Exploring the Role of Outdoor Recreation to Contribute to Urban Climate Resilience

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Abstract: Climate resilience is an important mix of climate mitigation and climate adaptation designed to minimize current and future disruption while promoting opportunity. Given the importance of the regional and local arena for consideration of impacts of climate change trends and needs for climate action, climate resilience in one community, Duluth, Minnesota, is considered. At the core of this project is the climate resilience question: what can we currently be doing in our communities to prepare for projected climate change while simultaneously improving life for current residents and visitors? Given the growing importance of outdoor recreation and nature-based tourism in Duluth, the role this sector may be able to play in climate resilience is considered. Using action research methodology, the research process of adjusting, presenting, and conducting follow-up from a National Oceanic and Atmospheric Administration Climate Adaptation for Coastal Communities workshop is presented. The study takes a unique look at one workshop outcome, a Duluth Parks and Recreation planning tool. Specifically, a resilience checklist is presented as a useful sample outcome of the overall process. Beyond the study community, the role of outdoor recreation to serve climate resilience is explored and affirmed.

Keywords: climate adaptation; climate resilience; multifunctional green infrastructure; nature-based tourism; outdoor recreation; sustainability

1. Introduction

1.1. Sustainability, Resilience, and Climate Change

Sustainability is often defined as meeting present needs without compromising the ability of future generations to meet their needs [1] and is often predicated on an idea of ecological balance [2]. The origins of sustainable development emphasize the core goals of protecting and maintaining natural and cultural resources for the future and mitigating undesirable change [3]. The aspect of mitigating unwelcome change is where the concept of sustainability intersects with resilience. Resilience is based on consideration of disruption [4]. For example, the ability for a system to bounce back from adversity is one way that resilience has been described [5]. The Stockholm Resilience Center defines resilience as “. . . the capacity of a system, be it an individual, a forest, a city or an economy, to deal with change and continue to develop . . . ” [6]. Drawing on these ideas, a useful way to describe socio-ecological resilience is the flexibility that allows for systems to adjust to disruption. If the idea is planning for disruption in ways that allow for improving current and future situations, then a description of resilience as the ability to bounce forward from adversity to new and improved states is useful [5]. While similar in many respects [7], differences underlying sustainability and resilience are apparent in two key questions [3]. If an underlying action or effort is based upon the question of what it is we want to protect and conserve, and to keep from changing, then we are asking a sustainability question. If, however, we are considering how or what we want to adapt and change into something new, possibly better, then we are asking a resilience question. Often, and importantly, we ask both
questions in the face of our environmental challenges. For example, in this project, consideration of protecting valuable outdoor recreation and environmental resources (sustainability) is wrapped within questions of preparing for climate change (resilience). Nonetheless, to avoid confusion over concepts and given the focus of this study on preparing for climate change disruption, the term resilience is best suited for use. More specifically, this project combines climate mitigation and climate adaptation within the idea of climate resilience. A mix of climate mitigation (carbon emissions reduction) and climate adaptation (preparing for change) designed to minimize current and future disruption while promoting opportunity is defined as climate resilience. Climate mitigation is not always directly highlighted in definitions of resilience; nonetheless, it is common for climate actions to have elements of both adaptation and mitigation [8]. Furthermore, given that urban areas play a fundamental role in the production of greenhouse gases, they may be able to provide a good focus for a mix of mitigation and adaptation strategy [9]. Ultimately, at the core of this project is the climate resilience question: what can we currently be doing in our communities to prepare for projected climate change while simultaneously improving life for residents and visitors right now? This “no regrets” approach allows for a focus not only on disaster and crisis but also on slow change variables, ultimately allowing for a more comprehensive view of resilience [10,11].

The project featured in this paper uses Duluth, Minnesota as a study site for consideration of the nexus of outdoor recreation and climate resilience. Note, there is a close relationship between outdoor recreation and nature-based tourism in Duluth. While not all tourism in Duluth is outdoor recreation-oriented or nature-based, the sector is significant and growing [12]. This paper will focus on the outdoor recreation component of this intertwined aspect of local amenities and tourist attraction. The phrase “outdoor recreation” will reference both opportunities for resident quality of life and quality of visitor experience. Separating these two is not easy nor useful. Consider recent comments by the construction project supervisor for the city of Duluth, who captured the overlap as he described the access provided to Lake Superior by Duluth’s signature outdoor recreation feature, the Lakewalk, a 7.2 mile long waterfront walk/bike trail. He stated “It’s why we live here, why we hang out down here, why millions of people visit here...” [13].

1.2. Climate Resilience and Outdoor Recreation

Interest in the intersection of outdoor recreation and climate change is not new. In 1991, Ewert wrote an article entitled “Outdoor recreation and global climate change: Resource management implications for behaviors, planning, and management” [14] and emphasized the idea that outdoor recreation has a critical role to play in nurturing positive relationships between people and nature. Ewert stressed that for millions of people, outdoor recreation experience “… may be one of the few definitive ways that the impacts of global climate change can be observed directly” (p. 375). More recently, several research publications have devoted special issues to the subject of climate change, including the 2015 Journal of Outdoor Recreation and Tourism Climate Change Special Issue [15] and the 2018 Journal of Park and Recreation Administration Special Issue, “Climate Change and Outdoor Recreation: Shifting Supply and Demand” [16]. This branch of outdoor recreation research literature provides a broad spectrum of study investigating the interaction between climate change and outdoor recreation. For example, one study from these collections of particular interest to outdoor recreation in Northeast Minnesota is a consideration of climate impacts upon skier recreational behavior in the province of Ontario [17].

This focus on climate change by leading outdoor recreation researchers is not surprising given concerns regarding the contribution of outdoor recreation to the problem, potentially contributing to the destruction of its own base of existence. Outdoor recreation groups like Protect our Winters (POW) acknowledge this concern and are addressing how the activities they enjoy both contribute to greenhouse gas emissions, and how that impact can be reduced and how adaptations can help ski sport to change [18]. The work of POW is of particular interest to this current effort, given the focus
of this study on how one community’s outdoor recreation community may be able to play a role in climate resilience.

A regional example of climate change/outdoor recreation research can be found in the efforts of the recent Building Climate Readiness on Minnesota’s North Shore project [19]. The project was designed to explore how projected hydroclimatic conditions along the North Shore of Lake Superior will affect the behavior of recreationalists and tourists and impact local economies. This research team was curious as to whether outdoor recreation tourism based economies are sustainable in the context of a changing climate. The research team noted the need for a scientifically-grounded understanding of how outdoor recreation systems will respond to climate and environmental change. In addition, the project was interested in how local residents are enabled to make strategic long term planning and policy decisions that maintain or improve their current levels of economic well-being while conserving the natural landscapes and outdoor recreational landscapes upon which they depend [20]. The data and discussion generated regarding climate change risk severity and thresholds for nature-based tourism and outdoor recreation system attributes [21] are of direct relevance to the community of Duluth. Ultimately, the Building Climate Readiness on Minnesota’s North Shore project served to motivate a deeper look at adaptation in Duluth. Specifically, the project encouraged application of an awareness to action framework to support community engagement in resilience [22].

Other community-based outdoor recreation-oriented climate adaptation trainings were not found in the research literature. The broader literature of climate adaptation and outdoor recreation, however, provide support for this study. For example, Askew and Bowker [23] emphasize that nature resource managers and planners must consider outdoor recreation responses to climate change in their outdoor recreation projections. Examples of this include the Climate Change Response Network (CCRN) efforts. CCRN work is focused on questions of climate and land management and provides structure for many outdoor recreation climate adaptation projects. For example, CCRN projects include a focus on degraded forests in a Minnesota North Shore state park and efforts in conjunction with the hunting organization Ducks Unlimited and the National Wild Turkey Federation in Indiana/Illinois bottomland forest [24]. Along with their outdoor recreation focus, these projects share a local, participatory, and collaborative approach; an approach emphasized by McNamara and Buggy [25] in their literature review of 128 cases of community-based climate change adaptation.

Multifunctional Green Infrastructure

The broader literature of urban climate change adaptation planning provides further support for consideration of the relationship between outdoor recreation and climate resilience. For example, A 2015 meta-analysis of urban climate change adaptation planning highlighted efforts likely to be beneficial to an urban area regardless of the severity and timing of climatic change. Many of the specific efforts noted in that analysis fit within the heading of multifunctional green infrastructure [26]. Multifunctional green infrastructure is defined as the capacity of green infrastructure (green space) to provide a variety of functions simultaneously, such as stormwater management, heat island mitigation, or recreation opportunity [27]. These multifunctional green spaces are considered fundamental to supporting quality of life in urban areas [28] and have direct implications for the potential promotion of outdoor recreation. Innovative examples of urban planning can enhance the understanding of how multifunctional green infrastructure may be able to link outdoor recreation opportunities and climate resilience [29,30].

1.3. Foundation in Climate Data

A final foundation for this study is climate data. Given the need to base climate resilience in local and regional contexts [31], regional climate change projections are an essential consideration for action. The landscapes that provide high quality outdoor recreation opportunities are highly variable ecological systems that can adversely respond to exogenous shocks and stressors [32], such as the specific changes in regional climatic conditions. Given the recent critique that very little outdoor recreation and tourism
research uses scientifically grounded climate change projections [32], both statewide (Minnesota) and regional (NE Minnesota) climate data are used as a foundation for this study. Current data point to three underlying trends at the source of climate disruption for Duluth [33]: one, in general, the climate is trending warmer and wetter; two, winter is warming the fastest, and specifically, the average overnight winter temperatures; and three, the region is experiencing an increase in severe precipitation events, or mega storms. A mega storm is defined as a rain event of six inches (15 cm) of rainfall (with the core of the event topping eight inches) covering more than 1000 square miles (2600 km$^2$) [34]. These three trends will be referenced throughout this paper as they provide a climate science foundation to the specific disruptions of concern. For example, the general warmer and wetter winters, coupled with a decline in winter overnight temperatures is having a negative impact on the skiing and other snow sports due to shortened and snow-uncertain winters [35]. Another example of impact on outdoor recreation is the increase threat of Lyme disease facilitated by increased deer tick survival based on temperature and humidity changes in the region [36]. A small sampling of the research literature based on the noted climate trends with implications for regional outdoor recreation (see Table 1).

### Table 1. Examples of research focus related to potential impacts of climate change on outdoor recreation.

| Climate Trend for NE Minnesota with Research Examples |
|-----------------------------------------------------|
| **1. Warmer and Wetter**                            |
| • Proliferation of disease-bearing insects, for example mosquitoes and ticks [36,37]. |
| • Proliferation of invasive plants that have the potential to damage ecosystem integrity, for example Reed Canary Grass [38]. |
| **2. Warmer Winters**                               |
| • Decrease in natural snow cover throughout the northern hemisphere [39,40]. |
| • Winter precipitation in the form of rain [41].    |
| **3. Severe Precipitation**                         |
| • Impacts upon outdoor recreational infrastructure, for example roads, trails, and campgrounds [42–45]. |

### Complexity of Climate Trends and Impacts on Outdoor Recreation

Given the noted importance of basing climate resilience on local and regional trends, it is essential for climate adaptation planning in Duluth to consider the interaction of factors that may negatively impact outdoor recreation and tourism. Interactions such as the modification, deterioration, or complete loss of (1) facilities, services, and infrastructure; (2) environmental and cultural resources; (3) tourist markets; and (4) skilled employees [11], as well as how such negative impacts in outdoor recreation are associated with broader overall climate impacts in the region. An example this interaction of the complex local/regional socio-ecological factors can be found in a more detailed consideration of climate impacts on the tree species Black Ash. Black Ash is a native species of Northern Minnesota, found commonly in forests, wetlands, and trail corridors throughout the Duluth area (including parkland in Duluth). All three climate trends come into play when the current and projected health of Black Ash is considered. Black Ash often grows in wetland areas and have a tremendous capacity to impact local hydrological cycles [46]. Black Ash is also of cultural importance to the Anishinaabe people of the region; the tree provides bark for traditional basket making [47]. The Emerald Ash Borer (EAB), an Asian insect species not native to Northern Minnesota and the Duluth area, has become an invasive pest in parts of North America, including Minnesota. EAB larvae feed on the inner phloem, cambium, and outer xylem of Ash species for up to two years, girdling and killing the trees [48]. With warmer winters, EAB is expanding its range, in part due to warmer winter overnight temperatures. EAB range is
significantly limited by overnight winter temperatures of below \(-30^\circ\text{F}\) [46]. With a loss of Black Ash, local water tables in area wetlands may rise dramatically, leaving these wetlands less capable of serving a natural stormwater management role (water retention) and subsequently unable to contribute to flood control. The loss of this aspect of stormwater management in the Duluth area may exacerbate the existing problem of stormwater. This concern includes impacts of stormwater run-off on recreation infrastructure, for example, severe erosion on Duluth trails and in parks. Stormwater management is a challenge in Duluth based on the local topography (steep hillsides down to Lake Superior), clay soils, exposed bedrock, and urbanization [49]. In addition, the loss of Black Ash will harm regional cultural traditions [47]. This mix of climate, ecology, topography, culture, and recreational land management provides an example of the complexity of the (climate/EAB/Black Ash/Stormwater) problem. The mix provides a sense of how outdoor recreation resources are intertwined within overall community resilience.

1.4. Duluth, Minnesota

In general, urban areas such as Duluth are important sites for climate change adaptation efforts, given the importance of considering local climate impacts and the scale of governance to address the challenges [10,25,50]. Furthermore, a local focus allows for outcomes that integrate different strategies with the overall specific character of a community, for example, governance and planning [51]. In the case of Duluth, a combination of three factors make the community highly suitable for consideration of the relationship between climate resilience and outdoor recreation: (1) availability of quality climate change data and projections; (2) local engagement in the outdoor recreation sector, i.e., public and private initiative to support social and economic development of the community; and (3) an expanse of urban nature. Each of these aspects of the local community is presented to provide a background to this project and provide support for inquiry into the role that outdoor recreation can play in community resilience.

The first factor is based mainly upon the efforts of the Minnesota Department of Natural Resources State Climatology Office. The specific outreach efforts of that office assure that Duluth has access to the most up-to-date climate information, both access to data and interpretation. State Climatology Office presentations in Duluth and efforts to mediate between the large climate data sets and public understanding is a tremendous asset for the community.

The second factor that makes Duluth suitable for consideration of the relationship between climate resilience and outdoor recreation is Duluth’s active engagement in the outdoor recreation sector as evidenced by city leadership, public political will, local non-profit commitment, and private sector investment [52]. Current and previous city administrations (the Mayor’s office) have provided strong support for outdoor recreation initiatives; consider the example of the on-going St. Louis River Corridor Initiative, a project designed to invest in public park and trail improvements along the Duluth shoreline corridor of the St. Louis River. The overall goals include support for outdoor recreation, economic opportunity, environmental quality, and tourism development resulting in $18 million secured for the project (via a tourism tax approved by the Minnesota Legislature in 2014) [53].

Beyond the Mayor’s office, non-profit community organizations and private enterprise, highlight other aspects of local engagement in the outdoor recreation sector. Groups like the mountain biking club Cyclists of Gitchee Gumee Shores (COGGS) [54] and the Duluth Cross Country Ski Club (DXC) [55] have worked to invest in public-private outdoor recreation initiatives. Examples of these partnerships on behalf of outdoor recreation in Duluth include DXC trail and snowmaking development at the Grand Avenue Lodge, and the Grand Traverse Trail development championed by COGGS. A June 2019 local newscast captured the importance of the partnership between the City of Duluth and groups like COGGS and DXC in the development of outdoor recreation infrastructure and opportunity, consider the emphasis from the report on collaboration: “Despite the monumental task ahead of them, joint efforts between The City of Duluth, COGGS, and other community organizations have turned what was once a dream into a reality for everyone to enjoy” [56]. Alongside, and often
in concert with community groups like DXC and COGGS, are private businesses. For example, the rise of urban outfitting and adventure programming by private enterprise appears to be a factor in the on-going development of outdoor recreation resources in Duluth; consider the examples of Day Tripper Duluth and The Duluth Experience [57,58], two relatively new companies that provide residents and visitors with opportunities for urban nature-based adventures, featuring kayaking, canoeing, hiking, snowshoeing, and mountain biking. Both of these companies aim to provide the resident and visiting public with meaningful outdoor recreation experiences. Beyond government, community organization, and private enterprise, the general public appears to have a willingness to support this community direction; for example, in 2011, residents voted themselves a property tax increase of 3.2% with proceeds from the levy dedicated to a fund to improve and maintain local parks and provide recreational programming [59].

Duluth Outdoor Recreation by the Numbers

The previous factors of leadership and community public/private support are grounded, in part on an expanse of urban nature—a third reason making Duluth exceptionally well suited for consideration of the relationship between climate resilience and outdoor recreation. Duluth, a small city of 86,000 residents [60] boasts the following outdoor recreation greenspace and infrastructure [61]:

- 11,000 acres (4452 hectares) of green space;
- 129 Parks with 6834 acres (2766 hectares) of city parkland;
- 12 miles (19 km) of paved, accessible trails;
- 85 miles (137 km) of bike-optimized, multi-use trails;
- 150 miles (241 km) of unpaved hiking trails.

Partially included in the list above are substantial coastal resources, approximately 18 miles (29 km) of Lake Superior shoreline, including both basaltic outcrops and sandy beach shorelines, approximately 17 river miles (27 km) of the St. Louis River, numerous urban streams including 16 trout streams [62]. Not only does Duluth have a wealth of outdoor recreation-related features, but also organizations and municipal structures designed to protect and manage these resources; for example, the Minnesota Land Trust and City of Duluth Commissions; for example, the Natural Resource Commission and Park and Recreation Commission. The combination and interaction of all of the noted Duluth factors (from parks to people) contributed to Duluth being designated as the “best town” in America by Outside Magazine in 2014 [45]. This designation helped highlight the growing importance of outdoor recreation for Duluth. Given these community factors underscoring the importance of outdoor recreation coupled with the noted climate change projections, Duluth provides a useful context to explore the role that outdoor recreation may be able to play in supporting community-based climate resilience [63]. Recent related tourism literature highlights the need for specific destinations to focus on climate change factors to develop efficient climate resilience adaptation and mitigation strategies [63].

2. Methods

Drawing upon an identified need for a framework to help Duluth address community resilience, a method to sequentially move from problem to action was chosen [22]. Community action-based research allows for a process designed to both identify and educate a professional community while also motivating action [64]; this goal of social action intertwined with a systematic process goes back to the roots of action research [65]. The community-based aspect of the action research is emphasized given the starting point of a community problem (in this case, local impacts of climate change). Further, the process is based on the idea that specific groups within the community (in this case outdoor recreation professionals) may be able to extend their understanding and see a professional role for themselves in problem-solving [66]. Another characteristic of action research is the dual role of practitioner-researcher [67]; the principal investigator in this study is positioned as both outreach educator and social science researcher, i.e., engaged in the process, while also in the role of documenting
and interpreting the efforts. This dual role was a good fit for the University of Minnesota Sea Grant Extension (hereafter Sea Grant), given the outreach and communication role played by Minnesota Sea Grant. Sea Grant Extension works to connect university resources and expertise with local communities and user groups. It is important to note that the goal of this project was community action—it is not the intent of this project to evaluate that action, but rather to document and review the overall process from conception to action.

Stringer describes an action research process of three primary phases described simply as Look-Think-Act [64]. The first phase, Look, is the formation of a definition and description of the problem. The second phase, Think, is interpretation and explanation of the problem situation with consideration of what problem-solving efforts are already in motion. In the third phase, Act, an attempt is made to resolve issues and problems; action is taken to formulate solutions [64]. The current project organization providing a brief overview of the progressive and systematic steps in this action research method is displayed in Table 2.

| Research Step | Process and Outcomes |
|---------------|----------------------|
| 1. Identifying the problem: Local climate resilience in the context of outdoor recreation. | Feedback from informal outreach to outdoor recreation community regarding community interest in the outdoor recreation and climate resilience connection. |
| 2. Exploring the opportunity: Developing the outdoor recreation and climate resilience connection. | Review of outdoor recreation and climate resilience in the research literature in conjunction with on-going outreach to the Duluth outdoor recreation community. In addition, initial outreach to the National Oceanic and Atmospheric Administration (NOAA) established. |
| 3. Program development: On-going outreach to NOAA and local community. | Adaptation of existing Climate Adaptation for Coastal Communities curriculum to fit a Duluth outdoor recreation focus. Outreach to outdoor recreation community for participation and planning. |
| 4. Program: Climate Adaptation for Coastal Communities. | Climate Adaptation for Coastal Communities workshop completion. |
| 5. Follow-up: Workshop follow-up with participants on an Intention to Act activity. | Intention to Act projects (from workshop curriculum); for example, Duluth Park and Recreation Department Resilience Checklist (Table 4 and Appendix B) developed. |
| 6. Synthesis: Reflection on the entire process, from conception to action. | Synthesis of planning notes, workshop documentation, and Intention to Act projects. In addition, on-going use of the Resilience Checklist by City of Duluth Park and Recreation Department as well as any other workshop inspired projects. |

The process highlighted in Table 2 included practitioner/researcher documentation of each step (in the form of notes, workshop activities, email communication, and draft documents). An example of the research documentation, specifically a copy of a document from the workshop representing one workshop group’s efforts to consider the outdoor recreation and climate resilience is provided in Figure 1.
3. Results and Analysis

The results section will follow the research steps, as presented in Table 2, and provide a short summary of action outcomes from each stage. One specific example from the process (the resilience checklist) has been chosen to highlight potential outcomes. The checklist represents an example of the cumulation of the process, i.e., how outdoor recreation planning efforts may be able to result in specific action.

3.1. Identifying the Problem

The problem was identified over time, given the unique composition of physical features, ecological features, and social-cultural features that provided the context to consider climate resilience in Duluth across multiple sectors. For example, a destructive mega-storm in 2012 [68] spurred a more in-depth consideration of climate resilience in Duluth across many sectors, not least outdoor recreation. Another example of this growing climate concern was the growth of the Twin Ports Climate Conversations (TPCC), a Duluth area monthly presentation and discussion on a wide variety of climate change-oriented topics [69]. Given the growing importance of outdoor recreation to the area economy [70] in sync with the growth in climate change awareness [49], a specific focus on climate resilience relative to outdoor recreational resources was deemed as an important focus by Sea Grant Extension Educators in collaboration with numerous actors in the community, not least University of Minnesota professionals, Minnesota state climatology professionals, and outdoor recreation leaders. It was hoped that climate resilience emphasizing outdoor recreation could serve as a positive, unifying direction for the community [71].
3.2. Outreach to Community

The noted community awareness of the need for climate resilience (community discussions at the Twin Ports Climate Conversations [69]) led to outreach from Sea Grant to various community sectors including outdoor recreation. Informal outreach to outdoor recreation professionals (from COGGS, the University of Minnesota Duluth Outdoor Program, the Minnesota Land Trust, and the City of Duluth) was conducted to ascertain whether professionals felt that additional focus and training in climate resilience was needed or would be embraced. Expressed interest among members of the outdoor recreation community consulted was used to motivate on-going outreach to NOAA during spring–summer 2017.

3.3. Outreach to NOAA

The 2017 National Adaptation Forum (NAF) was held in St. Paul, Minnesota and offered Sea Grant extension educators an opportunity to interact with NOAA outreach professionals on the topic of bringing the NOAA program, Climate Adaptation for Coastal Communities, to Duluth. The education arm of NOAA works to connect learning and teaching resources throughout the United States in an effort to meet community needs regarding ocean and atmosphere science education [72]. From initial contacts at the NAF, the discussion focused on workshop development continued; these discussions eventually expanded to include the idea of an outdoor recreation focus, and a target audience of outdoor recreation professionals. Workshop coordinators from NOAA shared their experiences of use of the workshop model with Sea Grant. Discussions with NOAA provided an overview of how the training had been previously adapted to specific groups (curriculum adjustments based on geography or profession). NOAA trainers communicated an expressed interest, openness, and previous experience with adjusting the base curriculum to meet particular needs of Duluth. Based on interactions between Sea Grant and NOAA, a Climate Adaptation for Coastal Communities workshop oriented toward outdoor recreational professionals in the Duluth area was planned.

3.4. Climate Adaptation Workshop

Fifty participants attended The Climate Adaptation for Coastal Communities workshop held on 25–26 October 2017. As noted, the general NOAA workshop plan, Climate Adaptation for Coastal Communities was followed with adjustments designed to make the content and process appropriate for the place and audience. Participants represented a broad cross-section of community organizations and professional roles in local/regional outdoor recreation including public parks and recreation professionals, state park recreational professionals, outdoor recreation private sector professionals, youth development professionals, Tribal professionals, community non-profit outdoor recreation representatives, and higher education professionals. In addition to leadership from NOAA, the workshop featured local and regional speakers on a broad range of topics related to climate change and outdoor recreation, including:

- Northeast Minnesota Climate Trends—Minnesota State Climatology Office (Minnesota Department of Natural Resources);
- Climate Change and Public Health—Sea Grant;
- North Shore Climate Readiness Research—University of Minnesota Center for Changing Landscapes;
- Adaptation in Action—City of Duluth Parks and Recreation Department;
- Land Preservation/Conservation in Duluth—Minnesota Land Trust.

The workshop was planned to integrate the sharing of high-quality information, to facilitate discussion of local problems and concerns, to provide tools for addressing climate adaptation, and for presentation of structured support for climate adaptation action. The workshop was designed to be interactive and participatory, and included a range of activity from localizing the idea of climate...
adaptation to climate adaptation implementation planning (see Table 3 and Appendix A). An example of one of the activities is provided in Figure 1. The activity, Identifying community outdoor recreational assets, provides data for this analysis, and the figure provides an example of the data. This activity was part of the effort to move participants along the noted Look-Think-Act action research progression [64]. This research progression is evident in the overall workshop agenda as well, early activities and presentations were planned to help develop a greater awareness of regional climate change and climate change impacts. The second stage of workshop activities attempted to help participants identify and consider potential impacts of particular interest or importance to their role as an outdoor recreation professional. Finally, the last stage of the workshop helped participants consider how to take the information and the identification of priorities and create a climate adaptation action plan.

Table 3. Workshop outline and basic outcomes.

| Workshop Topic                        | Brief Description of Workshop Activity, with Workshop Outcomes Italicized                                                                 |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| Localizing adaptation.                | Establishing a local focus to climate adaptation:                                                                                     |
|                                       | 1. Rationale for the consideration of outdoor recreation as critical to climate resilience in the community.                            |
|                                       |   • Workshop outcome: Participation identification of the relationship between outdoor recreation and climate adaptation in Duluth.    |
|                                       | 2. Local examples (applied throughout workshop).                                                                                       |
|                                       |   • Workshop outcome: Numerous local examples included in NOAA workshop curriculum.                                                    |
|                                       | 3. Local experts to guide the planning (case studies presented throughout workshop).                                                 |
|                                       |   • Workshop outcome: Presentation of five local aspects of outdoor recreation and climate adaptation.                                   |
| Planning framework introduction.      | Planning framework approach introduced designed to guide participants through an active process of identifying assets, conducting vulnerability assessments, and preparing plans to protect assets. |
| Identifying community outdoor         | Characterization and identification of community outdoor recreation assets of importance to climate resilience.                            |
| recreational assets.                 |   • Workshop outcome: 50+ sites identified as assets of importance to climate resilience.                                                |
| Stakeholder engagement.              | Identification of relevant stakeholders to address the climate resilience and outdoor recreation challenge.                              |
|                                       |   • Workshop outcome: 25+ stakeholders identified (beyond participants as assumed stakeholders).                                        |
| Vulnerability assessments of identified assets. | Identifying the basic components of vulnerability, the range of assessment types, and the function of assessments to support the planning process. |   • Workshop outcome: Six community vulnerability assessments completed for specific assets. |
| Climate adaptation implementation     | Application of planning process to protect local assets. Process includes prioritizing action, developing an implementation plan, and making commitments for implementation progress. |
| planning in order to protect assets.  |   • Workshop outcome: All participants completed “Intention at Act” commitments (42 total).                                             |
3.5. Workshop Follow-Up

One activity from the NOAA Climate Adaptation for Coastal Communities workshop was an exercise encouraging participants to consider follow-up actions and intentions (Intention to Act exercise). Specifically, actions in the context of their outdoor recreation profession that participants would be willing to take over the course of the year following workshop completion. Simply stated, participants identified actions along a timeline consisting of writing down intentions for action “Tomorrow”, “1 month from now”, and “6–12 months from now.” The idea behind this exercise was to encourage participants to consider how the workshop experience may be able to support climate action over the immediate future. Further, the activity helped participants to clarify the question of operationalizing climate adaptation, i.e., what climate adaptation means in actionable terms relative to specific professional settings. Beyond this exercise, a series of emails were sent to participants to encourage follow-through over the six months following the workshop. The emails were meant to provide a friendly reminder of the workshop and a nudge to promote reflection upon stated professional intentions. In response, many participants reported reflections, project questions, and requests for support. Specifically, examples of follow-up interactions included requests for grant funding support, requests for climate information sharing, consideration of storm-surge beach protection, a discussion of ice-farming for an ice climbing site in Duluth, and review of high-efficiency snow grooming machinery testing. Sea Grant provided follow-up consultation on six Intention to Act identified projects. The next section will detail one of these follow-up efforts.

Resilience Checklist

One post-workshop project originating from professionals with the City of Duluth Parks and Recreation Department was the idea of a resilience checklist, a potential planning tool to assist city recreation planners in considering, discussing, and assessing how to integrate climate resilience into the park planning process. The hope was to create a document that would guide and support without adding unnecessary burden to the planning process. The intention was not to create another official step in a decision-making process (mandate or requirement) that might involve city government officials, but rather a tool that would help planners to consider climate resilience and have climate conversations during early stages of project development.

The checklist was designed during the year following the workshop through a process that involved consultation with a small group of workshop participants who volunteered to be a part of an ad hoc checklist committee. The checklist development consisted of a review of similar tools from other projects/communities (for example, [73–75]), committee communication, and on-going review by Sea Grant and Duluth Parks and Recreation professionals. The process was managed by Sea Grant, while ultimately directed by the stated needs of the city parks and recreation professionals involved with park planning. One key motivation behind checklist development was the challenge the committee had in identifying an existing checklist that could be applied in Duluth. While guidelines and support documents were found, an outdoor recreation specific applicable tool to meet the planning needs in Duluth was not identified. This gap motivated the development of the tool presented with these results. A brief overview of the full checklist found in Appendix B is provided in Table 4.
Table 4. Resilience checklist overview (items from the full checklist, Appendix B, briefly described).

| Checklist Item: Overview of Checklist Items * | Description |
|-----------------------------------------------|-------------|
| Climate resilience definition.               | Definition provided: The capacity of park and/or trail infrastructure to absorb or withstand climate and severe weather disturbances and other related stressors such that the park and/or trail is capable of maintaining structure and/or function while adapting to change. |
| Project information to provide background and response guidance. | Project, location, and needs Response options—a basic key is provided to allow for details and efficient information sharing. |
| Resilience element: Stormwater Adaptation items. | Items to prompt information about actions designed to manage stormwater flow, infiltration, or retention. For example, measures to slow, reduce, or divert stormwater movement. |
| Resilience element: Environmental Adaptation items. | Items to prompt information about ecosystem health actions with an emphasis on vegetation/wildlife. For example, measures to replace species at risk (e.g., ash species), to address new species (e.g., deer ticks), or to safeguard priority species (e.g., browse control). |
| Resilience element: Economic Resilience items. | Items to prompt information about actions addressing how project work may serve city economic responsibility. For example, identifying how measures may be able to cut costs or raise revenue. |
| Resilience element: Social-Cultural Adaptation items. | Items to prompt information about actions addressing human nature experience including access to nature and recreation (geographic measures), equity (better serving the underserved), community building (place identity), or safety (risk management for recreational experiences). |
| Resilience element: Climate Mitigation items | Items to prompt information about actions designed to reduce contribution to greenhouse gas emissions. For example, new design or planned construction and/or planned retrofit of existing structures efforts to improve energy efficiency or carbon uptake. |

* Note: Full checklist is available in Appendix B.

Field testing of the draft checklist on two Duluth Parks and Recreation projects was undertaken during the autumn of 2018. Specific outcomes from the field testing of the checklist on one project is highlighted in Table 5 to provide a sense of its value in on-going park planning (reminder, the full checklist outline is available in Appendix B).
### Table 5. Outcomes from resilience checklist field testing on one city park project.

| Project: Restoration of a Miller Creek Riparian Corridor in a Section of City Park |
|---|
| Basic Description: The park area has experienced continual flooding and has aging park/recreation infrastructure in need of repair. |
| Resilience measure identified for project inclusion from checklist (by checklist category): |
| Stormwater Adaptation:  |
| • Green infrastructure to reduce erosion;  |
| • New impervious surfaces will drain to stormwater bioswales and/or infiltration ponds;  |
| • Infiltration ponds will be designed to retain stormwater and discharge at predevelopment rates. |
| Environmental Adaptation:  |
| • A planting plan will include native trees, shrubs, and perennials as part of the site restoration efforts;  |
| • Miller Creek is designated as an impaired trout stream. All new stormwater will be treated for water quality and temperature before outlet to the creek. |
| Economic Resilience:  |
| • As part of a larger network of projects along the St. Louis River corridor, this project will achieve the City’s economic and development goals to increase recreational park, enhance neighborhood quality of life, engage tourism, and attract new visitors to the area;  |
| • New design elements will all strive to be low maintenance costs;  |
| • Best practices will be used for longevity of building, walls, and pavement materials. |
| Social-Cultural Adaptation:  |
| • As part of a larger network of projects along the St. Louis River corridor, this project will achieve the City’s economic and development goals to increase recreational park, enhance neighborhood quality of life, engage tourism, and attract new visitors to the area;  |
| • Design decisions for removal of large retaining wall took into consideration risk management and long term maintenance costs;  |
| • There will be opportunity to educate visitors on the historic significance of the park as well as the resiliency of Miller Creek. |
| Climate Mitigation: No actions identified. |

Based on feedback from the trial and further discussion by Duluth Park and Recreation staff and Sea Grant (January 2019), the checklist was deemed effective. Continued use by Duluth Parks and Recreation was planned.

#### 3.6. Synthesis

This final section of the research process comprised of pulling together all of the previous elements to consider the overall effort. Response to participants post-workshop questions, community climate resilience discussions, and consideration of on-going climate change impacts on the community are intertwined in the reflection. This article is an attempt to synthesize the entire process and provide documentation of this final step in the research process.

#### 4. Discussion and Conclusions

This paper has provided an overview of a process designed to support engaging the professional outdoor recreation sector of one community in climate resilience. The process initially involved the defining of climate resilience in the Duluth context and identification of climate resilience concerns for the community of Duluth. The second phase involved interpretation and explanation of the Duluth context and preparations for action. In the third phase, an effort was made to address issues and problems, and to design and implement initiatives to support community climate resilience. One specific and tangible outcome, an example of a community climate resilience action, the resilience checklist, was presented. The checklist captured the essence of the question of what role outdoor recreation may be able to play in community resilience. Reflection and synthesis of the process highlights two critical points; one, the design of outdoor recreation infrastructure may be able to both
support specific resilience from current and future disruption while simultaneously improving the current lives of residents and visitors to Duluth, and secondly, such efforts may be able to help outdoor recreational professionals better understand that they have an essential role to play in climate resilience. Specifically, that role includes the development of awareness by outdoor recreation professionals to think about their work in the context of climate change and to consider how their work may be able to support climate resilience efforts.

The example of outdoor recreation as part of climate resilience is a reminder that community-based climate change adaptation is unique. Such approaches are based on local knowledge, bring together different sectors, and emphasize community participation [25]. Community-based climate adaptation is described by McNamara and Buggy, as the need to recognize adaptation as a social process that factors in the unique characteristics of a community [25]. The project presented in this paper is an example of just such a unique approach. Beyond outdoor recreation, this example from Duluth can provide a general roadmap for other communities considering climate adaptation action. Three critical elements from the Duluth process can be used to support other communities:

1. Localize climate adaptation: Identify a local climate resilience focus or sector of community need, interest, and importance;
2. Mobilize the community: Invite a broad base of community stakeholders from the identified focus or sector together to explore climate adaptation from their unique professional perspective;
3. Systematize the process: Use a deliberate progression of activity to develop the specifics of the implementation of community-based climate adaptation planning. For example, the NOAA workshop template used in this project provided a deliberate process.

4.1. Experiencing Climate Disruption

On October 27, the day after the Climate Adaptation for Coastal Communities workshop, a strong storm hit the Western Lake Superior region [76]. The combination of a high lake level, sustained high winds, and heavy precipitation resulted in significant damage throughout the region. Numerous Duluth area outdoor recreation sites suffered extensive damage, most significantly the Lakewalk and Kitchi Gammi Park (sites that had been reviewed the day before in a vulnerability assessment activity of the workshop). One year later, in October of 2018, another similarly intense storm hit the region and again, parts the City of Duluth suffered significant damage, physical damage that translated into a substantial economic loss. The two storms resulted in over 20 million USD worth of damage to the city of Duluth infrastructure, with much of the damage suffered at outdoor recreation sites [77,78]. These storm impacts highlight the need for an urgent response to climate change. While one cannot attribute these storms solely to the climate change trends, the current increased precipitation of 15% (above the historical record) translates to an additional four inches of rain falling on Lake Superior per year [79]. Historic high water levels coupled with powerful storm systems create one of many resilience problems for the city of Duluth—now and into the future. These storms provide a harsh example of what climate disruption looks like along the shores of Western Lake Superior. Given conversations at the TPCC and email discussion among workshop participants, the storms seem to also have provided a reminder of the importance of community preparedness in the form of climate resilience.

Earlier in the paper, a quote was used to underscore the value of the Duluth Lakewalk and the access it provides to Lake Superior; specifically, a city of Duluth official emphasized that access to Lake Superior is a significant reason why people live and visit Duluth [13]. This sentiment and the context of storm destruction is useful in synthesizing this project. Outdoor recreation and the access it provides to nature-based outdoor experience is critically important to the people who live and visit Duluth, and outdoor recreation has a role to play in community climate resilience. The role is two-fold, both planning for future disruption based on the climate projections while simultaneously making the city the best it can be for current residents and visitors.
4.2. Designing Climate Resilience

Outdoor recreation projects throughout Duluth are underway that capture public concern for climate change and an investment in climate resilience. Examples of this climate resilience trend include efforts by the Duluth Climber’s Coalition (DCC). The DCC was recently awarded a 10,000 USD grant for the Quarry Park Ice Farm construction [80]. The project was designed to provide a source of water to supplement natural ice formation while also ensuring reliable ice for climbing as naturally occurring ice is negatively impacted by the changing climate. This effort was one of many potential projects discussed and considered by participants at the NOAA Climate Adaptation for Coastal Communities workshop. Or, consider a recently completed trail section of the Duluth Grand Traverse multiuse trail; the section was designed to connect a forest trail with a traffic crossing. The section was intended not only for a trail to facilitate bikers through this new section but was designed to include a bioswale. A bioswale is a landscape element that is designed to maximize the length of time stormwater runoff is held to absorb low flows or slow heavy flows. Further bioswales provide a first infiltration of potential pollutants from stormwater runoff [81]. This bioswale example from Duluth is a reminder that the literature and practice of multifunctional green infrastructure is an essential direction for further consideration of the role of outdoor recreation to serve climate resilience. Multifunctional green infrastructure considers the ability of green spaces to simultaneously provide multiple benefits [27]. Benefits including stormwater management, flood control, pollination, temperature regulation, and not least, outdoor recreation. Innovative methods can enhance the understanding of outdoor recreation in cities like Duluth as part of a multifunctional green infrastructure [29]. Cities like Duluth can integrate cultural functions (such as outdoor recreation) along with ecologic function (such as support for biodiversity) as well as other functions (such as stormwater management) in the design and implementation of green infrastructure [26]. Application of multifunctional green infrastructure may not only serve to enhance places like Duluth in the present, but provide a glimpse of what “bouncing forward” in response to climate change looks like [5], i.e., an urban area with outstanding access to nature and support for environmental quality intertwined with resilience to current and future climate disruption.

4.3. An Important Role for Outdoor Recreation

Another important outcome of this project is the outline it provides to guide other communities. Outdoor recreation is an essential element in Duluth, not least based upon community identity and economy, and it provided an important arena in which to consider community climate resilience needs. This paper has documented a process based upon growing community awareness of climate resilience needs and how that awareness, via a deliberate process, resulted in specific action. It is hoped that given the broad-based participation in this process by the outdoor recreation community, the connection between climate resilience and outdoor recreation in Duluth is firmly established. And beyond Duluth, it is hoped that this paper may serve to inspire other communities to identify an appropriate sector for which to localize the efforts toward climate resilience. Climate resilience is best considered on regional or local levels [10,25,50]; it is up to each community to find the unique elements of their own path toward creating awareness and taking action. It is hoped that other communities may be able to learn from this effort and initiate a process to consider how different community sectors may be able to support local climate resilience.

In addition to the noted general support for outdoor recreation to serve climate resilience, a specific tool, the resilience checklist, has been developed and applied; the tool may also be able to be adapted for use in other communities (Appendix B and Table 4). The tool addresses a gap in the urban recreation and climate adaptation planning arena and may be able to inspire how parkland planners can integrate climate adaptation into their efforts early in the process. The resiliency checklist has a goal of both supporting specific projects, while also encouraging innovation and creative thinking about the role outdoor recreation plays in community climate adaptation in general. It should also be underscored that the resilience checklist provides an example of a “no regrets” approach [10]. It is
an outdoor recreation planning approach that helps the community to prepare for climate projections while simultaneously improving life for current community residents.

Beyond the specifics of the single community/outdoor recreation focus of this paper, the broader idea that outdoor recreation has a vital role to play may be able to be generalized. As Ewert [14] noted in his pioneering article exploring the topic of climate change and outdoor recreation, outdoor recreation may never achieve the level of importance that the effects it has upon other sectors, such as agriculture, energy, or transportation. Nonetheless, Ewert argued: “… examining the effects of global climate change on outdoor recreation does offer another picture of how society will adjust and deal with a resource that requires an interaction between the human being and the natural environment” (p. 375) [14]. This perspective was true in 1991 and remains true today. As was shown in this study, outdoor recreation can be an important sector to support meaningful climate resilience and further, may be able to help community stakeholders better understand a changing climate and human response to that change.

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**Appendix A Adaptation Planning for Coastal Communities Workshop Schedule**

**ADAPTATION PLANNING FOR COASTAL COMMUNITIES**

**GREAT LAKES AQUARIUM, DULUTH, MN OCTOBER 25–26, 2017**

| DAY 1—OCTOBER 25, 2017 |
|------------------------|
| **9:00** | Welcome from the Mayor, Emily Larson |
| **9:15** | Introductions and Overview of Training |
| **9:50** | Discussion: Incorporating Adaptation Locally |
| **10:00** | Introduction to the Planning Framework |
| **9:00** | Break |
| **10:30** | Activity: Identifying Community Assets |
| **11:15** | Discussion: What Changes Have You Seen? |
| **11:25** | Local Climate Trends and Projections |
| **12:10** | Lunch |
| **1:10** | Activity: Stakeholder Engagement |
| **1:10** | The Intersection between Outdoor Recreation, Climate Change and Public Health |

_Thomas Beery, University of Minnesota Sea Grant_
1:30 Activity: Characterizing an Asset
Participants identify and describe an asset of interest to focus on during the training.

1:45 Managing Uncertainties
Participants hear about the role uncertainty can play in adaptation planning, and approaches in moving beyond the challenges of making decisions in light of unknowns.

2:00 Break

2:15 Introduction to Vulnerability Assessments
Participants learn the basic components of vulnerability, the range of assessment types, and how assessments support the planning process.

2:45 Case Study: North Shore Climate Readiness
Mae Davenport, University of Minnesota, Department of Forest Resources

3:00 Break

3:15 Introduction to Vulnerability Assessments
Participants learn the basic components of vulnerability, the range of assessment types, and how assessments support the planning process.

3:30 Designing an Assessment – Scoping and Collecting
Participants will learn a process for developing and conducting a vulnerability assessment.

4:00 Activity: Scoping a Vulnerability Assessment
Participants scope a plan for conducting an assessment for a specific asset.

4:30 Activity: My Follow-up Actions
Participants capture ideas for how they will apply what they are learning after the training.

5:00 Wrap-up for the day

DAY 2–OCTOBER 26, 2017

9:00 Recap of Day 1, Review Agenda Day 2

9:15 Assessing Vulnerability
Participants learn about different sources of vulnerability for assets across sectors.

9:45 Activity: Conducting a Qualitative Assessment
Participants gain experience working through a vulnerability assessment in a collaborative setting.

10:30 Applying Assessment Findings
Participants learn about the importance and challenges in communicating assessment results, and how to use assessment information to begin considering adaptation actions.

10:45 Break

11:00 Activity: Writing a Climate Issue Statement
Participants describe the potential consequences of climate change for a specific asset.

11:20 Case Study: Adaptation in Action
Lisa Luokkala, City of Duluth Park and Recreation

11:40 Adaptation Strategies and Actions by Sector
Participants gain knowledge of a variety of adaptation strategies used by coastal communities.

12:30 Lunch

1:15 Activity: Identifying and Characterizing Options
Participants identify different adaptation strategies and describe various factors that contribute to their feasibility.

2:15 Tools and Techniques for Prioritization
Participants hear examples of methods used for analyzing and prioritizing adaptation actions.

2:40 Case Study: Securing Duluth’s Highlands
Daryl Peterson, Minnesota Land Trust

3:00 Break

3:15 Activity: Prioritizing Actions
Participants assess and prioritize their list of actions developed in an earlier activity.

3:30 Implementation–Executing your plan
Participants are prepared to develop an implementation plan for their prioritized strategy.

3:45 Activity: Drafting an Implementation Plan
Participants develop an implementation plan for an adaptation strategy.

4:30 Moving Forward with Adaptation
Participants work on their “My Follow-up Actions” and share commitments for applying what they’ve learned with the training group.

4:45 Training Evaluations

5:00 Adjourn
Appendix B Duluth Park and Recreation Resilience Checklist

### Stormwater Adaptation (SWA)
Any action designed to manage stormwater flow, infiltration, or retention. For example, measures to slow, reduce, or divert stormwater movement. Note relevant measures or design standards if appropriate, e.g., FEMA flood hazard area classifications in details.

| Action | Yes | No | NA | Details |
|--------|-----|----|----|---------|
| Reduces water consumption |       |    |    |         |
| Reduces Erosion |       |    |    |         |
| Improves water infiltration |       |    |    |         |
| Improves water retention |       |    |    |         |
| Provides other flood protection |       |    |    |         |
| Other: |       |    |    |         |

### Environmental Adaptation (EA)
Addressing how a changing climate impacts ecosystem health with an emphasis on vegetation/wildlife. For example, measures to replace species at risk (e.g., ash species) to address new species (e.g., deer ticks), or to safeguard priority species (e.g., browse control). Note relevant measures or specific species if appropriate in details.

| Action | Yes | No | NA | Details |
|--------|-----|----|----|---------|
| Addresses terrestrial vegetation change |       |    |    |         |
| Addresses aquatic vegetation change |       |    |    |         |
| Improves habitat for terrestrial wildlife |       |    |    |         |
| Improves habitat for aquatic wildlife |       |    |    |         |
| Addresses terrestrial invasive species |       |    |    |         |
| Addresses aquatic invasive species |       |    |    |         |
| Improves night sky compliance |       |    |    |         |
| Other: |       |    |    |         |

### Economic Resilience (ER)
Addressing how park and recreation work may ease city economic responsibilities. For example, identifying how measures may be able to cut costs or raise revenue. Please note specifics in details.

| Action | Yes | No | NA | Details |
|--------|-----|----|----|---------|
| Provides economic opportunity |       |    |    |         |
| Decreases maintenance costs |       |    |    |         |
| Decreases LiDAR costs |       |    |    |         |
| Other: |       |    |    |         |

### Social-Cultural Adaptation (SCA)
Addressing better residents experience including access to nature and recreation (geographic measures), equity (better serving the underserved, community building place identity) or safety (risk management for exceptional experiences). Please note specifics in details.

| Action | Yes | No | NA | Details |
|--------|-----|----|----|---------|
| Increases recreational access |       |    |    |         |
| Increases mobility access |       |    |    |         |
| Increases recreational equity |       |    |    |         |
| Increases LiDAR place identity |       |    |    |         |
| Risk management considered |       |    |    |         |
| Resilience education opportunity |       |    |    |         |
| Resilience education |       |    |    |         |
| Other: |       |    |    |         |

### Climate Mitigation (CM)
Any effort designed to reduce contribution to greenhouse gas emissions. For example, new design or planning construction and/or planned retrofit of existing structures efforts to improve energy efficiency or carbon uptake. Please note specifics in details.

| Action | Yes | No | NA | Details |
|--------|-----|----|----|---------|
| Reduces CO2 emissions |       |    |    |         |
| Increases use of renewable energy sources |       |    |    |         |
| Increases CO2 sequestration |       |    |    |         |
| Other: |       |    |    |         |

### Resilience indicators not captured in the checklist:

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