjoyed it, respected it. I’ve always protected the water if needed, but now there’s a sense of part of me that I’ll put my life on the line for it if I have to. That’s how important it is.”* This deep sense of responsibility to protect water was linked to his spiritual connection with water.

Other participants also identified how their spiritual and emotional connections to blue space were associated with their attitudes about care for nature. Sheri discussed how her spiritual relationship with nature informs her consideration of environmental impacts: *“A friend and I always say our church is going for a walk in the woods. I try to move through the world thinking about you know, trees, and water and the earth, what we’re doing to it, how we can move gentler on it.”* Care for water was linked to time and traditions also, through desires to protect the water for future generations. For example, Clarissa said, *“I feel like I’ve always had the perspective of making sure we have the natural resources available for the future generations to come. Always being smart with what we’re doing, and sustainable.”* Other empirical research also suggests a significant connection between place attachment, or emotional bonds with place, with pro-environmental attitudes and behaviors (Dang and Weiss, 2021; Tonge et al., 2015).

### *Fear and safety*

Thirty-four participants brought up fear or safety considerations, including twelve parents who had concerns for the safety of their kids. Isabel said about her son, *“He's got this draw to water, which, as a parent to a two-year-old, I love that for you. We just have to be careful because you can't swim.”* Broadly, discussions of fear and safety were tightly linked to feelings of awe and respect for the water. For example, Sheri emphasized, *“Being respectful... I can tell you I've probably kayaked less than five times without my lifejacket on, on Lake Superior.”* Anthony described how he and his wife, *“read a little bit about it and we were like, ‘Oh, we got to be careful and respect that.’ So, we've done a lot of stuff to prepare, rescue classes.”* Stella discussed how as she grew her sailing skills, her respect for the water grew also. *“It's quite dangerous when it comes down to it. The hypothermia, and the wind and the weather can change so easily. Being a lifeguard, [I] know the risks of water.”* Her comments illustrate how themes of exploration and learning are closely tied to fear and safety for the water. Jared said some of his most memorable experiences were the ones *“where there's a little bit of excitement in there and pushing your comfort level a little bit, but also nothing too scary to make people be like I'm never going [again].”* Melody shared a similar sentiment, *“To get on the water is my fear. But it's fun kind of to be able to push yourself a little bit.”*

Fear and consideration of safety can be a protective factor that ensured more positive experiences for people. But 24 people also shared negative experiences associated with water. People who had experienced tragedy (as well as some who shared negative experiences) put a heavy emphasis on caution and safety. Marcy described how her best friend's brother died cliff jumping when she was a teenager. She said, *“My parents were very careful with what happened, especially knowing the family that that had happened to.”* Later, she shared, *“I remember distinctly in college, [...] a group of us went [to a railroad bridge over Lester Creek] and people were jumping off that bridge. And that was actually really hard for me [...] I would swim those waters, but I wasn't willing to cliff jump or do anything else. But I remember sitting there and thinking, you always think it safe, until it's not.”* Sheri shared a scary experience kayaking, *“We decided we weren't going to go on any Lake Superior long trips any longer because we got caught in a waterspout – we didn't get caught in it, but it was happening. It was really dangerous, and it was really scary.”* In these cases, it's possible that traumatic experiences may go beyond protecting the

individual and could represent a barrier to potential future positive experiences. However, other participants described near-misses from which they took helpful lessons. For example, Erik described an incident when a friend exited her whitewater kayak and was swept away but was recovered uninjured. *“Some scary stuff can happen, and I think it humbles you, but you have to be in the mindset of not quitting, but [thinking], what did I do wrong here, and how can I not have it happen again?”*

Five participants, all women, mentioned fears or caution with respect to perceptions of incivility or crime, and two associated their fears specifically with gender. *Susan said, “I don’t know why it is, but males just feel like they can just walk up to you.”* Ravena described this also, *“Nothing has happened to me when I’ve been on the water, but as women [...], I think that most of us have had things that have happened [...] So, just having that in the back of my mind sometimes can be negative and can take away from the experience.”*

#### *Wild food and clean water*

Thirty-two participants mentioned the theme of wild food and clean water, including 27 participants who mentioned fishing. Participants expressed a range of meanings associated with fishing. Some participants were not active anglers but shared memories of fishing from their childhood, like the memory Lorelai shared above of fishing with her dad. Connie talked about her memories of being the “*sunny champion*” when she fished with her mom as a kid. Now, she shared, *“It’s just relaxing for the mind to be able to just sit there and fish.”* Tyler also discussed the relaxation, *“I could spend all day out on the boat by myself just kind of hanging out, me and the dog and just fishing. It’s a nice time to clear my head and just let the mind wander.”* Fiona talked about the comradery and atmosphere of netting for smelt in the spring, *“You’re out at midnight and there’s a bunch of other people with head lamps that are dip netting, and you hear the river, and I don’t know, there’s something kind of magical about it.”* Most active anglers discussed the desire or practice of catching fish to eat when they could (18). Tyler said, *“If the fish fall within the slot that I can keep, they’re usually going in the live well. We like to eat fish [...]. We have the parents and siblings over. So, it’s kind of a way to get together, for the fish fry.”* On the other hand, three folks talked about fishing mostly for sport. Danielle shared that she

and her partner have conservation licenses, which is less expensive but has a lower limit. Melody said that when she fished, *“I let [them] go because I don't like fish.”*

Three participants talked about fishing in the context of subsistence. Colette shared memories of her family fishing for their primary food in childhood. Henry shared how he learned fishing from his dad, who depended on fish for his diet, *“My dad was born up on the North Shore in the old Chippewa City, and they heavily depended on Lake Superior, you know, for trout sources, back in the old days. [...] They wouldn't be allowed into certain stores. They excluded them, so they had to resort back to their knowledge, you know, where you get your groceries out in the woods, fishing, and hunting, and trapping traditions, and passed all this stuff on.”*

Ten of the sixteen participants who discussed eating fish brought up fish consumption advisories, which currently limit consumption of fish in the study area (MN Department of Health, 2024). Amanda said, *“My sister lives out in Gary, but there's a boat landing and it says, ‘do not take the fish’ and that's scary. Who wants to even go there? If you've got huge signs that say the fish are dying or toxic here, I think that's really sad.”* She went on to say, *“I probably wouldn't fish in the Bay, period, just because of that.”* Henry said, *“With the upper St. Louis, I don't like fishing around the mills because people catch fish up here and some of them can have weird things going on, you know, and I just attribute that to whatever comes out of the mills.”* Kent shared, *“My daughters can't eat more than one meal a month because they want to have children in the future.”* Fish consumption advisories were integral to discussions of fishing, and an implicit part of participants' relationship to the ecosystem in its current condition. They represented a limit to the connection with water and a limit to the potential benefits for participants. As Kent said, *“I'll never eat a fish out of the St. Louis River, unfortunately. I wish we could.”* Furthermore, for Ojibwe participants, they represent an abrogation of treaty rights to access traditional lifeways of fish-based subsistence diets, which as Kent shared, had sustained the Ojibwe community for countless generations.

In addition to fishing, five participants mentioned foraging for wild foods and four mentioned wild rice specifically. Kent discussed the significance of wild rice as an Ojibwe person, *“the rice itself is medicine, it gives us life, sustenance.”* He went on to share some of the Ojibwe traditions,

like offering asemaa (a tobacco offering), around harvesting rice and other foods or medicines, to honor the water, the rice, and the spirits. Author Beeksma describes that offering asemaa is intertwined with all culturally based Ojibwe activities. It is a sign of respect and gratitude to the Creator of everything and requests guidance or protection while out. Tobacco offerings was one of the spiritual subthemes unique to Ojibwe participants (Table 3.2).

Seven participants mentioned food culture associated with food that comes from the water, including fish fries, wild rice dishes, and understanding certain ways of food preparation. Six participants mentioned a sense of responsibility for harvesting ethically or knowing where their food comes from. Three participants mentioned hunting, although no participants were waterfowl hunters. Twenty participants mentioned the importance of clean water for drinking and everyday use. In many parts of the study area, drinking water comes from Lake Superior. Cynthia, for example, compared Duluth's water to where she used to live, *"It just tastes better, clearer. It's just all around better."*

#### *Work and economics*

Work or economic ties were identified by half of participants. Unsurprisingly, work was identified only by participants whose work is or was tied to water, but for those for whom that is true, the connection may be quite important. The nature of participants' connections to water through work varied. Some participants identified how water had been a vehicle for upward mobility, entrepreneurship, or economic gains. Melody said, *"My brother is on the ships. [...] Oh my God, he's already made it further than I thought he would. [...] Even if he quit right now, we would be so proud of him."* Others identified how certain water-related jobs fulfilled their passion for the water and connected them to others. Erik described how as a guide, he had to pay for his own trainings and work long hours, but *"it was a great experience and really, I am passionate about learning and connecting with the community. I met several paddlers through [that job] that I probably wouldn't have met otherwise."* Eleven participants mentioned how their experiences with and exposure to water influenced their career decisions and offered a strong sense of purpose in life. Hugh shared how his paid and volunteer work for environmental organizations gave him a sense of purpose, *"I feel like I could be making a difference in some way with whatever project I'm working to help the environment, whether it be here or elsewhere."*

### *Art and inspiration*

The theme of art/inspiration came up in 14 interviews. Participants discussed a few different types of arts or crafts that were associated with the water including photography (5), writing (3), basketmaking (2), jewelry (2), painting (2), crafts (1), music (1), and tattoos (1). They also mentioned various motivations to engage in these things, including desires to document conditions (3), pursue creativity (2), acknowledge the importance of nature (2), capture beauty (1), communicate (1), connect to something bigger (1), experience the flow of creating art (1), earn money (1), take pride in creation (1), and for self-discovery or expression (1). Isabel shared, for example, how her deep motivations for photographing nature have evolved, *“I remember in high school, [it was more about] seeing the beauty in the world because I couldn't see it within myself. And then when I was going through a lot in college, it was more finding that sense of identity and peace and expression. Now, I think it's more [about] capturing the moment and seeing the little things or seeing how things have changed.”*

### *Changes in human-blue space relationship with time*

All but one participant discussed how their relationship to water had changed throughout their life, making age or stage of life was the most ubiquitous form of self-identity that participants discussed with respect to their relationship to water. Older participants described specific periods when they had different types of relationships with water, while younger participants discussed changes more simply. Many participants suggested that connection with the water had grown deeper throughout their life. Felicity (age 63) shared, *“Well, I think [my relationship with water has] grown. I've grown more connected to it.”* Robin (age 64) said her relationship *“definitely becomes more and more of a spiritual relationship the older I get.”* Hugh (age 65) said of the St. Louis River, *“And I've learned to appreciate that more and more over the past 20 years, where I mean, I have a deep love for it now that I didn't have at first.”* Patterns varied for how connection with water changed for participants over their lives. Some, like Robin, Calvin, and Erik, suggested that young adulthood was a time for exploring and testing oneself, as Calvin put it, *“getting out there.”* Others, like Tyler and Russ, said that young adulthood was associated with fewer water experiences because of education and career responsibilities. Parents shared how their relationship changed during the years they were raising a family. Some parents, like Robin, were challenged by a lack of time, while others, like Calvin, shared about how *“the parenting*

years” entailed a slower pace, “[The kids] never really wanted to see how far they could go. They just wanted to get out and find a nice campsite and play in the water.”

Older participants often described more nuanced and complex connections to water, possibly relating to more years of varied experiences and memories. Participants also talked about physical limitations increasing with age, and health challenges. Evelyn shared, “*I don't hike the Park Point Beach as much as I used to. [...] You know, as I get older. Also, it's more of a challenge because the dune is steeper going down to the water now to get up and down.*” Isabel, Marcy, Avery, and Susan expressed how their relationship evolved over time with their mental or physical health needs. Social factors may also play a role in changing relationships. Cynthia alluded to this when she shared that she doesn’t fish as much as she used to. “*I guess nobody's interested in fishing that much anymore. [...] It's fun to go with someone [but my family is] working all the time. Both my daughters and their husbands, they're busy.*” This was consistent with results of the Waterway Benefits Survey (Chapter 2), in which older participants generally reported fewer social experiences.

## **Discussion**

### ***Cultural ecosystem services framework***

The themes we identified in interviews were broadly consistent with mechanisms connecting CES to human wellbeing identified by Huynh et al. (2022). However, the prevalence of these mechanisms in the literature, or research efforts, were not aligned with what our participants indicated was important to them. For example, while the “regenerative” mechanism (e.g., mental health theme in this study) was cited most frequently in Huynh et. al.’s review of mechanisms connecting nature to human wellbeing, intuitive (e.g., spirituality and emotions), cognitive (e.g., learning), cohesive (e.g., social and community), and retrospective (e.g., memories) were just as or more important to our participants. Likewise, CES research has focused on recreation, tourism, and aesthetics, which likely represents a Western bias in how the human-nature relationship is constructed and may not reflect Indigenous participants’ worldview (Jones et al., 2022; Gould et al., 2020a; Zylstra et al., 2014). While recreation (enjoyment) was important to all participants, it was no more important than spirituality and emotions, exploration and learning, and time and tradition-based connections. Also, aesthetics was mentioned less often and by fewer participants

than any of the above. These are geographically specific findings, but they highlight the underrepresentation in the literature of some facets of CES important in at least some contexts. As such, our study confirms Huynh et al.'s (2022, p. 13) call for the need to investigate how “these [human-nature] connections unfold in reality,” especially in multi-cultural settings.

Our results highlight the limitation of published CES conceptual models (e.g., Sherrouse et al., 2022; Blicharska et al., 2017; Jones et al., 2022;) to effectively measure or communicate the complexity of CES and the human-nature relationship, much less inform recommendations for sustaining and increasing human well-being benefits and equity thereof. Recent conceptual models acknowledge the importance of personal identity and socio-historical context of place but offer little in terms of guidance for operationalization to understand how diverse constituents of a community might experience blue space benefits differentially (e.g., Zoeller and Cumming, 2023; Fish et al., 2016; Sangha et al., 2018; Mucioki et al., 2021).

### ***Sense of place: the human-blue space relationship***

Interpretation of CES results in the context of existing social theory offers the opportunity to understand and describe the nuances of the human-nature relationship associated with CES for the diversity of our participants. We focus on sense of place theory, which describes the human-nature (here, blue space) relationship, and therapeutic landscape theory, which describes how the human-nature relationship manifests in an individual's experience of a blue space. Both are well-documented theories that characterize connections between the human-nature relationship and well-being benefits (therapeutic landscapes: Bell et al., 2015; Bell et al., 2018; Marques et al., 2021; sense of place: Scannell and Gifford, 2017; Rollero, and De Piccoli, 2010; Yoshida et al., 2022, Knez and Eliasson, 2017). Importantly, both also are consistent with a relational conceptualization of CES as affordances, or emergent properties reflecting perceptions of an individual relative to their environment, in this case, blue space (Chapter 2, Lennon et al., 2017).

Sense of place theory encompasses multiple types of linked relationships between humans and place, including the affective (place attachment), cognitive (place meaning or identity), and behavioral (place dependence) dimensions of relationship to place (Jorgensen and Stedman, 2001; Hernández et al, 2007). Sense of place has been included under the umbrella of CES as a single

service, but because the components represent the human-nature relationship, alternatively, sense of place can be considered an overarching representation of CES (Gottwald et al., 2022).

We identified many themes that related to place attachment or emotional connections to place, especially enjoyment and spirituality and emotions. Place meaning was designated as its own theme (“place meaning and attachment”) based on cognitive links between a participant and blue space (Hernández, 2010): how they have been or are exposed to blue space, why they choose to live here, and what they choose to do in blue spaces. The dimension of place dependence reflects a functional relationship to a place (Stokols & Shumaker, 1981; Vaske & Kobrin, 2001). Some participants mentioned connections to places that support specific activities, while some participants had an almost obligate dependency on blue space for mental health benefits. As Anita put it, “*When I am really distressed, [...] I go to the water. [...] It's absolutely essential to me.*” Understanding these dimensions of relationships residents may have with blue space can help identify intervention priorities to support different types of connection to water for members of different identity groups such as class, gender, and ethnicity (Shamai and Ilatov, 2005; Paasi, 2002).

### ***Therapeutic landscapes: how the human-blue space relationship manifests as experience***

Therapeutic landscapes were originally defined by Gesler (1992, 1996) as places where natural and physical environments, social conditions, and human perceptions create a place or setting conducive to physical, mental, or spiritual healing. Although the term originally derived from medical geography research, Smith (2018) argues that the growing literature on the health and well-being effects of blue space has made the therapeutic landscape concept relevant for interpreting cultural ecosystem services. Consistent with the relational framing of CES, the theory proposes that therapeutic properties emerge from the interaction of an individual with a landscape (e.g., a blue space) within a given set of socio-environmental conditions (Conradson, 2005). The term “therapeutic” refers to the experience of a landscape rather than on the qualities of a landscape alone (Kearns and Milligan 2020).

Bell et al (2015) recognized four overlapping dimensions of therapeutic experiences, including symbolic (cultural/personal place meanings), social (opportunities to engage with others),

achieving (pursuing fitness or other meaningful internal goals), and immersive experiences (restorative sensory experiences). The themes identified from our interviews can be mapped onto these dimensions. For example, enjoyment is likely at the intersection of all these dimensions, the place meaning and attachment theme is highly symbolic, and experiences coded as exploration and learning, associated with goals and personal growth, can be seen as achieving. We showed in Chapter 2 how these dimensions can be associated with identity. Women more commonly reported immersive and symbolic dimensions and men were more likely to report achieving dimensions. Our interviews reveal how over the course of life, dominant dimensions associated with the benefits of therapeutic landscape experiences evolve. For example, Calvin's shared how his connection with water shifted from "getting out there" (achieving) to slowing down with his family (social and immersive) to spiritual experiences (symbolic) later in life. Furthermore, recollection of experiences may shift them toward a more symbolic meaning over time. For example, a sailing regatta may be considered "achieving" at the time it occurs, but with time, memories of that experience may become primarily symbolic. Understanding how identity might be associated with these dimensions facilitates identifications of intervention priorities to support all dimensions and thus all identities. This could include for example, communication or education efforts for specific populations (e.g., increasing exposure to water experiences for girls and women), amenities to support specific experiences or populations (e.g., universal access, emotional connection with water), or environmental work to improve conditions for certain experiences (e.g., reducing fish contaminants to remove fish consumption advisories).

### ***Implications for assessing human-blue space relationships***

Statistically representative CES assessments or those focused on specific beneficiary groups likely exclude the perspectives of underrepresented populations with unique connections with water, and those approaches may inadvertently reinforce misconceptions about and inequalities in CES experiences and benefits. This study was designed to identify the range of benefits associated with a single, diverse population rather than distinguish between CES experiences and benefits for different groups of participants, but our results did suggest that participants with Indigenous cultural identities had unique ways of relating with water. This was consistent with both the experience of our Indigenous authors, with regional scholarship on Ojibwe cultural traditions associated with water (Conaway and Leoso, 2024), and with broader studies that

suggest leisure in blue spaces is best understood through a culturally centered lens (Mansfield et al., 2020). While Indigenous scholarship continues to highlight the need for research in Indigenous communities to be led by and rooted in Native perspectives and process, (e.g., Kovach, 2009; Conaway and Leoso, 2024), our research highlights how imperative it is that research in diverse and multicultural communities also adopt approaches and methodologies that accommodate diverse ontologies, incorporate multiple epistemologies, and adequately reflect the values of residents. Transdisciplinary approaches such as community-based research, participatory research methods, and two-eyed seeing can facilitate this work by engaging with diverse perspectives (e.g., Berkes, 2012; Peltier, 2018). In this case, our research included Indigenous perspectives so that the results have the potential to inform decision-making to benefit local Tribal communities who would otherwise be excluded from assessments because they are a statistical minority.

Our results have significance for improving CES conceptual models. By adopting an inter- and transdisciplinary approach paired with a multi-cultural perspective offered by Indigenous advisors and co-authors, we were able to apply well-documented social theories within the cultural ecosystem service framework to interpret results. While current conceptual models frame CES benefits as arising from the interaction of two separate entities, “nature” and “people,” with certain factors mediating these interactions, our results suggest that these entities are not separate but rather deeply enmeshed over the course of life in ways that that give rise to emergent wellbeing benefits, and in some cases prevent or degrade benefits. This understanding supports interpretation of benefits and barriers through a social framework of affordance, rather than the simplified equation of “people plus nature equals benefits.” This framework acknowledges the complexity in how identity influences CES experiences and benefits and facilitates its application for equitability-based decision-making. This is the first study of CES to our knowledge that applies mixed methods to assess the full breadth of CES in a multi-cultural population to explore how identity influences CES delivery. Our results reiterate the need for research methods as well as decision-making processes that equitably include the perspectives, needs, and preferences of historically underrepresented and marginalized communities.

## References

- Adams, D.W., 1995. *Education for extinction*. Lawrence: University Press of Kansas, 23, p.164.
- Bell, S.L., Phoenix, C., Lovell, R., and Wheeler, B.W., 2015. Seeking everyday wellbeing: The coast as a therapeutic landscape. *Social Science & Medicine*, 142, pp.56-67.
- Bell, S.L., Foley, R., Houghton, F., Maddrell, A., and Williams, A.M., 2018. From therapeutic landscapes to healthy spaces, places, and practices: A scoping review. *Social Science & Medicine*, 196, pp.123-130.
- Berkes, F., 2017. *Sacred Ecology*. Routledge.
- Blicharska, M., Smithers, R.J., Hedblom, M., Hedenås, H., Mikusiński, G., Pedersen, E., Sandström, P., and Svensson, J., 2017. Shades of grey challenge practical application of the cultural ecosystem services concept. *Ecosystem Services*, 23, pp.55-70.
- Bratman, G.N., Olvera-Alvarez, H.A., and Gross, J.J., 2021. The affective benefits of nature exposure. *Social and Personality Psychology Compass*, 15(8), p.e12630.
- Brymer, E., and Gray, T., 2010. Developing an intimate “relationship” with nature through extreme sports participation. *Leisure/Loisir*, 34(4), pp.361-374.
- Collado, S., Staats, H., Corraliza, J.A., and Hartig, T., 2017. Restorative environments and health. *Handbook of Environmental Psychology and Quality of Life Research*, pp.127-148.
- Chan, K.M., Guerry, A.D., Balvanera, P., Klain, S., Satterfield, T., Basurto, X., Bostrom, A., Chuenpagdee, R., Gould, R., Halpern, B.S., and Hannahs, N., 2012. Where are cultural and social in ecosystem services? A framework for constructive engagement. *BioScience*, 62(8), pp.744-756.
- Chan, K.M., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., Gould, R., Hannahs, N., Jax, K., Klain, S., and Luck, G.W., 2016. Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of The National Academy of Sciences*, 113(6), pp.1462-1465.

- Chan, K.M., Gould, R.K., and Pascual, U., 2018. Editorial overview: relational values: what are they, and what's the fuss about? *Current Opinion in Environmental Sustainability*, 35, pp.A1-A7.
- Conaway, J.D., and Leoso, E.S., 2024. Ganawendan Ginibiiminaan (Take care of our Water!): mobilizing for Watersheds-at-risk with the Bad River Ojibwe. *Ecology and Society*, 29(2).
- Conradson, D., 2005. Landscape, care and the relational self: Therapeutic encounters in rural England. *Health & Place*, 11(4), pp.337-348.
- Comberti, C., Thornton, T.F., de Echeverria, V.W., and Patterson, T., 2015. Ecosystem services or services to ecosystems? Valuing cultivation and reciprocal relationships between humans and ecosystems. *Global Environmental Change*, 34, pp. 247-262.
- Dang, L., and Weiss, J., 2021. Evidence on the relationship between place attachment and behavioral intentions between 2010 and 2021: A systematic literature review. *Sustainability*, 13(23), p.13138.
- DeJong, D.H., 2007. " Unless They Are Kept Alive": Federal Indian Schools and Student Health, 1878-1918. *American Indian Quarterly*, pp.256-282.
- Díaz, S., Pascual, U., Stenseke, M., Martín-López, B., Watson, R.T., Molnár, Z., Hill, R., Chan, K.M., Baste, I.A., Brauman, K.A., and Polasky, S., 2018. Assessing nature's contributions to people. *Science*, 359(6373), pp.270-272.
- Edwards, R.C., Larson, B.M., and Church, A., 2022. A “magic teleportation machine”: Ethnically diverse green space users derive similar cultural ecosystem benefits from urban nature. *Urban Forestry & Urban Greening*, 67, p.127409.
- FDL (Fond du Lac Band of Lake Superior Chippewa). (2022) Onigamiinsing Dibaajimowinan-Duluth's Stories. Accessed April 29, 2024: <http://www.duluthstories.net/index.html>
- Fish, R., Church, A., and Winter, M., 2016. Conceptualising cultural ecosystem services: A novel framework for research and critical engagement. *Ecosystem Services*, 21, pp.208-217.

- Fischer, A., and Eastwood, A., 2016. Coproduction of ecosystem services as human–nature interactions—An analytical framework. *Land Use Policy*, 52, pp.41-50.
- Gascon, M., Zijlema, W., Vert, C., White, M.P., and Nieuwenhuijsen, M.J., 2017. Outdoor blue spaces, human health, and well-being: A systematic review of quantitative studies. *International Journal of Hygiene and Environmental Health*, 220(8), pp.1207-1221.
- Gendle, M.H., 2016. The problem of dualism in modern western medicine. *Mens Sana Monographs*, 14(1), p.141.
- Georgiou, M., Morison, G., Smith, N., Tiegies, Z., and Chastin, S., 2021. Mechanisms of impact of blue spaces on human health: a systematic literature review and meta-analysis. *International Journal of Environmental Research and Public Health*, 18(5), p.2486.
- Gesler, W., 1996. Lourdes: healing in a place of pilgrimage. *Health & Place*, 2(2), pp.95-105.
- Gesler, W.M., 1992. Therapeutic landscapes: medical issues in light of the new cultural geography. *Social Science & Medicine*, 34(7), pp.735-746.
- Gibbon, G., 2012. *Archaeology of Minnesota: The prehistory of the upper Mississippi River region*. University of Minnesota Press.
- Gottwald, S., Albert, C., and Fagerholm, N., 2022. Combining sense of place theory with the ecosystem services concept: Empirical insights and reflections from a participatory mapping study. *Landscape Ecology*, pp.1-23.
- Gould, R.K., Morse, J.W., and Adams, A.B., 2019. Cultural ecosystem services and decision-making: How researchers describe the applications of their work. *People and Nature*, 1(4), pp.457-475.
- Gould, R.K., Bremer, L.L., Pascua, P.A., and Meza-Prado, K., 2020a. Frontiers in cultural ecosystem services: Toward greater equity and justice in ecosystem services research and practice. *BioScience*, 70(12), pp.1093-1107.

- Gould, R.K., Adams, A., and Vivanco, L., 2020b. Looking into the dragons of cultural ecosystem services. *Ecosystems and People*, 16(1), pp.257-272.
- Herzog, T.R., Black, A.M., Fountaine, K.A., and Knotts, D.J., 1997. Reflection and attentional recovery as distinctive benefits of restorative environments. *Journal of Environmental Psychology*, 17(2), pp.165-170.
- Heintzman, P., 2022. Empirical research on leisure and spiritual well-being: Conceptualisation, measurement, and findings. In: Mansfield, L., and Daykin, N. (eds.), *Leisure and Wellbeing*. London: Routledge, pp.146-155.
- Hernández, B., Martin, A.M., Ruiz, C., and del Carmen Hidalgo, M., 2010. The role of place identity and place attachment in breaking environmental protection laws. *Journal of Environmental Psychology*, 30(3), pp.281-288.
- Himes, A., and Muraca, B., 2018. Relational values: The key to pluralistic valuation of ecosystem services. *Current Opinion in Environmental Sustainability*, 35, pp.1-7.
- Houge Mackenzie, S., and Hodge, K., 2020. Adventure recreation and subjective well-being: A conceptual framework. *Leisure Studies*, 39(1), pp.26-40.
- Huynh, L.T.M., Gasparatos, A., Su, J., Dam Lam, R., Grant, E.I., and Fukushi, K., 2022. Linking the nonmaterial dimensions of human-nature relations and human well-being through cultural ecosystem services. *Science Advances*, 8(31), p.eabn8042.
- Ives, C.D., Giusti, M., Fischer, J., Abson, D.J., Klaniecki, K., Dorninger, C., Laudan, J., Barthel, S., Abernethy, P., Martín-López, B., and Raymond, C.M., 2017. Human–nature connection: a multidisciplinary review. *Current Opinion in Environmental Sustainability*, 26, pp.106-113.
- Jones, L., Boeri, M., Christie, M., Durance, I., Evans, K.L., Fletcher, D., Harrison, L., Jorgensen, A., Masante, D., McGinlay, J., and Paterson, D.M., 2022. Can we model cultural ecosystem services, and are we measuring the right things? *People and Nature*, 4(1), pp.166-179.

- Jorgensen, B.S., and Stedman, R.C., 2001. Sense of place as an attitude: Lakeshore owners attitudes toward their properties. *Journal of Environmental Psychology*, 21(3), pp.233-248.
- Joye, Y., and Van den Berg, A.E., 2018. Restorative environments. *Environmental Psychology: An Introduction*, pp.65-75.
- Kaups, M., 1978. North Shore commercial fishing, 1849-1870. *Minnesota History*, 46(2), pp.42-58.
- Kearns, R., and Milligan, C., 2020. Placing therapeutic landscape as theoretical development in Health & Place. *Health & Place*, 61, p.102224.
- Kirchhoff, T., 2019. Abandoning the concept of cultural ecosystem services, or against natural-scientific imperialism. *BioScience*, 69(3), pp.220-227.
- Knez, I., and Eliasson, I., 2017. Relationships between personal and collective place identity and well-being in mountain communities. *Frontiers in Psychology*, 8, p.241606.
- Kovach, M., 2021. *Indigenous methodologies: Characteristics, conversations, and contexts*. University of Toronto press.
- Kummu, M., De Moel, H., Ward, P.J., and Varis, O., 2011. How close do we live to water? A global analysis of population distance to freshwater bodies. *PloS One*, 6(6), p.e20578.
- Langemeyer, J., and Connolly, J.J., 2020. Weaving notions of justice into urban ecosystem services research and practice. *Environmental Science & Policy*, 109, pp.1-14.
- Lennon, M., Douglas, O., and Scott, M., 2017. Urban green space for health and well-being: Developing an 'affordances' framework for planning and design. *Journal of Urban Design*, 22(6), pp.778-795.
- Li, J., Luo, J., Deng, T., Tian, J., and Wang, H., 2023. Exploring perceived restoration, landscape perception, and place attachment in historical districts: insights from diverse visitors. *Frontiers in Psychology*, 14, p.1156207.

Mandle, L., Shields-Estrada, A., Chaplin-Kramer, R., Mitchell, M.G., Bremer, L.L., Gourevitch, J.D., Hawthorne, P., Johnson, J.A., Robinson, B.E., Smith, J.R., and Sonter, L.J., 2021. Increasing decision relevance of ecosystem service science. *Nature Sustainability*, 4(2), pp.161-169.

Mansfield, L., Daykin, N., and Kay, T., 2020. Leisure and wellbeing. *Leisure Studies*, 39(1), pp.1-10.

Markevych, I., Schoierer, J., Hartig, T., Chudnovsky, A., Hystad, P., Dzhambov, A.M., De Vries, S., Triguero-Mas, M., Brauer, M., Nieuwenhuijsen, M.J., and Lupp, G., 2017. Exploring pathways linking greenspace to health: Theoretical and methodological guidance. *Environmental Research*, 158, pp.301-317.

Marques, B., McIntosh, J., and Kershaw, C., 2021. Therapeutic environments as a catalyst for health, well-being, and social equity. *Landscape Research*, 46(6), pp.766-781.

Millennium Ecosystem Assessment (MA), 2005. Ecosystems and human well-being. 563 p.

Minnesota Department of Health, 2024 “Fish Consumption Guidance” Accessed May 20, 2024: <https://www.health.state.mn.us/communities/environment/fish/index.html>.

Mokos, J.T., 2017. Stigmatized places as therapeutic landscapes. *Medicine Anthropology Theory*, 4(1).

Mucioki, M., Sowerwine, J., Sarna-Wojcicki, D., Lake, F.K., and Bourque, S., 2021. Conceptualizing Indigenous cultural ecosystem services (ICES) and benefits under changing climate conditions in the Klamath river basin and their implications for land management and governance. *Journal of Ethnobiology*, 41(3), pp.313-330.

NCAI (National Congress of American Indians), September 2019. *Becoming Visible: A Landscape Analysis of State Efforts to Provide Native American Education for All*. Washington, DC. Accessed May 25, 2024: [www.ncai.org/policy-research-center/research-data/publications/NCAI-Becoming\\_Visible\\_Report-Digital\\_FINAL\\_10\\_2019.pdf](http://www.ncai.org/policy-research-center/research-data/publications/NCAI-Becoming_Visible_Report-Digital_FINAL_10_2019.pdf)

- Normyle, A., Vardon, M., and Doran, B., 2023. Aligning Indigenous values and cultural ecosystem services for ecosystem accounting: A review. *Ecosystem Services*, 59, p.101502.
- Oyserman, D. (2001). Self-concept and identity. In A. Tesser and N. Schwarz, *The Blackwell handbook of social psychology* (pp. 499-517). Malden, MA: Blackwell.
- Paasi, A., 2002. Place and region: regional worlds and words. *Progress in Human Geography*, 26(6), pp.802-811.
- Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., Watson, R.T., Dessane, E.B., Islar, M., Kelemen, E., and Maris, V., 2017. Valuing nature's contributions to people: the IPBES approach. *Current Opinion in Environmental Sustainability*, 26, pp.7-16.
- Peltier, C., 2018. An application of two-eyed seeing: Indigenous research methods with participatory action research. *International Journal of Qualitative Methods*, 17(1), p.1609406918812346.
- Phillips, B.A., 1993. A time-space model for the distribution of shoreline archaeological sites in the Lake Superior Basin. *Geoarchaeology*, 8(2), pp.87-107.
- Pitt, H., 2019. What prevents people accessing urban bluespaces? A qualitative study. *Urban Forestry & Urban Greening*, 39, pp.89-97.
- Ratima, M., Martin, D., Castleden, H., and Delormier, T., 2019. Indigenous voices and knowledge systems—promoting planetary health, health equity, and sustainable development now and for future generations. *Global Health Promotion*, 26(3\_suppl), pp.3-5.
- Restall, B., and Conrad, E., 2015. A literature review of connectedness to nature and its potential for environmental management. *Journal of Environmental Management*, 159, pp.264-278.
- Rollero, C., and De Piccoli, N., 2010. Does place attachment affect social well-being? *European Review of Applied Psychology*, 60(4), pp.233-238.
- Ryan, G.W., and Bernard, H.R., 2003. Techniques to identify themes. *Field Methods*, 15(1), pp.85-109.

Sangha, K.K., Preece, L., Villarreal-Rosas, J., Kegamba, J.J., Paudyal, K., Warmenhoven, T., and RamaKrishnan, P.S., 2018. An ecosystem services framework to evaluate indigenous and local peoples' connections with nature. *Ecosystem Services*, 31, pp.111-125.

Satz, D., Gould, R.K., Chan, K.M., Guerry, A., Norton, B., Satterfield, T., Halpern, B.S., Levine, J., Woodside, U., Hannahs, N., and Basurto, X., 2013. The challenges of incorporating cultural ecosystem services into environmental assessment. *Ambio*, 42, pp.675-684.

Scannell, L., and Gifford, R., 2017. The experienced psychological benefits of place attachment. *Journal of Environmental Psychology*, 51, pp.256-269.

Seymour, V., 2016. The human–nature relationship and its impact on health: A critical review. *Frontiers in Public Health*, 4, p.221109.

Shamai, S., and Ilatov, Z., 2005. Measuring sense of place: Methodological aspects. *Tijdschrift voor Economische en Sociale Geografie*, 96(5), pp.467-476.

Sherrouse, B.C., Semmens, D.J., and Ancona, Z.H., 2022. Social values for ecosystem services (SolVES): Open-source spatial modeling of cultural services. *Environmental Modelling & Software*, 148, p.105259.

Smith, M.K., 2018. Cultural ecosystem services of visited landscapes. *Socio. hu Társadalomtudományi Szemle*, 8(Spec 6), pp.23-36.

Soga, M., and Gaston, K.J., 2016. Extinction of experience: the loss of human–nature interactions. *Frontiers in Ecology and the Environment*, 14(2), pp.94-101.

Tonge, J., Ryan, M.M., Moore, S.A., and Beckley, L.E., 2015. The effect of place attachment on pro-environment behavioral intentions of visitors to coastal natural area tourist destinations. *Journal of Travel Research*, 54(6), pp.730-743.

Twigger-Ross, C., Bonaiuto, M., and Breakwell, G., 2003. *Identity theories and environmental psychology*. Abingdon, Oxfordshire, UK: Routledge.

US Census Bureau, 2022. QuickFacts, 2020 Decennial Census. Accessed February 28, 2022: <https://www.census.gov/quickfacts/fact/table/cloquetcityminnesota,superiorcitywisconsin,duluthcityminnesota#>

Vaske, J.J., and Kobrin, K.C., 2001. Place attachment and environmentally responsible behavior. *The Journal of Environmental Education*, 32(4), pp.16-21.

Walker, B.W., 2022. A dynamic reframing of the social/personal identity dichotomy. *Organizational Psychology Review*, 12(1), pp.73-104.

Weller, S.C., Vickers, B., Bernard, H.R., Blackburn, A.M., Borgatti, S., Gravlee, C.C., and Johnson, J.C., 2018. Open-ended interview questions and saturation. *PloS One*, 13(6), p.e0198606.

Whitburn, J., Linklater, W., and Abrahamse, W., 2020. Meta-analysis of human connection to nature and proenvironmental behavior. *Conservation Biology*, 34(1), pp.180-193

Whyte, K., 2018. Settler colonialism, ecology, and environmental injustice. *Environment and Society*, 9, pp. 125-144.

Winthrop, R.H., 2014. The strange case of cultural services: Limits of the ecosystem services paradigm. *Ecological Economics*, 108, pp.208-214.

Wright, K., Eden, S., Hancox, A., Windget, D., Elliott, L., Glossop, Z., Johnston, G., Johnston, R.I., Lobban, F., Lodge, C., and Palmier-Claus, J., 2024. A qualitative exploration of the contribution of blue space to well-being in the lives of people with severe mental illness. *People and Nature*, 6(2), pp.849-864.

Yoshida, Y., Matsuda, H., Fukushi, K., Takeuchi, K., and Watanabe, R., 2022. The missing intangibles: nature's contributions to human wellbeing through place attachment and social capital. *Sustainability Science*, 17(3), pp.809-822.

Zoeller, K.C., and Cumming, G.S., 2024. Towards an integrated framework for understanding social-ecological interactions: nature's contributions to people meets cultural ecosystem services. *Ecosystems and People*, 20(1), p.2329576.

Zylstra, M., Esler, K., Knight, A., and Le Grange, L., 2019. Integrating multiple perspectives on the human-nature relationship: A reply to Fletcher 2017. *The Journal of Environmental Education*, 50(1), pp.1-10.

Zylstra, M.J., Knight, A.T., Esler, K.J., and Le Grange, L.L., 2014. Connectedness as a core conservation concern: An interdisciplinary review of theory and a call for practice. *Springer Science Reviews*, 2, pp.119-143.

## *Conclusions*

This dissertation reports on novel research on assessing CES holistically across dimensions of CES and across diverse CES beneficiaries in a single multi-cultural community. Our results address aspects of both the process of community-engaged research as well as outcomes. Our results reveal institutional challenges associated with university research partnership with sovereign Indigenous nations. Results of our assessment of CES reveal the complex connections among individual identity, CES, and barriers to CES. Here we synthesize the significant findings from this study, recommendations, the study limitations, describe scientific, local and policy relevance, and future research needs.

### **Summary of findings**

In Chapter 1 of this dissertation, we provided a case analysis of navigation of Indigenous data sovereignty and university open research policies. We found that open research policies that do not consider Indigenous sovereignty can hamper collaboration between university researchers and tribal nations, even when there is broad agreement on research goals and objectives. University open research policies that do not explicitly address Indigenous sovereignty fall short of the open research principles they intend to support and need revising to fully comply with current ethical standards in the U.S.

Chapters 2 and 3 reveal complexities in associations among individual identity, CES, and barriers to CES. Survey data showed older age groups derived fewer different CES than younger age groups, and older groups reported more barriers associated with health. The types of CES reported also changed with age, with younger participants more commonly reporting physically demanding and social experiences, and older participants appreciating slower-paced and nature-based activities. Interview data showed how connection with water generally grew deeper over the course of life, and individuals went through phases when their connection took different forms.

Survey data showed that men derive more different CES than women and non-binary genders. Men report more recreational experiences, but women and non-binary genders reported more immersive and symbolic experiences like inspiration, art, and mindfulness. Some women reported

barriers specifically associated with their gender, which interviewees described as being associated with fears of gender-based harassment.

Indigenous survey participants reported that they derived more and different CES benefits and reported fewer barriers than other race/ethnic groups evaluated. Indigenous/White participants reported barriers more frequently than other racial groups, but also reported many CES experiences at higher rates than White participants. This suggests that because of the high personal or cultural value placed on CES, motivations to engage with blue space persist despite the reduced quality of CES due to barriers like pollution, access, health, and resources. In follow-up interviews, Ojibwe and Ojibwe/White participants shared cultural connections with water unique within our sample. These results illustrate the deep, multi-generational connection of Ojibwe participants with the blue space in the study area.

Although our survey did not address disability or health-related sociodemographics directly, redundancy analysis suggested a potential intersection of disability, age, and employment associated with fewer types of CES benefits: older, non-native participants unable to work with lower education reported fewer types of CES. In interviews, some participants explained how their health impacted their relationships with water. For some, the water offered specific benefits and opportunities to help cope with mental illness or the psychological aspects of life-threatening illness like cancer. For other participants with physical limitations due to a disability or illness, their condition limited their experiences and thus the nature of their current relationship with water.

The redundancy analysis accounted for a relatively small proportion of variance for both CES and barriers. Interview data suggested other important components of identity associated with blue space in our sample: occupation, religion, and recreation group. Participants described experiences with the water in youth and young adulthood that influenced their pursuit of water-based occupations, while others described occupations that afforded them unique access to places or experiences that enriched their relationship with water. Some described how their religious beliefs were associated with their relationship with water, for example, that water was a sign of Creation; that water offered a symbol of cleansing or purification, or that water offered a place to

pray or practice meditation. Lastly, some people expressed an identity as part of a recreation group, for example as a paddle, camper, or swimmer.

Overall, interviews highlighted how the facets of identity that are salient for one's relationship with water are unique to each person. For example, while disability or health, religion, occupation, or recreation group may not be important to everyone, for some individuals who hold these identities, they can be incredibly important. Identity influences individual connection with water and cultural ecosystem services in highly complex ways. We interpreted our results, in the context of social theories for the human-nature relationship, including affordance theory, therapeutic landscapes, and sense of place. Therapeutic landscapes and sense of place theory both offer opportunities to help interpret CES benefits, with dimensions of therapeutic landscapes referring to the *experience of* blue space, and dimensions of sense of place referring to the *relationship with* blue space. These theories allowed us to interpret differences in both quantitative and qualitative results about how individuals across different ages, genders, and recreation groups connect with water and experience CES.

CES benefits, barriers to CES, and individual identity were highly interdependent and inseparable, based on both our survey and interview results. Although we were not explicitly coding barriers in interview transcripts, interviewees identified ways in which their relationship with blue space itself could be self-limiting, or function as a barrier, for example fear-based aspects of relationships. We interpreted these results in the context of affordance theory, which poses that both benefits from and barriers to CES are emergent properties of an individual's perception of themselves relevant to the environment, in this case, the water. While this interpretation makes simple quantitative assessments more challenging, it more accurately reflects the social processes that facilitate CES delivery.

### **Limitation of the approach**

Overall, this study was limited to self-selecting participation by individuals who have a sufficient affinity (or disaffinity) for blue space to voluntarily participate in a survey and interview. While we successfully engaged the Indigenous population, we did not reach the Black or Asian American population, which are small but not insignificant groups in the Twin Ports. The study

was based on individual perceptions, with the assumption that benefits depend on awareness and attribution of meaning by an individual. However, some benefits may have been outside the realm of perception. This study represents the relationships of individuals to blue space at a specific point in time. Although we explored how relationships changed for the participants through their lives, it is unclear how relationships with water, and CES in general, change over time more broadly. Lastly, the study area encompassed urban, peri-urban, and rural neighborhoods and three cities with unique histories and qualities. Further analysis of our data is needed to explore how connections to blue space were associated with residence location.

### **Recommendations**

Based on our case analysis of navigation of Indigenous data sovereignty and university open research policies (Chapter 1), we recommend that UMN and other major universities establish open research principles that accommodate and facilitate the unique case of university partnership with sovereign nations. We recommend establishing required training for university staff on Indigenous history, treaty rights, and tribal sovereignty. To improve coordination and trust among university and tribal researchers and members, we also recommend formal adoption of principles for ethical research with sovereign tribal governments by universities.

Our survey and interview results (Chapters 2 and 3) can inform decision-making to increase equity of blue space CES in the study area. Centering our results within the context of a growing body of literature on how to engage diverse communities during environmental decision-making, we have derived a set of recommendations that explicitly account for sociodemographic-specific experiences and barriers (Fig. 4.1). Our recommendations include broad recommendations for governance and decision-making processes, including that agencies must build capacity for trans and interdisciplinary partnership, prioritize long-term trust-based relationship building with partners, engage partners early in planning and often throughout the subsequent process, and work towards establishing co-management and shared decision-making systems. These recommendations can be summarized as shifting up the ladder of engagement from non-participation or exclusion towards power sharing (Arnstein, 1969; Schively Slotterback & Lauria). An important component of this is supporting and advancing cultural competency, defined as the awareness, knowledge, skills, and practices that allow an organization and its

members to effectively engage with diverse groups and communities (e.g., Sarang and Prabhakar, 2023). The range of barriers identified by survey participants suggests that extending partnerships outside of the traditional environmental fields of natural resources, parks, and planning could support more impactful and equitable decision-making. This could include partnership with sectors such as social services, health, transportation, housing, education, recreation, safety, and private business. Of particular importance is partnership with Indigenous organizations and tribal nations, who our data revealed have unique relationships with water. Alongside the establishment of relevant partnerships, decision-making should explicitly consider the diversity of identities within the resident population (Fig. 4.1).

Based on the barriers and benefits identified in survey and interviews, we identified three categories of possible interventions to increase human well-being benefits for residents (Fig. 4.1). Environmental work (protection and restoration, with consideration for a changing climate) addresses the physical blue space environment that can provide human well-being benefits. However, access and communication are just as important for translating environmental investments into human well-being benefits. Communication and education (Fig. 4.1) refer to interventions to ensure residents have access to the minimum level of information, skills, and knowledge necessary to experience benefits, as well as access to potential additional knowledge, understanding, and social bonds that can enrich and deepen the human-nature relationship.

Access and amenities (Fig. 4.1) include interventions to the built environment or physical systems (e.g., transportation) that are necessary to support a given relationship with blue space. We suggest that a primary focus should be on ensuring most access points have basic amenities to support universal access. Additional safety amenities should be supported where hazards exist. While standard recreation amenities like trails, boat launches, campsites and playgrounds should be supported where appropriate, we also highlight additional specialized amenities based on our results. For example, we recommend considering designing and maintaining spaces specifically for spiritual, mental health, and mindfulness opportunities. These benefits were especially important to interview participants, who expressed deep spiritual and emotional relationships with the water and described the important services blue spaces offered for mental health. These types

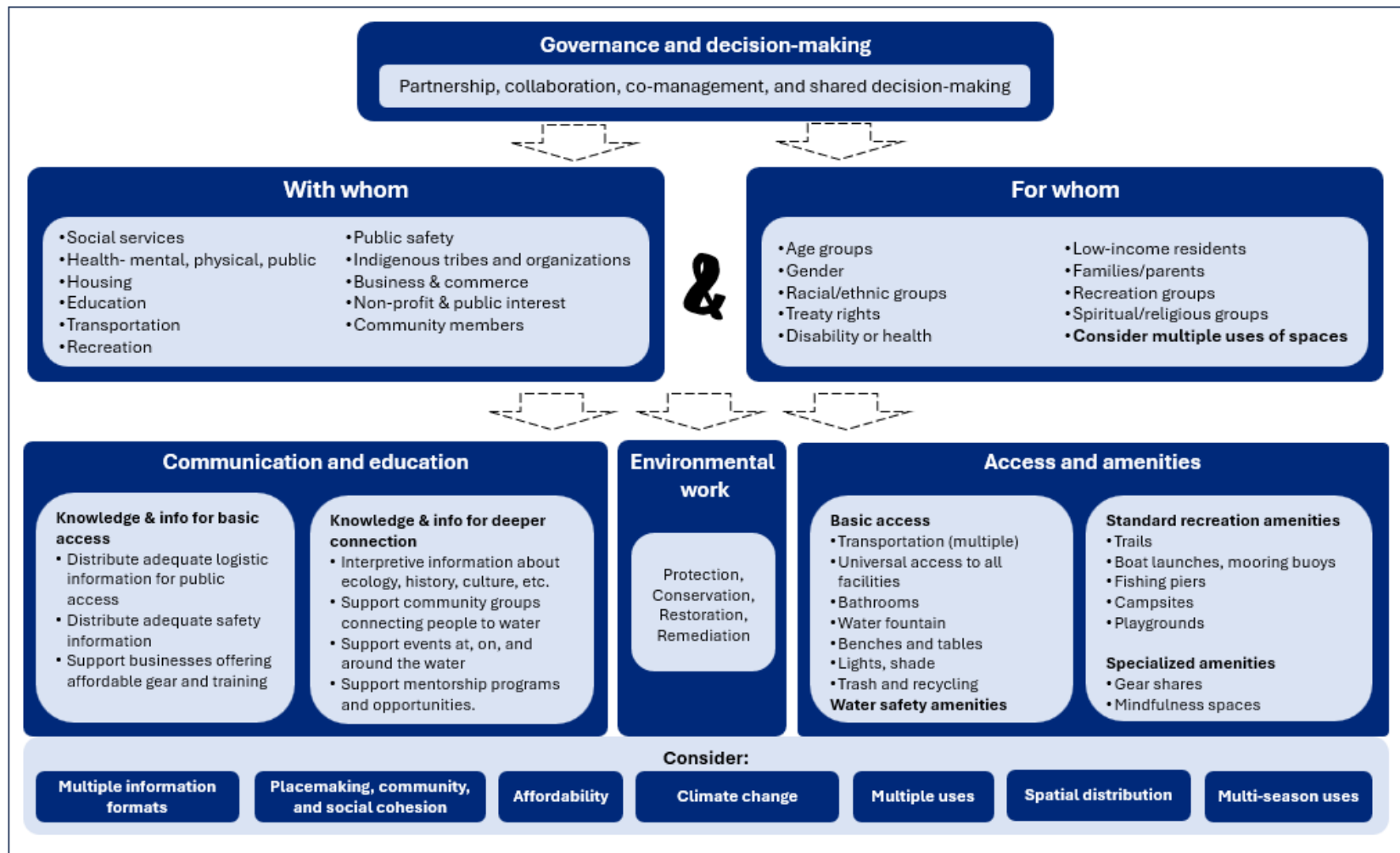


Figure 4.1 Summary of recommendations for decision-makers to increase human well-being benefits associated with blue space.

of benefits were reported more often by women in the survey, and increasing opportunities for these benefits may increase these benefits across all genders. We also suggest supporting social and community gathering space amenities, which were important to most participants. To support accessibility of experiences with costly gear requirements, we suggest supporting programs like gear shares, cooperatives, or rentals. Broadly, we advocate for consideration of multiple diverse uses, across multiple seasons, in all publicly accessible blue spaces.

### **Significance of this research**

Our results improve understanding of CES delivery across multi-cultural communities and have significance for improving CES models, addressing inequity in human wellbeing benefits from nature at multiple scales, and informing policy on ecosystem services and Indigenous Knowledge in decision-making. By adopting an inter- and transdisciplinary approach paired with a multi-cultural perspective offered by Indigenous advisors and co-authors, we were able to apply well-documented social theories in cultural ecosystem service frameworks to interpret results and improve understanding of cultural ecosystem service delivery. While current conceptual models frame CES benefits as arising from the interaction of two separate entities, “nature” and “people,” with certain other factors mediating these interactions, our results suggest that these entities are not separate but rather deeply enmeshed over the course of life in ways that that give rise to emergent wellbeing benefits, and in some cases prevent or degrade benefits. This understanding supports the interpretation of benefits and barriers through a social framework of affordance rather than the simplified equation of “people plus nature equals benefits.” This approach enables CES assessment to facilitate equitability-based decision-making based on the suite of recommendations described above.

Environmental decision-making has the potential to either reinforce existing inequities or help address and reduce them. This is the first study of CES to our knowledge that applies mixed methods to assess the full breadth of CES in a multi-cultural population to explore how identity influences CES delivery. Our results highlight the complexity in how personal and social identity influence CES experiences and benefits and reiterate the need for research methods as well as decision-making processes that equitably include the perspectives, needs, and preferences of historically underrepresented and marginalized communities.

### ***Local and regional significance***

The study area is currently the focus of major investments to remediate and restore coastal waters, including the St. Louis River and estuary. The community-engaged nature of this project means decision-makers with local municipalities, state and Federal agencies, SeaGrant agencies, local community organizations, and tribal entities have been involved in interpreting research results and developing recommendations, some of which have already been applied in the community. In addition to consulting directly with some decision-makers, this research has already informed two specific initiatives aimed at applying results in the community, including a Placemaking Visioning process for the Lake Superior Estuarium in Superior, Wisconsin, and in the development of the Lake Superior Headwaters Sustainability Partnership environmental justice priority.

The Lake Superior Estuarium, part of the Lake Superior National Estuarine Research Reserve (hereafter, the Reserve), one of the funders of this research, was interested in developing a design for their outdoor space that celebrates community connections to water and shares the findings of this research with the public. The Estuarium is located on Barker's Island in Superior, Wisconsin, located in the St. Louis River Estuary, and adjacent to a city park and many popular public waterfront amenities. We worked with University of Wisconsin Extension and a volunteer professional landscape designer to host a placemaking charette to develop a vision for the outdoor space. Members of the research advisory groups and additional community representatives including high school students and community organizations participated in the two-day workshop held in December 2023. Findings from this research were shared with participants and used as a foundation for the visioning session. The charette produced a vision for the Reserve property and the western end of Barker's Island that is guiding the City of Superior (property owner) and the Reserve and University of Wisconsin Superior (property managers) in grant-seeking and decision-making for the area (Johnson et al., 2024).

Another example of how this research is informing local decision-making is through the Lake Superior Headwaters Sustainability Partnership (HP), which is a collaborative partnership and framework for achieving a thriving estuary landscape and community. Reflecting a central principle of equity, the partnership developed environmental justice (EJ) priorities in 2022

(Minnesota Land Trust, 2023). The Partnership is developing tools to support equitable decision-making based on the EJ priorities for understanding and knowledge. The results of this study are being incorporated in HP tools and shared with partners to help design environmental restoration and remediation plans with consideration of equity of human well-being benefits.

These results should inspire comparative research. We demonstrate the benefits of applying mixed qualitative and quantitative methods. While quantitative social research can be limited by low statistical power and high variability, and qualitative research can be limited by reproducibility, researcher bias, and representativity; paired together, they can offer a more complete understanding of CES in a given context. These methods can be applied elsewhere to explore variability in the links between identity and CES. Similar investments to those made in the study area are being made across the U.S. For example, \$1 billion was recently added to the Great Lakes Restoration Initiative, already funded at approximately \$300 million/year since 2010, to advance the cleanup of the Great Lakes (Gillespie, 2022). Similar efforts are happening on the Canadian side of the Great Lakes, and in U.S. marine estuarine systems under the National Estuary Program and NOAA's National Estuarine Research Reserve program. These investments are usually focused on environmental targets but also can catalyze revitalization of waterfront communities, although data are rarely collected to document community benefits or the equitability thereof (Angradi et al., 2019; Hartig and Wallace, 2015). The methods developed and applied here demonstrate an approach to assessment that can be applied in these other areas to develop recommendations for ensuring these investments contribute to increased equity in human well-being benefits and could be repeated over time to evaluate benefits associated with investments.

### ***Policy implications***

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) put out a report in 2022, *The Methodological Assessment Report on the Diverse Values and Valuation of Nature*, which highlighted the diversity of understandings of nature's values across cultures and nations, and advocated for institutional acknowledgement and application of methodologies that are inclusive of this diversity. Our research responds to this need by applying such a methodology, and our results reiterates these points. The IPBES report highlighted how

transdisciplinary work can help address “limitations in information, resources, and capacity hinder the inclusion of diverse values in decision-making” (IPBES, 2022, p. 15). This study is an example of a transdisciplinary approach. We partnered with local communities to apply mixed methods and collect extensive data that captured CES across a range of identities and elucidated inequities in CES for decision-makers. As such, we contribute to overcoming “knowledge-to-action gaps” (ibid, p. 15) to advance IPBES’s calls for normative transformations towards sustainable improvements to quality of life globally.

This study advances knowledge in support of recent guidance published by the Executive Branch of the US Government directing federal agencies to consider ecosystem services, including CES, in decision-making about regulations, policy, and programs (OIRA, 2024). The guidance acknowledges the inequities in distributions of ecosystem services benefits and costs and highlights the importance of considering these inequities for overburdened communities in decision-making. As such, it requires “distributional analysis” to understand these differences. However, distributional analysis depends on an adequate understanding of distributional differences and the existence of data to describe these effects, which are rarely collected. While this study provides those data for one study area, it also identifies broadly some of the potential groups associated with unequal distribution of benefits that should be considered. Our data support the importance of qualitative research for evaluation of some CES noted in the guidance, and furthermore suggest that qualitative data may be essential to fully understand how distributional outcomes of decision-making. For example, while the federal guidance acknowledges the importance of cultural values for Tribal Nations and Indigenous Peoples, it does not acknowledge that some benefits may be federally protected in some areas by treaty agreement, as for our study area. Our interviews highlighted the personal and cultural importance of these treaty rights to Ojibwe participants.

In 2022, the U.S. executive branch released guidance on the recognition and inclusion of Indigenous Knowledge in federal decision-making, research, and policies, “where relevant and appropriate in Federal decisions.” (Prabhakar and Mallory, 2022, p. 3). While this is clearly relevant for decisions made directly in or impacting Indigenous communities, this guidance has broad relevance across the United States, all of which was historically Indigenous lands. Our case

study offers an example of one approach to implement this guidance in an area that includes reservation and ceded lands, and an Indigenous community with deep, multi-generational connection to the land and water who is a statistical minority population. Our research was overseen by the local tribal Institutional Review Board, through which we established a data sharing agreement that protects tribal sovereignty. We then utilized qualitative research methods to understand how both Indigenous and non-Indigenous participants connected with water. Although Western science methods were applied for data collection, we worked with an Indigenous advisory team to ensure data interpretations were appropriate, effectively co-producing knowledge, consistent with the federal guidance (Prabhakar and Mallory, 2022). By engaging both the community and an Indigenous advisory group and working through the Tribe's IRB, we produced results that were relevant for the multi-cultural community with both Indigenous and non-Indigenous members. This approach was a successful way to include and recognize Indigenous Knowledge in research in other pluralistic communities.

## **References**

Angradi, T.R., Williams, K.C., Hoffman, J.C., and Bolgrien, D.W., 2019. Goals, beneficiaries, and indicators of waterfront revitalization in Great Lakes Areas of Concern and coastal communities. *Journal of Great Lakes Research*, 45(5), pp.851-863.

Arnstein, S.R., 1969. A ladder of citizen participation. *Journal of the American Institute of planners*, 35(4), pp.216-224.

Gillespie, T., 2022. President Biden, EPA \$1 Billion Investment from the Bipartisan Infrastructure Law Will Accelerate Cleanup Efforts and Benefit Michigan. USEPA News Release: Region 5. February 17, 2022. Accessed March 3, 2022:

<https://www.epa.gov/newsreleases/president-biden-epa-1-billion-investment-bipartisan-infrastructure-law-will-1>

Gould, R.K., Morse, J.W., and Adams, A.B., 2019. Cultural ecosystem services and decision-making: How researchers describe the applications of their work. *People and Nature*, 1(4), pp.457-475.

Hartig, J.H., and Wallace, M.C., 2015. Creating world-class gathering places for people and wildlife along the Detroit Riverfront, Michigan, USA. *Sustainability*, 7(11), pp.15073-15098.

IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) , 2022. Methodological assessment report on the diverse values and valuation of nature: Summary for policymakers. IPBES. Accessed May 24, 2024: <https://zenodo.org/records/7410287>

Johnson, T., University of Wisconsin Extension, 2024. Summary Report Lake Superior Estuarium Community Design Charrette.

Langemeyer, J., and Connolly, J.J., 2020. Weaving notions of justice into urban ecosystem services research and practice. *Environmental Science & Policy*, 109, pp.1-14.

Mandle, L., Shields-Estrada, A., Chaplin-Kramer, R., Mitchell, M.G., Bremer, L.L., Gourevitch, J.D., Hawthorne, P., Johnson, J.A., Robinson, B.E., Smith, J.R., and Sonter, L.J., 2021. Increasing decision relevance of ecosystem service science. *Nature Sustainability*, 4(2), pp.161-169.

Minnesota Land Trust, 2023. *Goals and objectives for the twelve priority concerns, Lake Superior Headwaters Sustainability Partnership*. September 20, 2022; Updated December 2023. Accessed May 24, 2024: <https://headwaterspartnership.org/documents?id=2&mode=view>

Office of Information and Regulatory Affairs (OIRA) Office of Management and Budget, February 28, 2024. Guidance for assessing changes in environmental and ecosystem services in benefit-cost analysis. Accessed May 24, 2024: <https://www.whitehouse.gov/wp-content/uploads/2024/02/ESGuidance.pdf>

Prabhakar, A., and Mallory, B. (2022) *Memorandum for heads of federal departments and agencies*. Executive office of the President, Office of Science and Technology Policy, Council on Environmental Quality.

Slotterback, C.S., and Lauria, M., 2019. Building a foundation for public engagement in planning: 50 years of impact, interpretation, and inspiration from Arnstein's Ladder. *Journal of the American Planning Association*, 85(3), pp.183-187.

Sarang, S., and Prabhakar, R., 2023. Capacity-building for successful climate justice collaborations. *Journal of Climate Resilience and Climate Justice*, 1, pp.93-106.

## *Appendices*

### **Chapter 2 Appendices**

#### *Appendix 2.1 Waterway Benefits Survey questions.*

The following is the hard copy version of the Waterway Benefits Survey. The survey was also available online, which was hosted on ESRI's Survey123.

## Waterway Benefits Survey

*You are invited to take part in a survey about your connection to the waterways in the Duluth-Superior area. Our thank you: A \$10 debit cash card to the first 500 participants*

**Learn more or take the survey online!** Visit [z.umn.edu/waterwaybenefits](http://z.umn.edu/waterwaybenefits).

**Purpose** University of Minnesota Duluth researchers are conducting this study to understand how residents of Duluth-Superior and the surrounding communities benefit from Lake Superior (Gichigami), the St. Louis River (Gichigami-Ziibi) and estuary, and the many streams and lakes in our area. The results from this study will be shared with the community on the study webpage. Results will also be shared with local environmental managers at the Lake Superior National Estuarine Research Reserve, the US Environmental Protection Agency, Minnesota and Wisconsin water management agencies, and the Fond du Lac Band of Lake Superior Chippewa. This survey will ask you questions about:

- What kinds of activities you have done and experiences you have had with Lake Superior, the estuary, river, streams, and inland lakes
- Where you have done these activities and had these experiences
- What barriers you faced in participating in your favorite water-related activities
- Details about you (background, age, gender, ethnicity, etc.)

**Survey Details** The survey has four parts and will take about **20 minutes** to finish. Feel free to use extra paper if needed.

**Who can take this survey?** This survey is open to all adults 18 years or older who are current residents of the study area (see page 13 for map of study area).

**Participation** Your participation in this survey is entirely voluntary. You may refuse to take part in the research or exit the survey at any time. You are free to skip and decline to answer any question you do not wish to answer for any reason.

**Benefits to you** Your responses will help us understand where and how people in the region benefit from local rivers, lakes, and streams. The first 500 participants will receive compensation of a \$10 debit cash card for completing this survey. Instructions to redeem your debit card will follow submission of the survey. To redeem your card, visit: [z.umn.edu/redeemwaterwaybenefits](http://z.umn.edu/redeemwaterwaybenefits) after submitting your survey.

**Risks** The possible risks or discomforts of taking this survey are minimal. All survey responses will be collected confidentially and will not be shared publicly. You are free to skip and decline to answer any question you do not wish to answer.

**Confidentiality** This survey is confidential and **does not** collect personally identifying information such as your name, email address, phone number, or your computer's IP address. Your survey responses will be sent to a website where data will be stored in a password-protected electronic format. To redeem your \$10 debit card, you will be sent to a separate link where you will be asked for your contact information so the card can be sent to you. This information is collected independently and cannot be linked to the study survey.

**Contact** This research study is being conducted by Molly Wick, a PhD candidate at the University of Minnesota. If you have questions at any time about the study or the procedures, you may contact Molly at 218-529-5053, or [wick0256@d.umn.edu](mailto:wick0256@d.umn.edu); or the principal investigator, Lucinda Johnson at 218-788-2651 or [ljohnson@d.umn.edu](mailto:ljohnson@d.umn.edu).

**Research Oversight** This research (IRB Study 13475) has been reviewed and approved by an IRB within the Human Research Protections Program (HRPP). To share feedback privately with the HRPP about your research experience, call the Research Participants' Advocate Line at 612-625-1650 (Toll Free: 1-888-224-8636) or go to [z.umn.edu/participants](http://z.umn.edu/participants). You are encouraged to contact the HRPP if:

- Your questions, concerns, or complaints are not being answered by the research team or you cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.

This research was also approved by the Fond du Lac IRB (Study #102).

**Instructions to submit survey:**

Keep this page for your records. Use the enclosed envelope to return the rest of your survey to the address at the right.

**Waterway Benefits Survey**

Department of Biology, University of Minnesota Duluth  
207 James I. Swenson Science Building

<b>Consent</b>						
By submitting your survey, you agree to participate in this survey and acknowledge that you meet all the following criteria:						
<ul style="list-style-type: none"> <li>A. You have read the study information on page 1.</li> <li>B. Your current main residence is within the study area shown on page 13.</li> <li>C. You are at least 18 years of age.</li> </ul>						
<b>Part 1: Benefits</b> This section of the survey is designed to understand how you benefit from Lake Superior, the St. Louis River and estuary, and the many streams and inland lakes in the study area. When answering the following questions, consider only experiences in the study area shown on p. 13. For a digital map, visit <a href="https://z.umn.edu/waterwaybenefits_studyarea">https://z.umn.edu/waterwaybenefits_studyarea</a> . You will be asked about your water-related experiences within the following categories during the last year:						
<ul style="list-style-type: none"> <li style="width: 50%;">• Cultural and traditional experiences</li> <li style="width: 50%;">• Shore-based recreational experiences</li> <li style="width: 50%;">• Spiritual and emotional experiences</li> <li style="width: 50%;">• Water-based recreational experiences</li> <li style="width: 50%;">• Social experiences</li> <li style="width: 50%;">• Work and stewardship experiences</li> <li style="width: 50%;">• Aesthetic, inspirational, and art experiences</li> <li style="width: 50%;">• Fishing, hunting, and foraging experiences</li> <li style="width: 50%;">• Educational and learning experiences</li> <li style="width: 50%;">• Other water-related experiences</li> <li style="width: 50%;">• Active experiences</li> </ul>						
<b>1.1 Cultural and traditional experiences</b> Select all the positive or enjoyable cultural and traditional experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes that you had in the last year in the study area. Only include experiences in which the water played a role in your experience.						
<ul style="list-style-type: none"> <li style="width: 50%;">D. Attended or participated in a recurrent ceremony at or overlooking the water (e.g., birthday, holiday, solstice party, pow wow, etc.)</li> <li style="width: 50%;">F. Visited, learned, or taught about an historical, cultural, or family history site associated with the water (e.g., ship watching, sightseeing, visiting historical markers, etc.)</li> <li style="width: 50%;">E. Attended or participated in milestone ceremony or tradition at or overlooking the water (e.g., wedding, funeral, baby shower, etc.)</li> <li style="width: 50%;">G. Practiced traditional knowledge at or involving the water (e.g., oral traditions like song, dance, ceremony, traditional ways of planting, harvesting, hunting, gathering, etc.)</li> <li style="width: 50%;">H. None of these</li> </ul>						
I. Other, describe:						
<b>1.2 How often did you have any of these types of cultural or traditional experiences in the project area in the past year?</b> Choose one.						
A. Never	B. Rarely Less than monthly	C. Occasionally 1 to 3x per month	D. Frequently About 1x per week	E. Often Several times per week	F. Daily or more	
<b>1.3 Spiritual and emotional experiences</b> Select all the positive or enjoyable spiritual or emotional experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes that you had in the last year in the study area. Only include experiences in which the water played a role in your experience.						
<ul style="list-style-type: none"> <li style="width: 50%;">J. Attended a faith-based service or community gathering at or overlooking the water (e.g., ceremony, communal worship, church picnic, etc.)</li> <li style="width: 50%;">M. Remembered or honored deceased ancestors or loved ones at or overlooking the water</li> <li style="width: 50%;">K. Prayed or connected to higher power at or overlooking the water</li> <li style="width: 50%;">N. Rested, relaxed, reflected, or recuperated at or overlooking the water</li> <li style="width: 50%;">L. Practiced meditation (still or moving) or mindful breathing at or overlooking the water</li> <li style="width: 50%;">O. None of these</li> </ul>						
P. Other, describe:						

<b>1.4 How often did you have any of these types of spiritual or emotional experiences in the project area in the past year?</b> Choose one.	A. Never	B. Rarely Less than monthly	C. Occasionally 1 to 3x per month	D. Frequently About 1x per week	E. Often Several times per week	F. Daily or more
<b>1.5 Social experiences</b> Select all the positive or enjoyable social experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes that you have had in the last year within the study area. Only include experiences in which the water played a role in your experience.						
<ul style="list-style-type: none"> <li>• Socialized with friends or family at or overlooking the water</li> <li>• Attended a public gathering/event sponsored by a government, organization, or business at or overlooking the water</li> <li>• Attended an event sponsored by local club or group at or overlooking the water</li> <li>• None of these</li> </ul>						
<ul style="list-style-type: none"> <li>• Other, describe:</li> </ul>						
<b>1.6 How often did you have any of these social experiences in the project area in the past year?</b> Choose one.	G. Never	H. Rarely Less than monthly	I. Occasionally 1 to 3x per month	J. Frequently About 1x per week	K. Often Several times per week	L. Daily or more
<b>1.7 Aesthetic, inspirational, and art experiences</b> Select all the positive or enjoyable aesthetic, inspirational, or artistic experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes that you had in the last year in the study area. Only include experiences in which the water played a role in your experience.						
<ul style="list-style-type: none"> <li>• Appreciated the scenery, view, or beauty of the water or shoreline</li> <li>• Named something in your personal life or business after a water-related natural setting or feature in the study area (e.g., child or pet named Nemadji, a business named Lake Superior YoYo Company)</li> <li>• Found artistic inspiration for work or a hobby from a lake, river, or stream (e.g., the water inspired artistic or creative work, etc.)</li> <li>• Searched for or harvested materials for making art or traditional use (e.g., feathers, birchbark, basketmaking materials, agates, sea glass, picked flowers, etc.)</li> <li>• Made art from or associated with the water for fun, as a hobby, or for profit (painted the lake, photographed the river, nature writing, made sandcastle, made driftwood sculpture, etc.)</li> <li>• Appreciated art associated with water in the study area (including public art, visual arts, literature, film, etc.)</li> <li>• None of these</li> </ul>						
<ul style="list-style-type: none"> <li>• Other, describe:</li> </ul>						
<b>1.8 How often did you have any of these types of aesthetic, inspirational, or art experiences in the project area in the past year?</b> Choose one.	M. Never	N. Rarely Less than monthly	O. Occasionally 1 to 3x per month	P. Frequently About 1x per week	Q. Often Several times per week	R. Daily or more

<p><b>1.9 Educational and learning experiences</b> Select all the positive or enjoyable educational or learning experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes that you had in the last year in the study area. Include experiences as an educator or learner, only when the water played a role in your experience.</p>						
<ul style="list-style-type: none"> <li>Learned/shared traditional knowledge associated with the water (e.g., oral traditions like song, dance, ceremony, traditional ways of planting, harvesting, hunting, gathering, etc.)</li> <li>Participated in formal education at or overlooking the water (primary, secondary, or higher education, e.g., outdoor learning, tour, field trip)</li> <li>Participated in informal education at or overlooking the water (took lessons, tutoring, summer camp, etc.)</li> <li>Learned, developed, or shared a hobby or skill at or overlooking the water (e.g., learning without formal or informal education, individual learning)</li> <li>None of these</li> </ul>						
<ul style="list-style-type: none"> <li>Other, describe:</li> </ul>						
<p><b>1.10 How often did you have any of these types of educational or learning experiences in the project area in the past year?</b> Choose one.</p>	A. Never	B. Rarely Less than monthly	C. Occasionally 1 to 3x per month	D. Frequently About 1x per week	E. Often Several times per week	F. Daily or more
<p><b>1.11 Active experiences</b> Select all the positive or enjoyable active experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes that you had in the last year in the study area. Only include experiences in which the water played a role in your experience.</p>						
<ul style="list-style-type: none"> <li>Walked or hiked along or overlooking the water</li> <li>Jogged or ran along or overlooking the water</li> <li>Bicycled along or overlooking the water</li> <li>Cross country skied, skijored, or snowshoed</li> <li>Ice skated or played hockey at or on a natural waterbody</li> <li>Played team or individual sports (e.g., volleyball, catch, water polo, disc golf, etc.) at the water</li> <li>None of these</li> </ul>						
<ul style="list-style-type: none"> <li>Other, describe:</li> </ul>						
<p><b>1.12 How often did you have any of these active experiences in the project area in the past year?</b> Choose one.</p>	G. Never	H. Rarely Less than monthly	I. Occasionally 1 to 3x per month	J. Frequently About 1x per week	K. Often Several times per week	L. Daily or more
<p><b>1.13 Shore-based recreational experiences</b> Select all the positive or enjoyable shore-based recreational experiences you had in the last year in the study area. Only include experiences in which the water played a role in your enjoyment or ability to have the experience.</p>						
<ul style="list-style-type: none"> <li>Exercised a pet at or overlooking the water</li> <li>Picnicked at or overlooking the water</li> <li>Birdwatched or viewed wildlife at or overlooking the water</li> <li>Used a motorized recreational vehicle (snowmobile, ATV, dune buggy, 4x4, dirt bike, etc) at or overlooking the water</li> <li>Played in snow (e.g., sledged, built snowman or snow cave, snowball fights, etc.) at or overlooking the water</li> <li>Camped at or overlooking the water</li> <li>None of these</li> </ul>						
<ul style="list-style-type: none"> <li>Other, describe:</li> </ul>						
<p><b>1.14 How often did you have any of these shore-based recreational experiences in the project area in the past year?</b> Choose one.</p>	M. Never	N. Rarely Less than monthly	O. Occasionally 1 to 3x per month	P. Frequently About 1x per week	Q. Often Several times per week	R. Daily or more

<p><b>1.15 Water-based recreational experiences</b> Select all the positive or enjoyable water-based recreational experiences you had in the last year in the study area. Only include experiences in which the water played a role in your experience.</p>						
<ul style="list-style-type: none"> <li>• Swam, or soaked</li> <li>• Paddled or rowed a boat (e.g., canoed, dragon boated, kayaked, rafted, paddleboarded, etc.)</li> <li>• Other, describe:</li> </ul>						
<ul style="list-style-type: none"> <li>• Boated in a motorized boat or personal watercraft, waterskied, tubed, etc.</li> <li>• Sailed</li> <li>• None of these</li> </ul>						
<p><b>1.16 How often did you have any of these types of water-based recreational experiences in the project area in the past year?</b> Choose one.</p>	A. Never	B. Rarely Less than monthly	C. Occasionally 1 to 3x per month	D. Frequently About 1x per week	E. Often Several times per week	F. Daily or more
<p><b>1.17 Work and stewardship experiences</b> Select all the positive or enjoyable work and stewardship experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes that you had in the last year in the study area. Only include experiences in which the water played a role in your experience.</p>						
<ul style="list-style-type: none"> <li>• Worked/held a paid position associated with water or waterfront (e.g., shipping, education, recreation, tourism, environment, military/security, health, the arts, etc.)</li> <li>• Volunteered for an organization at or overlooking the water (e.g., wildlife monitor, invasive species removal, tour guide, trail maintenance, rescue squad, etc.)</li> <li>• Other, describe:</li> </ul>						
<ul style="list-style-type: none"> <li>• Took part in caretaking for the water not associated with a volunteer organization (e.g., picked up litter, cleared trail, etc.)</li> <li>• Took part in water or shore management or restoration activities (e.g., restoring habitat, using fire, etc.)</li> <li>• None of these</li> </ul>						
<p><b>1.18 How often did you have any of these types of work (paid or volunteer/voluntary) experiences in the project area in the past year?</b> Choose one.</p>	G. Never	H. Rarely Less than monthly	I. Occasionally 1 to 3x per month	J. Frequently About 1x per week	K. Often Several times per week	L. Daily or more
<p><b>1.19 Fishing, hunting, and foraging experiences</b> Select all the positive or enjoyable fishing, hunting, and foraging associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes that you had in the last year in the study area. Only include experiences in which the water played a role in your experience.</p>						
<ul style="list-style-type: none"> <li>• Fished from shore (e.g., from a bank, pier, dock, beach)</li> <li>• Fished from a boat (e.g., canoe, motor, etc.)</li> <li>• Ice fished</li> <li>• Hunted with a gun or bow for food at or overlooking the water</li> <li>• Other, describe:</li> </ul>						
<ul style="list-style-type: none"> <li>• Trapped animals for fur or food at or overlooking the water</li> <li>• Harvested or foraged for food or medicinal plants (e.g., wild rice, mushrooms, ramps, berries, etc.) at or overlooking the water</li> <li>• None of these</li> </ul>						
<p><b>1.20 How often did you have any of these types of food or subsistence experiences in the project area in the past year?</b> Choose one.</p>	M. Never	N. Rarely Less than monthly	O. Occasionally 1 to 3x per month	P. Frequently About 1x per week	Q. Often Several times per week	R. Daily or more

<b>1.21 What kind of fishing do you typically do?</b> Skip this question if you did not fish in the study area in the past year.	<ul style="list-style-type: none"> <li>All for sport: for recreation, for catch and release, and/or for mounting</li> </ul>	<ul style="list-style-type: none"> <li>Mostly for sport</li> </ul>	<ul style="list-style-type: none"> <li>Some for sport, some for food</li> </ul>	<ul style="list-style-type: none"> <li>Mostly for food</li> </ul>	<ul style="list-style-type: none"> <li>All for food: fishing to keep and eat or share with others to eat</li> </ul>
<b>1.22 Do you consider wild foods to be a significant portion of your normal diet?</b> Significant portion of your normal diet means a portion of your normal daily diet that makes a personally important contribution to your health or well-being.					<ul style="list-style-type: none"> <li>Yes</li> <li>No</li> </ul>
<b>1.23 If you selected yes, what kinds of wild foods were a significant portion of your normal diet?</b>					
<b>1.24 How often do wild foods contribute to your diet?</b> Wild foods are defined as foods caught, hunted, trapped, or foraged in the study area.	<ul style="list-style-type: none"> <li>I have not eaten wild foods from the study area in the past year.</li> </ul>	<ul style="list-style-type: none"> <li>Rarely - I ate wild foods from the study area less than five times over the past year.</li> </ul>	<ul style="list-style-type: none"> <li>Occasionally - I ate wild foods from the study area about monthly over the past year.</li> </ul>	<ul style="list-style-type: none"> <li>Frequently - I ate wild foods from the study area about weekly over the past year.</li> </ul>	<ul style="list-style-type: none"> <li>Often - I ate wild foods from the study area several times a week or more over the past year.</li> </ul>
<b>1.25 Did a significant portion of your normal diet come from wild foods from the study area at any point in your life prior to the last year?</b>					<ul style="list-style-type: none"> <li>Yes</li> <li>No</li> </ul>
<b>1.26 At any point during their lives, did a significant portion of your parents' or ancestors' diets come from wild foods from the study area?</b>					<ul style="list-style-type: none"> <li>Yes</li> <li>No</li> </ul>
<b>1.27 Other water-related experiences</b> Did you have any other experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes in the last year in the study area that were not covered above? Only include experiences in which the water played a role in your experience.					<ul style="list-style-type: none"> <li>Yes</li> <li>No</li> </ul>
<b>1.28 If you selected yes, please describe these other water-related experiences.</b>					
<b>1.29 If you selected yes, how often did you have these other experiences in the past year?</b> For each experience you listed above, please include a frequency of rarely (< monthly), occasionally (1-3x/month), frequently (~1x/week), often (several times/week), or ongoing (daily or more).					
<b>1.30 Negative experiences</b> Did you have any significant negative experiences associated with Lake Superior, the St. Louis River and estuary, or local streams and lakes in the last year in the study area? Negative experiences are defined as any unpleasant or distressing experiences that could influence your decision to return to a place or an activity.					<ul style="list-style-type: none"> <li>Yes</li> <li>No</li> </ul>

<p><b>1.31 If you selected yes, please describe any significant negative experiences you had.</b> If possible, provide specific examples.</p>	
<p><b>1.32 Experiences over time</b> Our experiences of water can change throughout our lives for many reasons. Although we change the way we interact with the water, past experiences (defined as those before the past year) may remain very important to us. <b>Are there important water-related activities that you used to do in the study area prior to the past year, but you cannot do anymore?</b></p>	<p>• Yes      • No</p>
<p><b>1.33 If you selected yes, please describe them, and briefly explain why you can no longer participate in those experiences.</b></p>	
<p><b>1.34 If you selected yes, how have you adapted to not being able to participate in those activities anymore?</b> For example, maybe you do those activities outside the study area, ceased doing those activities, replaced those activities with something else, or changed your actions in some other way.</p>	

<p><b>Part 2: Location</b> This section of the survey will ask you to think back to all your water-related experiences in the last year in the study area. Then you will answer some questions about the locations of 3 of your favorite experiences. Favorite experiences are water-related experiences that were especially meaningful or important to you personally, for any reason.</p>
<p><b>Directions:</b></p> <ul style="list-style-type: none"> <li>• Identify the location of your favorite or most important water-related experience.</li> <li>• Pull out page 13, which has a color map of the study area. Use a pen or marker to clearly outline the area of this favorite experience on the map. Include the entire area you used or enjoyed for the experience. For example, you do not need to identify your favorite fishing spot but outline the entire area where you accessed the water and went during your fishing outing. Label the area clearly with the letter A.</li> <li>• Repeat for two other areas in order of importance to you using letters B. and C.</li> <li>• Answer each of the questions below for each of the areas you outlined.</li> </ul>

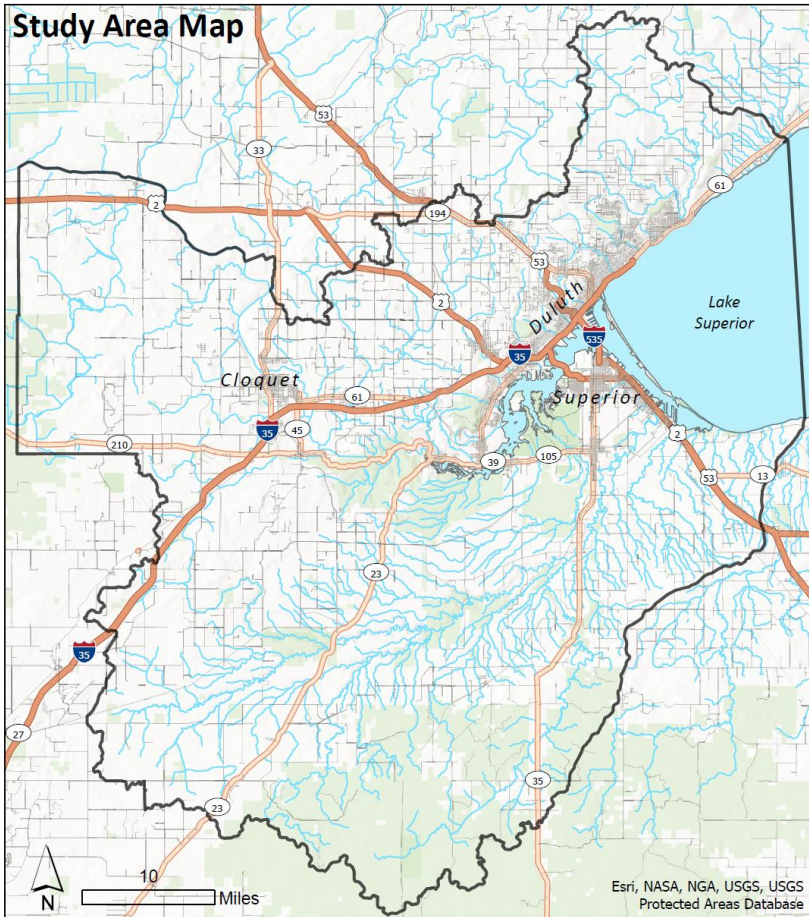
<b>2.2 Describe the location:</b> Provide the name or a brief description of the location.			
•			
•			
•			
<b>2.3 Select the categories that each experience location falls in.</b> Your favorite experience may have included more than one type of experience. Select all the types of experiences that you enjoyed in this location. For example, for fishing with your family, you may select both social experiences and fishing, hunting and foraging experiences.			
<b>Experience category</b>	<b>Locations</b>	<b>Experience category</b>	<b>Locations</b>
<b>Cultural and traditional experiences</b> , including attending or participating in ceremonies or historical experiences, and practicing traditional knowledge associated with the water	A. A B. B C. C	<b>Active experiences</b> , including experiences done for health and exercise reasons at or associated with water	D. A E. B F. C
<b>Spiritual and emotional experiences</b> , including attending church services/events, praying, relaxing, practicing mindfulness, or other spiritual experiences associated with the water	G. A H. B I. C	<b>Shore-based recreational experiences</b> , including wildlife viewing, exercising pet, picnicking, fishing, camping, ATVing, dogsledding, etc. done on the shore	J. A K. B L. C
<b>Social experiences</b> , including experiences socializing with family friends or at a group or public event associated with water	M. A N. B O. C	<b>Water-based recreational experiences</b> , including sailing, boating, fishing, swimming, or any other activities done directly in or on the water	P. A Q. B R. C
<b>Aesthetics, inspirational, and art experiences</b> , including experiencing inspiration, gathering materials for art, or creating art associated with the water.	S. A T. B U. C	<b>Work and stewardship experiences</b> , including paid or volunteer work associated with the water, and/or taking care of the environment like picking up litter or maintaining trails	V. A W. B X. C
<b>Education and learning experiences</b> , including learning from the water or waterfront through formal, informal, or unaccompanied education, including traditional knowledge	Y. A Z. B AA. C	<b>Fishing, hunting, and foraging experiences</b> , including fishing, hunting, trapping, and foraging for recreation and consumption.	BB. A CC. B DD. C
<b>2.4 Describe your experiences.</b> Describe your favorite experiences or activities in the last year at each location in more detail.			
A.			
B.			
C.			

<b>Part 3: Barriers</b> This section of the survey asks you about what barriers you faced to participate in the positive water-related experiences that were important you during the last year.						
<b>3.1 Did you face barriers associated with <u>the site, natural environment, or the landscape</u> to participating in experiences associated with lakes, streams, and rivers?</b> This could include but is not limited to public access to sites, appropriate amenities, availability of gear or programs, weather, safety, public health, health of the environment, discriminatory features, or government regulations.				• Yes      • No		
<b>3.2 Please describe the environmental/site barriers you experienced in the last year.</b>						
<b>3.4 How often did these environmental/site barriers decrease the quality of your water-related experiences and/or prevent your participation in water-related experiences?</b>		• Never	• Rarely	• Occasionally	• Frequently	• Often
<b>3.5 Did you face social barriers to participating in experiences associated with lakes, streams, and rivers?</b> This means barriers associated with other people and could include but is not limited to crowding, safety, incivility, discrimination, harassment, etc.				• Yes      • No		
<b>3.6 Please describe the social barriers you experienced in the last year.</b>						
<b>3.7 How often did these social barriers decrease the quality of your water-related experiences and/or prevent your participation in water-related experiences?</b>		• Never	• Rarely	• Occasionally	• Frequently	• Often
<b>3.8 Did you face barriers associated with your personal life to participating in experiences associated with lakes, streams, and rivers?</b> This could include but is not limited to your amount of free time, knowledge and skills, belonging and identity, finances/employment status, family obligations, housing security, safety and security of personal relationships, physical health or fitness, mobility, mental health, or prior negative experiences.				• Yes      • No		
<b>3.9 Please describe the barriers associated with your personal life you experienced in the last year.</b>						
<b>3.10 How often did these barriers associated with your personal life decrease the quality of your water-related experiences and/or prevent your participation in water-related experiences?</b>		• Never	• Rarely	• Occasionally	• Frequently	• Often
<b>3.11 Did you face any other barriers to participating in experiences associated with lakes, streams, and rivers?</b> This includes any barriers that did not fit under the categories of site/environment barriers or barriers associated with your personal life.				• Yes      • No		

<b>3.12 Please describe these other barriers you experienced in the last year.</b>					
<b>3.13 How often did these other barriers decrease the quality of your water-related experiences and/or prevent your participation in water-related experiences?</b>	<input type="radio"/> Never	<input type="radio"/> Rarely	<input type="radio"/> Occasionally	<input type="radio"/> Frequently	<input type="radio"/> Often
<b>3.14 Were there specific factors, features, or amenities that helped you participate in experiences associated with lakes, streams, and rivers?</b>			<input type="radio"/> Yes	<input type="radio"/> No	
<b>3.15 Describe the important factors that helped you participate in experiences associated with lakes, streams, and rivers.</b>					
<b>3.16 Did the COVID-19 pandemic change how you experienced lakes, rivers, and streams in the last year?</b>			<input type="radio"/> Yes	<input type="radio"/> No	
<b>3.17 Briefly describe how the COVID-19 pandemic has changed how you experienced lakes, rivers, and streams.</b>					
<b>3.18 In your opinion, what are the most important things that should be done to increase access to and quality of benefits from the lake, river, and tributaries for the study area communities?</b>					

<b>Part 4: About you</b> This section of the study asks you for demographic information. This information will be used to understand how water-related experiences and barriers relate to demographics. The information will inform possible approaches for more equitable environmental management in the future. You are free to skip and decline to answer any question(s) you do not wish to answer.				
<b>4.1 How many people reside in your current household, including yourself?</b>				
A. 1	B. 2	C. 3 - 4	D. 5 - 6	E. More than 6
<b>4.2 What year did you first move to the study area?</b>				
<b>4.3 City or township. Select the location of your main residence within the study area for the last year.</b>				
A. Carlton	B. Hermantown	C. Proctor	D. Superior	
E. Cloquet	F. Lakewood	G. Saunders	H. Wrenshall	
I. Duluth	J. Oliver	K. Scanlon		
L. Eldes Corner	M. Parkland	N. South Range		
O. Other (describe):				

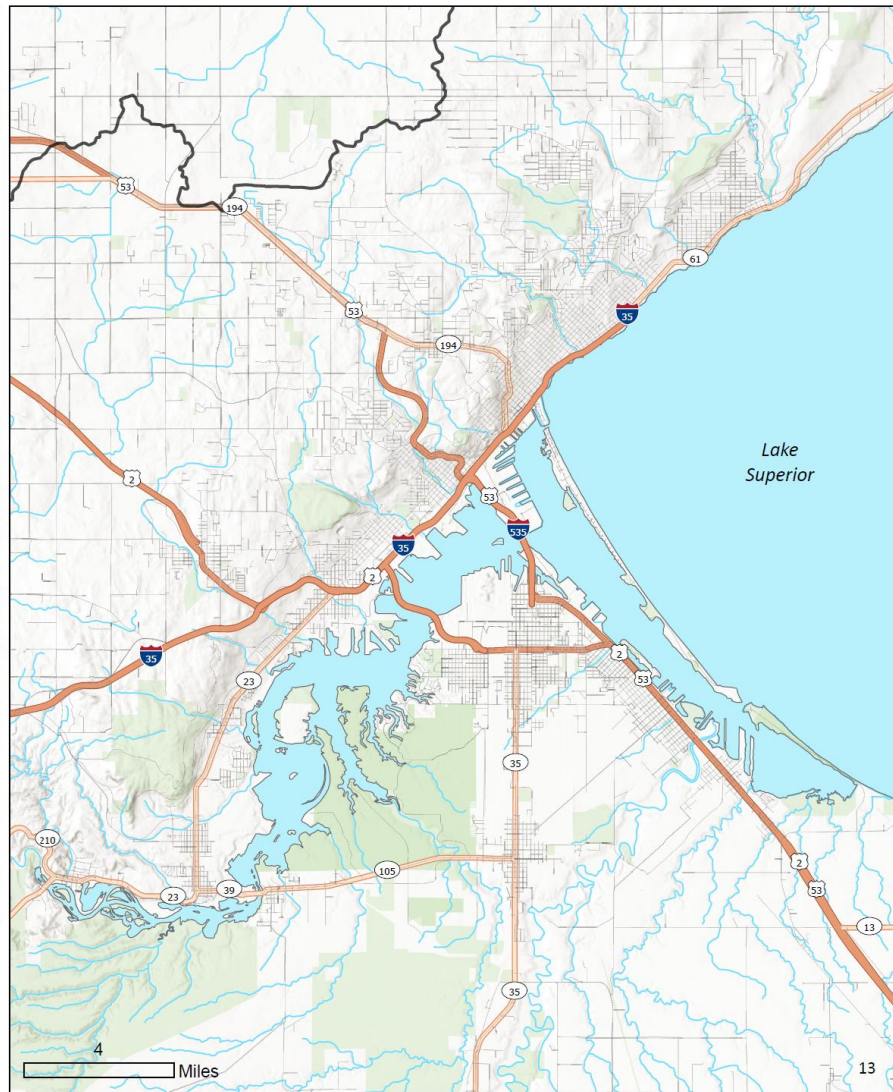
<b>4.4 If you selected Duluth, Minnesota or Superior, Wisconsin, which neighborhood was your main residence?</b>			
<b>Duluth, Minnesota</b> Not sure? Check out <a href="http://duluthmn.gov/media/8099/neighborhoods-map.pdf">duluthmn.gov/media/8099/neighborhoods-map.pdf</a>		<b>Superior, Wisconsin</b>	
• Canal Park	C. Kenwood	N. Gary – New Duluth	X. Billings Park
• Central Hillside	D. Piedmont Heights	O. Norton Park	Y. North End
• Downtown Duluth	E. Woodland	P. Morgan Park	Z. South Superior
• East Hillside	F. Bayview Heights	Q. Park Point	AA. Central Park
• Chester Park/UMD	G. Cody	R. Rice Lake Annex	BB. East End
• East End/Endion	H. Denfeld	S. Riverside	CC. Allouez
• Hunter’s Park	I. Fairmount	T. Smithville	DD. Itasca
• Lakeside/Lester Park	J. Irving	U. Lincoln Park	
• Midway Annex	K. Oneota	V. Goat Hill	
• Morley Heights/Parkview	L. Spirit Valley	W. Rice’s Point	
A. North Shore	M. Fond du Lac	EE. Other (describe):	
B. Duluth Heights			
<b>4.5 What gender best describes you?</b>			
FF. Woman	GG. Man	HH. Non-binary (e.g., third gender, agender, genderqueer)	
II. Other (describe):			
<b>4.6 Are you of Hispanic, Latino, or of Spanish origin?</b>		JJ. Yes	KK. No
<b>4.7 Check all the following races that describe you:</b>			
A. Asian or Pacific Islander	A. Native American or Alaskan Native		
B. White or Caucasian	B. Other (describe):		
C. Black or African American			
<b>4.8 What is your age group?</b>			
A. 18-29 years	B. 30-39 years	C. 40-49 years	D. 50-59 years
E. 60-69 years	F. 70 years or older		
<b>4.9 What is your total household annual income?</b>			
A. Less than \$25k/year	B. \$25-50k/year	C. \$50-90k/year	D. Greater than \$90k/year
<b>4.10 What is your employment status?</b>			
A. Employed or self-employed	C. Student	E. Retired	G. Unable to work
B. Homemaker	D. Military	F. Out of work	
<b>4.11 What is the highest degree or level of school you have completed?</b>			
1. No schooling or less than to 8th grade	5. Trade/technical/vocational training or Associate degree		
2. Some high school, no diploma	6. Bachelor’s degree		
3. High school graduate, diploma, or the equivalent (GED)	7. Advanced degree (masters, professional degree, doctorate)		
4. Some college, no degree			
<b>Thank you for participating!</b>			
Your participation is helping environmental managers increase the quality, quantity, and equity of community benefits from our local streams, the St. Louis River estuary, and Lake Superior.			
To redeem your \$10 debit cash card, visit: <a href="http://z.umn.edu/redeemwaterwaybenefits">z.umn.edu/redeemwaterwaybenefits</a>			



The study area is outlined in black above. The area includes Duluth, Superior, and the surrounding communities including the Fond du Lac Reservation. It includes the areas that drain to the St. Louis River and its estuary below Scanlon, Minnesota. It extends from the French River in Minnesota to the Amnicon River in Wisconsin along the Lake Superior shoreline. It includes the lower 39 river miles of the St. Louis River.

**Part 2 Instructions:**

Identify the locations of your 3 favorite water-related experiences. Use a pen or marker to outline these areas on either map on this page. Clearly label each of your three areas, in order of importance to you, with A, B, or C. Then, return to Part 2 of the survey to answer questions 2.2, 2.3, and 2.4 for each of the areas you outlined.



***Appendix 2.2 Summary of guidance used for identifying invalid survey responses.***

We first reviewed the debit card request form used to distribute debit card compensation to identify the number of total scam responses that might be present in the survey dataset. The following factors were considered when classifying respondents as invalid. If multiple of the below factors were present, then the response was classified as invalid. If only one factor was present, then we verified validity by sending the person an email. If there was no response, or if the response was form language requesting to convert the \$10 to an electronic card, the response was categorized as invalid. During initial review, if unsure, we emailed respondents to verify, to be sure we did not eliminate valid responses. The patterns we noticed in the scam email responses informed future determinations and increased confidence in identifying other invalid responses.

- The address provided was not a real address. I verified this by searching for the address in Google Maps. The following scenarios were typical:
  - The street address provided was a real address but not located in the city/state/zip given.
  - The city/state/zip listed was not located in the study area. Many scam responses provided addresses for towns with the same names as towns in the study area, but listed in different states (e.g., Carlton, PA, Proctor, OK, Duluth, GA, Oliver, GA). For occasions when the city was in Minnesota but outside the study area, and all other information provided looked accurate, then I reached out to the person to verify.
  - The person did not include a street address at all and left it blank, included only their email, or text was nonsensical.
  - The *street address line* included a city, state, zip, that sometimes did not match what was listed in the city, state, and zip fields.
  - Repeated street names or addresses for multiple respondents around the same time.
- The email address contained a name that did not match the name provided for the participant.
- Additional factors that helped verify the response was invalid when the above factors were present:

- Spam responses never offered to participate in an interview – if the person checked yes to do this, we did not classify as invalid. Or, if they did offer, it was within a series of responses that listed the same exact demographics.
- A full name was not provided.
- The phone number listed did not have the area code of the study area.
- Many real participants lived in apartments and addresses included apartment numbers, while no scam responses listed apartment numbers, so the presence of an apartment number was a sign of a valid response.
- Email was listed for the phone number field.

Because the debit form responses were not linked to the survey responses, to maintain confidentiality of survey responses, we were not able to use the information above to QA the survey responses themselves. Because of multiple submissions around the same time, timestamps could not be used to link the forms. However, the above system helped us know the extent of the problem and showed that at least half of the total responses were likely invalid. The invalid responses were associated with two timeframes, approximately the first week of the data collection (when the survey was shared widely on social media), and a period of several days near the end of data collection, when the survey was shared on social media again.

To QAQC the survey responses, we used the following criteria to define invalid survey responses during the time periods which scam responses were submitted.

- If the responses to the location questions were missing, outside of the study area, or the short-answer description of the location was nonsensical, the survey was classified as invalid and dropped. Note: If there were no answers to location data or any short answer, but it was during a time when no scam responses were known to be submitted, based on the debit card request form (10/14 to 12/9/22), and the QA responses were correct, and there was no other indication that it was invalid, then the record was kept. Some individuals had trouble with the mapping questions and/or and did not care to include any short answers.

- If the survey had no responses to any short-answer questions, or the only answers provided were nonsensical or unrelated to the study area, the survey was classified as invalid and dropped.
- The survey included three QA questions, which were added on 10/19/2022 in response to invalid responses, which directed the user to pick a specific answer. If all three were answered incorrectly, the survey was classified as invalid and dropped.

Lastly, we compared the number of responses per day identified as invalid with the number identified as invalid from the debit card request form for the surveys submitted before the QA questions were implemented (on 10/19/2022) to ensure that we removed at least as many invalid responses from the survey dataset as were submitted to the debit card request form.

***Appendix 2.3 Other CES identified by survey participants.***

CES experience reported in short answer “other” questions in addition to multiple choice CES listed. This table includes experiences reported by only a single respondent. See table 2.3 for additional experiences listed by more than one respondent.

CES benefit	Response from survey (Respondent ID number)
Wastewater treatment	"Wastewater treatment" (911)
Self-care experiences	"Other self-care experiences" (430)
Tattoo of Lake Superior	"Tattoo of Lake Superior" (194)
Water as an ancestor	"Bodies' of water are much like The Ancestors, and spirit lives among some of the islands." (533)
Built sailboat	"Sailed often on a sailboat I built" (211)
Dance/Performance about/on the water	"The yearly dance performance of 'Dances on the Lakewalk' at 'Lake Place Park/Gichi-ode' Akiing" (420)
Snow kiting	"Snow kiting" (601)
Bike-joring	"Bike joring" (601)
Skateboard	"Skateboard" (675)
People-watching	"Watch people skip stones." (425)
Identify as lifelong hunter/angler but not currently active	"It has been routine in my life to do most of these things [hunting, fishing, foraging, trapping]. I would answer yes to several of these for the period of concern here but for my age and increasing difficulties." (508)
Leaf Battery Scooters	"Leaf battery scooters" (92)
Tour (ferry or train) experiences	"Vista fleet boat tours" (352) "Riding the train along the lake" (648)
Honor the water	"Make offerings to the water" (398)
Skip rocks	"skipping rocks" (403)
Identify as water protector	"I am a water protector." (432)
Perceive the water as a living being.	"The lake is a living being and it would be hard to describe the experience in this space." (467)
Think about the lake and it's past, present, future	"I ... wonder, remember, muse, consider my future, contemplate the future of the area..." (508)

Made new friends	"I met neighbors and made new friends -- became more deeply embedded in my community -- through a club focused on water-related recreation." (517)
Weather watching	"Watching the weather change over the bay." (517)
Seaplane activities	"Seaplane activities" (544)
Infrastructure and commerce	"Infrastructure and commerce (watching canal ship traffic, bridge work over tributaries)"
Experienced mental/emotional healing	"When I am stressed, grieving or experiencing other strong negative emotions I seek out the water and I find peace and healing." (658)
Climate benefits	"My community garden is less than a quarter mile from Lake Superior. We benefit directly from the thermal effect of Lake Superior on the weather which creates a milder microclimate and longer growing season near the shore." (704)
Cold water immersion	"Cold water immersion for healing" (709)
Learn about the water online	"Learning about the progress to restore the estuary through online resources." (1133)
Sand play - castles/construction	"Playing with sand construction." (1494)

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**Appendix 2.4 P-value tables for Sociodemographic groups and CES**

P-value results for Fischer Exact tests for association between count reporting the CES and sociodemographic groups including gender, age, income, race, ethnicity (Eth.), education (Edu.), employment status (Emp.), household size (Size), and duration of residency in study area (Dur.). P values significant at a Bonferroni-corrected  $\alpha \leq 0.006$  are shown in bold and others shown in gray.

CES	Gender	Age	Income	Race	Eth.	Edu.	Emp.	Size	Dur.
Biked	<b>0.002</b>	0.143	<b>0.001</b>	0.262	0.135	0.029	0.013	0.511	0.015
Jogged/ran	1.000	<b>&lt;0.001</b>	0.888	<b>0.003</b>	0.518	0.027	<b>&lt;0.001</b>	0.178	<b>0.005</b>
Skated	0.943	0.110	0.615	0.486	1.000	0.613	0.010	0.478	0.210
Skied	0.192	<b>0.006</b>	<b>&lt;0.001</b>	<b>0.001</b>	0.516	<b>&lt;0.001</b>	<b>&lt;0.001</b>	0.133	<b>0.004</b>
Sports	0.041	0.267	0.128	0.126	1.000	0.589	0.079	0.463	0.968
Walked	0.120	0.493	0.556	0.643	1.000	0.084	0.104	0.883	0.009
Aesthetics	0.389	0.097	0.123	0.038	0.457	0.071	0.129	0.543	0.419
Created	<b>&lt;0.001</b>	0.501	0.662	0.176	1.000	0.091	0.557	0.935	<b>0.003</b>
Inspiration	0.099	0.733	0.340	0.234	0.544	0.195	0.131	0.782	0.336
Collected	<b>&lt;0.001</b>	0.287	0.563	<b>&lt;0.001</b>	0.369	0.041	0.159	0.909	0.284
Named	0.154	0.395	0.760	<b>0.003</b>	0.692	0.704	0.521	0.651	0.487
Art	0.114	0.964	0.210	0.068	0.351	0.009	0.057	0.311	0.195
Annual	0.210	0.628	0.135	<b>&lt;0.001</b>	0.123	0.153	0.457	0.500	0.797
History	0.168	0.180	0.503	0.198	0.513	0.053	0.044	0.782	0.629
Milestone	0.974	0.095	0.067	0.049	0.759	0.046	0.215	0.144	0.260
Practiced TEK	0.145	0.264	0.673	<b>&lt;0.001</b>	1.000	0.945	0.292	0.043	0.057
Classes	0.865	0.862	0.529	<b>0.005</b>	1.000	0.058	0.069	0.152	0.468
Learned	0.544	0.511	0.121	<b>0.001</b>	0.272	0.074	0.744	0.793	0.433
Hobby/skill	0.775	0.228	0.985	0.079	0.229	0.264	0.326	0.117	0.109
Shared TEK	0.919	0.172	0.519	<b>&lt;0.001</b>	0.087	0.380	0.160	0.075	0.621
Fish-boat	<b>&lt;0.001</b>	0.231	0.010	<b>&lt;0.001</b>	0.731	0.054	0.556	0.009	<b>&lt;0.001</b>
Fish-shore	<b>&lt;0.001</b>	0.499	0.095	<b>&lt;0.001</b>	1.000	<b>0.001</b>	0.181	0.410	0.007
Forage	0.852	0.220	0.604	<b>&lt;0.001</b>	0.300	0.184	0.011	0.751	0.182
Hunted	<b>&lt;0.001</b>	0.606	0.261	<b>&lt;0.001</b>	0.593	<b>0.005</b>	0.797	0.326	0.009
Icefished	<b>0.002</b>	0.103	0.072	<b>0.001</b>	0.372	0.185	0.269	<b>0.004</b>	<b>0.002</b>
Trapped	<b>0.001</b>	0.578	0.331	<b>&lt;0.001</b>	1.000	0.020	0.747	0.215	0.036
ATVed	0.021	0.009	0.142	<b>&lt;0.001</b>	0.374	<b>0.005</b>	0.487	0.005	<b>0.001</b>
Wildlife	0.475	<b>0.003</b>	0.230	0.060	1.000	<b>&lt;0.001</b>	<b>0.002</b>	0.013	0.195
Camped	0.591	0.338	0.139	<b>0.006</b>	1.000	0.447	<b>0.001</b>	0.022	0.360
Pets	0.230	0.059	0.028	0.311	0.549	0.223	0.039	0.446	0.031
Picnicked	0.292	0.304	0.765	0.173	0.754	<b>0.004</b>	0.667	0.031	0.471
Snow play	0.463	0.114	0.032	0.555	0.539	0.365	0.035	0.183	0.029

Club/group	0.553	0.063	<b>0.002</b>	0.196	0.376	<b>0.001</b>	0.212	0.038	0.033
Socialized	0.551	<b>0.001</b>	0.516	0.750	0.013	0.118	<b>0.001</b>	0.341	0.054
Events	0.563	0.446	<b>0.001</b>	0.059	0.222	<b>0.001</b>	0.054	0.924	0.258
Deceased	0.875	0.020	0.568	<b>&lt;0.001</b>	0.206	0.161	0.090	0.903	0.111
Faith	0.804	0.152	0.695	<b>&lt;0.001</b>	1.000	0.505	0.631	0.757	0.152
Mindfulness	0.042	0.413	0.891	<b>0.006</b>	0.755	0.010	0.987	0.664	0.094
Prayed	0.107	0.107	0.835	<b>&lt;0.001</b>	0.751	0.237	0.652	0.784	0.573
Relaxation	<b>&lt;0.001</b>	0.689	0.253	0.013	<b>0.003</b>	<b>0.003</b>	0.568	0.328	0.559
Boated	<b>0.003</b>	0.497	0.019	0.025	0.115	0.101	0.896	<b>&lt;0.001</b>	<b>&lt;0.001</b>
Paddled	0.742	0.318	<b>&lt;0.001</b>	0.393	1.000	0.009	<b>0.006</b>	0.478	0.408
Sailed	0.012	0.161	<b>0.005</b>	0.425	1.000	0.137	0.135	0.482	0.826
Swam	0.164	<b>&lt;0.001</b>	0.766	0.061	0.518	0.019	<b>&lt;0.001</b>	0.012	<b>0.002</b>
Caretaking	0.832	0.009	0.011	0.160	0.334	<b>0.003</b>	0.897	0.629	0.034
Paid work	0.012	0.081	0.019	0.369	0.222	0.282	<b>&lt;0.001</b>	0.744	0.814
Stewardship	0.120	0.053	<b>0.004</b>	0.014	1.000	0.634	0.152	0.064	0.051
Volunteer	0.012	0.184	0.160	0.008	0.079	0.087	0.445	0.678	0.138

P-value results for Fischer Exact tests for association between count reporting the CES category (A) or RCI (B), and sociodemographic groups including gender, age, income, race, ethnicity (Eth.), education (Edu.), employment status (Emp.), household size (Size), duration of residency in study area (Dur.) and town/neighborhood residency (Res.). P values significant at a Bonferroni-corrected  $\alpha \leq 0.006$  are shown in bold.

CES Category	Gender	Age	Income	Race	Eth.	Edu.	Emp.	Size	Dur.
Culture	0.258	0.028	0.953	0.024	0.375	0.915	0.013	0.056	0.347
Spirit	<b>&lt;0.001</b>	0.027	0.903	0.059	1.000	0.467	0.837	0.982	0.866
Social	0.105	0.030	0.825	0.774	0.030	0.302	0.056	0.283	0.054
Art	0.249	0.953	0.227	0.603	1.000	0.385	0.243	0.639	0.452
Education	0.677	0.361	0.428	<b>&lt;0.001</b>	0.107	0.233	0.184	0.584	0.135
Active	0.169	0.108	0.346	0.750	1.000	0.119	0.077	0.616	<b>0.005</b>
Shore	0.344	0.333	0.194	0.392	0.580	0.895	0.378	0.037	0.067
Water	0.451	<b>0.002</b>	<b>0.002</b>	0.212	0.111	0.015	<b>0.001</b>	<b>0.002</b>	<b>0.001</b>
Work	0.933	0.037	<b>0.001</b>	0.158	1.000	<b>&lt;0.001</b>	0.239	0.488	0.241
Wild foods	0.016	0.787	0.377	<b>&lt;0.001</b>	0.217	0.108	0.040	0.472	0.016

**Appendix 2.5 Table of P-values for Sociodemographic groups and barrier themes**

P-value results for Fischer Exact tests for association between count reporting the Barrier themes and sociodemographic groups including gender, age, income, race, ethnicity (Eth.), education (Edu.), employment status (Emp.), household size (Size), and duration of residency in study area (Dur.). P values significant at a Bonferroni-corrected  $\alpha \leq 0.006$  are shown in bold.

Barrier	Gender	Age	Income	Race	Eth.	Edu.	Emp.	Size	Dur.
Access	0.323	0.719	0.381	0.248	1.000	0.129	0.573	0.912	0.531
Amenities	0.201	0.703	0.333	0.287	0.229	0.063	0.492	0.335	0.721
Climate/weather	0.361	0.909	0.206	0.700	0.234	0.359	0.545	0.079	0.697
Communication/ education	0.218	0.288	0.392	0.557	0.700	<b>0.001</b>	0.487	0.333	0.386
Programs/events	0.726	0.516	0.237	0.096	0.547	0.919	0.442	0.926	0.701
Environment	0.440	0.123	0.262	0.456	0.747	0.751	0.562	0.813	0.930
Health/Ability	0.097	<b>0.006</b>	0.387	0.081	1.000	0.488	<b>0.001</b>	0.159	0.057
Other	0.511	0.436	0.812	0.899	1.000	0.753	0.103	0.754	0.169
Regulations/ Governance	0.099	0.311	0.406	0.170	0.536	0.617	0.848	0.972	0.055
Resources	0.446	0.009	0.270	0.026	0.519	0.047	<b>0.001</b>	0.877	0.635
Safety	0.116	0.168	0.559	0.755	0.210	0.586	0.320	0.158	0.693
Social	0.145	0.141	0.052	0.940	0.216	0.299	0.226	0.224	0.303
Transportation	0.049	0.040	0.974	0.354	0.630	0.962	0.756	0.846	0.962

## Chapter 3 Appendix

### *Waterway Benefits Interview Guide*

The interview guide is aimed at addressing the following questions: What benefits associated with Lake Superior, the St. Louis River, and local tributaries of the study area are the most important to the community? How do these benefits vary with demographic and socioeconomic groups, personal identities, and why? What are the barriers to experiencing benefits? What facilitates access to benefits?

**TRANSCRIPT/INTERVIEW NAMING:** *WBS-001-20230524-01* -  
WBS\_interviewnumber(overall)\_YYYYMMDD\_interviewnumber(day)

#### Materials:

- Large study area map
- Recorder
- Clock/timer to track time
- Snacks for participants
- Debit cards preloaded with \$25 to thank participants

#### Overview of interview process: (XX:00; 5 minutes)

- Share background information
  - Thank the participant in advance for participating.
  - Give an overview of interview, including breaks and logistics if conducted over Zoom: Estimated time: 1 hour; a little background about you, half on your relationship with the water, half on what helps or prohibits you from experiencing the water.
  - Give a description of the study objectives and purpose.
  - Share the map of study area and describe its boundaries.
  - Remind the participant that this is research and there are no right or wrong answers.

- Share that the participant may mention places and chose not to identify them exactly or may choose not to mention places you prefer to protect from general knowledge.
- Go over consent form and confidentiality agreement.
  - We will record the interview for transcription with your permission.
  - Participation is entirely voluntary and if at any point you'd like to stop, you can at any time. You can skip any questions you want also.
  - There are no right or wrong answers, we're just interested in your perspective and experiences.
  - All the interview data will be treated confidentially, and your identity will be protected for all reports produced. However complete anonymity may not be possible and there is a small risk that someone who knows you could identify you based on your responses.
  - Data will be owned by the university EXCEPT data from people who self-identify as Native Americans – those data will be owned by Fond du Lac Band and are used with permission by UMN just for this project.
  - Sign the consent form.
- Notify that you will start the recording now.

Questions:

About you/background (5 minutes)

We are asking these questions first because we are interested in understanding how CES benefits vary with sociodemographic groups and personal identities, and why.

What town or neighborhood do you live in?

How long have you lived in the area?

Where are you from originally?

What do you do for work or an occupation?

How far did you go in school? - What did you go to school for?

Are you married? Do you have kids? Are you responsible for the care of anyone?

How do you describe your gender? What pronouns do you use?

Do you mind telling me how old are you?

How would you describe your race and ethnicity?

Relationship with the water (25 minutes)

The next few questions relate to your relationship with the water.

1. **What events or experiences in your life** have contributed to your relationship or experiences with water? -- Childhood? Growing up? College? Family? Retirement? Now?
  
2. What do you like **to do** in/on/around the water now? In the past?
  - Are the **social** aspects of water activities important to you? Or do you prefer **solitude**? Or both?
  - How does water play into your **mental and physical health**?
  - Wild foods? • Culture/history? • Work/stewardship? • Education/learning? • Art/inspiration?
  - Do you feel like you have a **spiritual** connection to water?
  - Are there places you are **attached** to or really enjoy? What do those places mean to you?
  
3. How has your relationship with water or experiences with water **changed** during your lifetime?
  
4. How does your relationship or experiences with water relate to your **identity or who you are** as a person?

Identity is the ideas, relationships, and sense of belonging that help shape who we are – who or where we belong to, the community we are a part of and so on.

Barriers (20 minutes):

We are interested in the positive and negative factors that affect people's relationships with nature. This next set of questions is about what factors affect that.

5. What sorts of things in the physical **environment** affect your experiences or relationship with the water?

What about in your **personal** life? What factors in your personal life affect your experiences or relationship with the water?

- Have you had any significant **negative** experiences with the water?
6. Do you have any thoughts about **what needs to be done** in the community or in the world generally for more people to experience and benefit from the water?
  7. Last question: how would you summarize or characterize your relationship with water?

Other thoughts (5 minutes):

8. Do you have **any other thoughts** you'd like to share?

Closing

Thanks for your time. That's all the questions I have for you. Do you have any questions for me?

I'll be in touch in the next few weeks if there is anything I need to clarify as I transcribe and compile the information you've shared.

I'll also be in touch with information about the results of this work. We plan to create a public resource from the information you've shared. If you have **additional ideas** of how to disseminate this information, please let me know.

Give debit card.

Thank you again.