

Article

Advancing Park Climate Planning Through Scaled Inquiry on Regional and Park-Based Ecosystem Services and Place Attachment

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Abstract: Parks near urban areas provide important opportunities for locals to connect with nature and enjoy outdoor leisure. Climate change planning needs in these parks are pronounced, especially given the large local populations they serve. Ecosystem services, particularly cultural ecosystem services, can frame people's perceived benefits from these park systems and the larger region. Place attachment on park system and regional scales can differentiate the extent of perceived benefits by the strength of park and regional connection. Together, these can highlight priorities for climate action and communication. The Huron-Clinton Metroparks in densely populated southeast Michigan (US) exemplify an important urban-proximate park system grappling with climate change effects within the parks and across the region. We assisted the Metroparks in creating their Climate Action Plan, including surveying regional residents' and Metroparks recreationists' (n = 4069). Here, we examine associations between respondents' prioritized ecosystem services and levels of place attachment to southeast Michigan and the Metroparks. Results show that on both geographic scales of the park system and region, the three most valued cultural ecosystem services were leisure time spent outdoors, appreciation of beauty, and physical/mental health benefits. However, place attachment level (ambivalent, moderate, or strong) on both scales surfaced ecosystem services prioritization differences and a potentially enhanced role of cultural ecosystem services related to relationships—cultural heritage, social capital, and spirituality—within the Metroparks and with the strong place attached. We discuss these patterns and their connections to the park system and regional climate action planning and communication.



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1. Introduction

Creating climate action plans requires a scaled perspective: proposing actions within a managerial entity's control and understanding the broader context to which these actions contribute, such as a region. In this work, we examine outdoor recreationists' perceived benefits from outdoor recreation settings (i.e., ecosystem services) contributing to positive outdoor recreation experiences within a park system and across its larger region, and how these benefits interact with levels of attachment to that park system and larger region. This allows us to identify areas of discussion for framing park-based climate actions that complement and extend residents' and recreationists' most noted benefits to retain in the social-ecological system.

The consequences of climate change are affecting humans, including through the ecosystem services we receive from nature in our regional and global habitats [1]. As a global phenomenon, climate change is causing rising sea levels from glacial melt, inconsistent rainfall, increased water temperature, and changes in weather patterns [2,3]. As a regional manifestation, different areas are experiencing variations, so that "abnormal" conditions are increasingly "normal", and extreme weather events are occurring with

greater frequency [4]. In park systems, climate change is having pronounced effects across natural resources [5] (though often without correspondingly specific plans [6]), cultural resources [7], and visitation trends [8]. When an ecosystem is robust, humans may receive many benefits, such as clean air and water, food, spiritual connection, and inspiration. With climate change shifting our weather patterns, the services we receive could alter.

Shifting climate patterns in the U.S. are expected to continue patterns of increased—though variable—park visitation, as people look for places to go to escape the effects of climate change, experience these effects to a lesser extent (e.g., reprieve from heatwaves), and receive the ecosystem services nature offers [9,10]. In southeast Michigan, where more than half of Michiganders reside and multiple large industries and urban areas are found, climate planning is underway [11]. In plans addressing aspects of climate adaptation and mitigation, management actions are focused on where each planning entity has control but speaks to other planning efforts through regional initiatives and collaborative efforts (e.g., stormwater management) [11]. The Huron-Clinton Metropolitan Authority, which manages 14 Metroparks in the area, desired to also be part of this conversation and action. These parks are places where locals and visitors have strong attachments to experiences and memories and where intact ecosystem functions may take on an important role in climate mitigation [12,13]. They offer numerous outdoor recreation activities on land and water and across a spectrum of development, from natural areas to managed golf courses and aquatic centers [12]. They also support four-season recreation, offering places for individualized recreation pursuits, physical activity and mental reprieve, and the creation of memories and attachments to the local community, family, and friends. In this way, the parks support multiple ecosystem services.

Ecosystem services are the benefits that nature, particularly in robust and intact form, provides us [1,14]. They are a means to identify and understand social-ecological systems, such as regions and outdoor recreation areas (e.g., [15,16]). These benefits come in four main areas: regulating, supporting, provisioning, and cultural ecosystem services. Regulating services are natural processes that function to moderate or control ecosystem conditions, including climate regulation, water runoff channeling/absorption, and air quality. Supporting services are those necessary for the basic functioning of ecosystems and enable the existence of other services, such as soil formation, nutrient cycling, and habitat provisioning. Provisioning services are tangible goods harvested from ecosystems, such as food, fiber, and fuel that we can retrieve or grow from the land. Cultural services are the intangible benefits people receive from ecosystems, such as aesthetic appreciation, recreation, connection to other places and ways of life, and spiritual enrichment.

The current and expected ecosystem shifts with climate changes on the macro and site-specific levels influence the availability and quality of these services where we work, live, and play [1]. Regulating services have been pulled out of sync by the increase in carbon emissions from human causes such as buildings, transportation, and the energy sector [2]. Supporting services have been altered due to a change in the balance of carbon and nitrogen within soils [1]. An extended growing season due to climate change in parts of the world has resulted in more agricultural production of food, while the changes in water supply due to increased drought have decreased crop yield in other areas [1]. An integrated example may demonstrate the climate-induced ripple effects across these three broad categories of services. Hotter days with less rain can alter the plants and animals that are able to inhabit an area [3]. One potential outcome of this change in weather is the potential for new invasive species, like bark beetles in the western U.S., to thrive in these new areas as their range expands. This results in tree loss as the local biota is decimated because of a lack of defenses to fend off the new bark beetles [1,17]. Tree loss also means less carbon dioxide being removed from the air through carbon sequestration and changes to the water cycling process (e.g., reduced filtration and absorption of rainwater) [18]. The loss of trees after extreme events such as fire due to climate change can also create soils that are more easily washed from rainstorms due to the lack of roots holding soil in place. This creates increased sediment in waterways reducing water quality [19]. Along with this, the

United Nations Educational, Scientific and Cultural Organization has identified climate change and the stressors that come with it (air pollution, sea level rise, storm surges, etc.) as threats to cultural heritage sites [20], therefore threatening the cultural ecosystem services such sites offer.

The fourth set of services, cultural ecosystem services, can vary widely and can form and inform our connections to place [21–24]. Cultural ecosystem services are increasingly examined with recreation (e.g., [16]), though the nexus between climate change and recreation is less studied [25–27]. Gould and Lincoln [28] undertook an extensive review of cultural ecosystem services and synthesized a list of 13 common benefits. This listing has informed further work and framings for analysis on identifying cultural ecosystem services across discrete locations and large geographies, such as in school forests associated with institutes of higher education in the U.S. [29]. These 13 benefits comprise:

- Aesthetics—appreciation of the ecosystem’s beauty;
- Artistic inspiration—inspiration from the ecosystem to create art;
- Bequest—the value of the ecosystem for future generations;
- Cultural diversity—a reflection of different ways of living and cultural practices;
- Cultural heritage—connections to traditional practices and ways of life;
- Education—opportunities for learning about the ecosystem and ecological practices;
- Existence—satisfying knowledge that a given ecosystem is preserved;
- Identity—one’s understanding of one’s self as it relates to the ecosystem;
- Knowledge systems—different ways of knowing, such as traditional ecological knowledge;
- Recreation—leisure time spent outdoors;
- Sense of place—a deep sense of connection to a given ecosystem or geographic area;
- Social capital—forming of social bonds as a result of the ecosystem;
- Spirituality—connections to forces larger than oneself.

An additional cultural ecosystem service of human health benefits (e.g., physical and mental) has been examined as well [30]. It is expected that individuals will experience these cultural benefits differently based on their own personal life experiences and the degree of connection they have to a specific location. The stronger the attachment and length of time in an area, the stronger they may feel about particular cultural ecosystem services [31]. With increasing studies showing ecosystem services in general, and cultural ones in particular, being good for our physical and mental health [25,30], understanding cultural services and the role they play in creating feelings of place attachment could help to preserve important areas in communities as climate change alters our ecosystems.

Place attachment is a measurement of connection to place [32,33]. There are three common dimensions of place attachment: place identity—the emotional response we have to a place; place dependence—our functional need for a place; and place bonding—social relationships we have formed facilitated by the place [25,32–34]. Other quantitative research has surfaced place affect (i.e., emotional connections) as a fourth dimension [35], though it has similarities with place bonding. Place attachment has been used in numerous studies to examine our responses to changing conditions in a place, from COVID-19 [36] to new protected areas [37] to destination loyalty [35]. In relation to changing environmental conditions, including climate change, place attachment has been examined as a factor in both why people return to certain outdoor recreation places and why they may have different levels of place fidelity (i.e., commitment to a location) even when conditions are altered [25,31]. In the face of climate change, levels of place attachment could become even more important as a motivator to mitigate climate change effects where people feel the strong connection within community settings (e.g., within a regional identity, within a park system) as place attachment is linked with pro-environmental behavior [38].

Climate change affects the place attachment of residents and park recreationists within regions. Those living in highly climate-affected areas must choose to either live in and adapt to these affected areas or move and potentially sever the bonds and identity forged by living there [31]. For example, Swapan and Sadeque [39] found that those who have

a strong place attachment, especially related to aspects of religion and social capital, are unlikely to leave areas highly climate change impacted. This strong place attachment also increases the probability that those affected by environmental change will return to a location that has been affected by a related event (e.g., wildfire, flood) and rebuild, restore, or assist those affected [31]. This trend holds for second homeowners in climate-influenced disaster areas as well, as their response (relocating after a disaster, returning, or returning and adapting) depends on the level of place attachment they have for their second home location, with those having the highest attachment always returning [40]. Researchers in these areas [31,39] implore that more research is needed to unravel the connection between place attachment, climate change, and human migration.

On the visitor side, climate is impacting choices of where, when, and if all to recreate [9, 25,41–43]. These choices can be influenced by how strong of a place attachment one has to a recreation experience. For example, Perry et al. [25] examined summer season visitors' responses to expected manifestations of climate change across the Vermont State Park system and segmented visitors based on lower or higher levels of attachment. They found that the concept of place attachment could be successfully transferred to a system of parks (beyond the usual one-site study of place attachment). They also found that those with higher levels of place attachment to the Vermont State Parks were more likely to endure changed conditions (i.e., higher daytime temperature, more biting insects, and more days above 90 F) to maintain site fidelity than those with lower place attachment. In other words, those with lower place attachment to Vermont State Parks were more sensitive and more likely to be displaced (spatially, temporally, activity-wise, or totally). However, other conditions were not influenced as strongly by place attachment (i.e., the number of rainy days per week and higher nighttime temperatures). These types of patterns are important to distill for in-system considerations of where to expect visitation and how to consider corresponding resource allocations (e.g., staffing, infrastructure developments).

As climate change continues altering our presently known and valued ecosystem services, place attachment could be correspondingly affected. The loss of certain ecosystem services like clean water could result in residents leaving that location to live where the valued ecosystem services still exist [31] and could reduce the appeal of locations for recreationists as well. For example, with clean water regulating ecosystem service, there could be a reduction in water-based recreation opportunities, diminishing an avenue of place attachment for recreationists. Smaller snowpacks can lower winter recreation in typically snow-covered destinations [43–45] and in general, increased droughts and dead trees from invasive species [17] can reduce the awe and appeal of scenic views from these locations, all of which are part of the provisioning, supporting, regulating, and cultural services the ecosystem provide. As these services are altered and are projected to continue being altered with climate change, there is the chance for mitigation of impacts through policy and behavioral change. One prominent example among these is coordinated climate action efforts among entities.

The Huron-Clinton Metropolitan Authority is an organization in southeast Michigan willing to engage in climate action [13]. This organization manages the Huron-Clinton Metroparks, a set of 14 parks (13 at the time of data collection) that span 25,000 acres across southeast Michigan. Within this expansive system are opportunities for many outdoor recreation activities, such as more than 400 miles of trails, 14 miles of shoreline, and 3600 acres of inland lakes; pools and splash pads, golf courses, mini golf, disc golf, horseback riding; and more. Annually, over 7 million visitors recreate in the Metroparks system [12]. Southeast Michigan is a region diverse in culture, race, ethnicity, and population size [46]. The region increased by 2.7% in population from 2010–2020 and is increasingly racially and ethnically diverse. For example, 35.7% of the population in 2020 identified as non-white, a 4.2% increase from 2010 [47]. Eight counties in the region (Wayne, Macomb, Oakland, Lapeer, St. Clair, Monroe, Genesee, and Washtenaw) are classified by the state of Michigan as urban, as they each have a city with more than 50,000 people or 100,000 people in a shared commuter community, and two counties (Livingston and

Lenawee) are classified as rural [47]. When compared to rural counties, urban counties have more people and infrastructure and fewer and smaller natural areas. Michigan is trying to combat the disparity in green space between rural and urban counties with the Southeast Michigan GREEN initiative, where their goal is to increase tree canopy in urban areas to at least 40%, with priority on areas that have 20% or less tree canopy cover [48]. Efforts like this mean that the Metroparks have the potential to play a large role in offering these urban areas green spaces and opportunities for outdoor recreation close to home for large populations. However, the park administrators are also aware of climate change and the potential impacts it could have on the activities they offer and the communities they border and serve.

Given the extent of their resources in the region and their meaning to recreationists, a climate action plan from the Metroparks would have the potential to impact the integrity of the region's ecosystem services and people's attachments to the region and the Metroparks specifically. With the Huron-Clinton Metroparks offering residents an opportunity to connect with nature that they might not otherwise have and being a treasured outdoor recreation space that many community members repeatedly visit, the parks' climate planning could incorporate valuations of park-based ecosystem services and place attachment by recreationists for identification of community-centered priorities. For efficiency of planning and to complement other regional efforts, similar valuations on the regional level might provide perspective on the unique services and attachments of the Metroparks in particular (or, if absent, then themes of resonance across jurisdictions in the region).

The Metroparks' staff correspondingly considered a multi-phasic creation of a climate action plan to help mitigate climate change effects on social-ecological systems including a suite of ecosystem services, maintain/enhance attachments to these services and the places they are found, and support climate actions already occurring across the southeast Michigan region [11]. A climate action plan is a "set of strategic goals to address climate impacts, implement policies, and reduce reliance on resources through practical solutions" [49]. The goal of such a plan is to mitigate climate impacts, reduce reliance on resources, and enact change climate policy to reduce the overall carbon footprint of an area [11]. Climate action plans are being incorporated into city and state comprehensive plans more frequently as a way for states to prepare for climate change impacts. Michigan State University faculty and student researchers (led by the first author of this work) worked with leadership at the Metroparks to define a program of research that would assist the Metroparks in creating a climate action plan. This two-year process included examining the contents of existing plans and efforts [11]; conducting a variety of data collections with residents, visitors, and staff; and analyzing perspectives and capacities to prioritize a final set of actions for inclusion in this initial plan. The climate action plan was approved in October 2023 and implemented beginning January 2024.

In this article, we address one nexus of interest within this larger project: the relationships between ecosystem services and place attachments on the regional and Metroparks' scales, and how this area assists in defining and communicating climate action within the Metroparks system. Addressing this nexus provides insights into conceptual linkages among these concepts and park manager and park climate planning audiences and areas of focus. To assess the different levels of importance ecosystem services play regionally and in parks at the Huron-Clinton Metroparks and how this might change with differing place attachment levels, we investigated the following:

- RQ1: How do residents and recreationists' perceived benefits of the region and the parks (i.e., ecosystem services) vary based on geographic scale?
- RQ2: How do residents and recreationists' place attachment to the region and the parks vary based on geographic scale?
- RQ3: How do residents and recreationists' perceived benefits of the region and the parks (i.e., ecosystem services) vary for these geographic scales based on place attachment?

2. Materials and Methods

2.1. Data Collection

An Internet-based survey was administered in winter 2022/2023 to two populations: a panel of southeast Michigan residents and those on the Metroparks' email listserv. The survey development and administration followed a series of focus groups and Metroparks staff engagements, to expand upon themes heard during these sessions with a larger population. The study was approved by the Michigan State University Human Research Protection Program (STUDY00007455) and all participants acknowledged informed consent as a prerequisite to access the questionnaire.

A panel sample of southeast Michigan residents was purchased through Qualtrics, a reputable survey software firm through which the survey was also administered. Purchasing this panel sample was an attempt to reach visitors of the Metroparks who may not be on the email list along with an attempt to reach residents of the region who may not be visitors of the Metroparks. For the five counties where the Metroparks are based, minimum quotas for responses from each were used ($n = 250$) along with an additional quota for respondents within zip codes of the city of Detroit ($n = 250$). Together, 271 zip codes were sampled. This allowed for county-level representation and acknowledgment of Detroit as the major city within the region. Quotas were also placed by Qualtrics on race, income, and gender independently, to maintain general parity between the demographic composition of the sample and the five-county region (based on the most recently available US Census or American Community Survey for the sampling frame). All questions were mandatory for a response within the survey. Qualtrics compensated panelists for completing a quality response (e.g., finished questionnaires, completion times not below a standard deviation of the mean, germane answers in open text fields, and zip codes within the sampling frame). The survey was administered from 27 December 2022–3 February 2023, ending when the minimum quotas were all reached. During this time, 1684 valid responses were received.

The Metroparks' email list consists of annual pass holders and those who have opted-in to periodic email communications from the Metroparks and totals approximately 80,000 active email addresses. The survey was announced to this email list and open from 3 January–10 February 2023, with one email reminder sent during these five weeks. In total, 2385 valid responses were received. The initial invitation to participate was an email that also contained Metroparks news and a New Year's greeting. All questions on the survey except for the first two (how often they have recreated outdoors in southeast Michigan and how often have they visited the Metroparks, if at all) were optional for response. No compensation was provided for completion.

The survey was identical between the two populations. In each, respondents were provided with initial definitions for the three following concepts as follows:

- Outdoor recreation setting means any location in southeast Michigan managed for protection and/or enjoyment of nature, where you might participate in outdoor activities for fun and leisure. Examples of these locations include your neighborhood open spaces, community gardens, recreational sports fields, water bodies, riverfronts, dog parks, and parks and forests.
- Southeast Michigan means the region encompassing Genesee, Lapeer, Lenawee, Livingston, Macomb, Monroe, Oakland, Saint Clair, Washtenaw, and Wayne counties.
- Huron-Clinton Metroparks means the 13 parks managed by the Huron-Clinton Metropolitan Authority: Delhi, Dexter-Huron, Hudson Mills, Huron Meadows, Indian Springs, Kensington, Lake Erie, Lake St. Clair, Lower Huron, Oakwoods, Stony Creek, Willow, and Wolcott Metroparks.

Using these definitions, respondents indicated how often they had visited an "outdoor recreation setting" and "the Huron-Clinton Metroparks" during the time they have spent in southeast Michigan in two separate questions with seven-point Likert scale response options of Never, Once a year, A few times a year, Once a month, A few times a month, Once a week, or A few times or more a week. These two scales—outdoor recreation settings

across southeast Michigan and in the Metroparks specifically—are nested and provide a geographic comparison for this work. Figure 1 details this sampling frame.

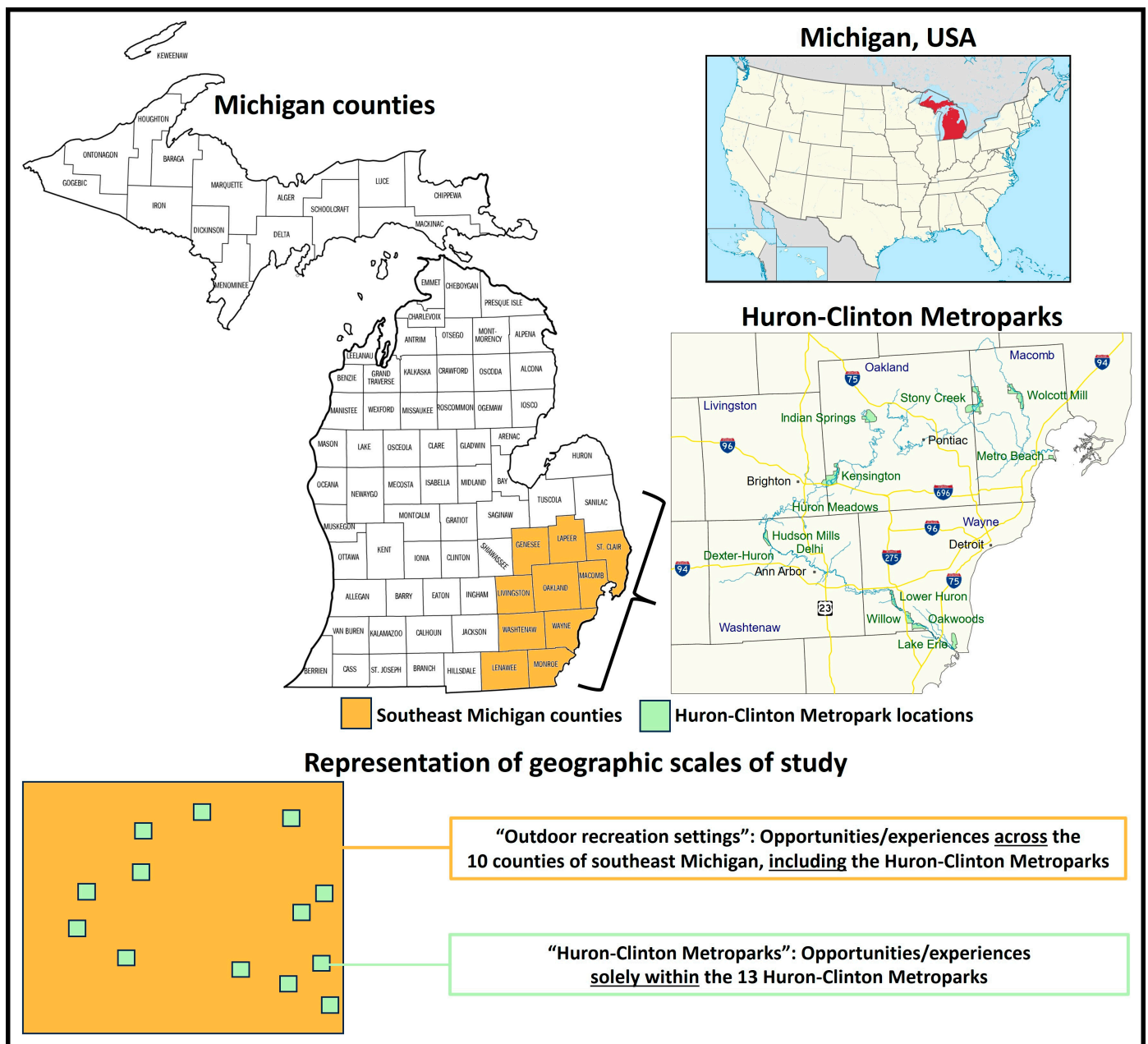


Figure 1. Study location and frame of the two nested geographic scales. The larger scale is southeast Michigan, a collection of 10 counties (shaded in orange), and outdoor recreation settings across this region. Within that larger geographic area and definition of outdoor recreation settings is the specific highlight of the opportunities and experiences within the Huron-Clinton Metroparks, a system of 13 park units within southeast Michigan.

Ecosystem services were presented with different response options across the scales. At both scales, provisioning, regulating, and supporting services were presented as single items for response, and cultural ecosystem services as an overarching category were presented as 14 discrete items (see listing in Introduction and Table 1). At the regional scale, respondents were asked: “Different aspects of recreation experiences may impact people’s enjoyment in various ways. Please consider your favorite recreation experiences in southeast Michigan and indicate how much, if at all, each of the following statements

positively contributed to those experiences for you.” Response options were a five-point Likert scale, from Strongly disagree (1) to Strongly agree (5). To provide Metroparks-specific information on the ecosystem services perceived as most important in these locations, we then asked respondents a rating question: “Of the aspects that contributed to your positive recreation experiences throughout southeast Michigan, which three are/were most important in contributing to your positive recreation experiences in the Huron-Clinton Metroparks in particular? (select up to three)”. Response options were truncated to the ecosystem services that respondents had selected as Somewhat agree (4) or Strongly agree (5) (i.e., a level of agreement) in the previous question on regional contributions. We opted for this format as the Metroparks are within the available recreation experiences of southeast Michigan and therefore a respondents’ response to regional contributions of each ecosystem service would already encompass the Metroparks. To not be duplicative and to highlight the ecosystem services contributing most to positive experiences in the Metroparks, the “top three” format was used for this more localized scale.

Table 1. Identification of ecosystem services’ importance to a positive experience in outdoor recreation settings in southeast Michigan and to the Huron-Clinton Metroparks specifically. Regional measures are means on a five-point Likert scale and park measures are percentage of respondents selecting a particular ecosystem service in their top three for positive contributions. Shading indicates the three cultural ecosystem services that appear (by ranking) to be higher valued within the Metroparks than across the region.

This Setting Contributed to My Positive Experience by Providing. . .		Southeast Michigan (M)	Huron-Clinton Metroparks (%)
Cultural Services	Leisure time spent outdoors	4.64	50.7
	An appreciation of beauty	4.51	43.8
	Physical/mental health benefits	4.44	44.1
	The satisfying knowledge that this setting is protected	4.36	27.9
	A sense of the conservation value for future generations	4.16	22.2
	A deep sense of connection to this setting/the geography it represents	4.13	7.4
	Opportunities for learning about this setting and/or its environmental processes	3.91	4.6
	General or other personal/cultural benefits	3.85	2.1
	Greater understanding of myself in relation to this setting	3.70	2.9
	Connection to traditional places/ways of life	3.65	7.8
	Social relationships I’ve formed as a result of this setting	3.63	7.4
	Connection to forces/spirituality larger than myself	3.57	6.6
	Different ways of knowing, such as traditional knowledge systems	3.43	0.9
	Reflection on different ways of living/different cultural practices	3.41	1.6
	Inspiration to create art	3.32	3.9
Benefits for humans and nature, such as clean water, food, wood, or fuel		4.09	6.2
Benefits supporting all life, such as nutrient cycling, soil formation, or habitat provision		4.02	6.7
Benefits for natural processes, such as climate or flood regulation or water purification		3.90	4.0

Place attachment was measured using an established set of items relating to both place identity and place dependence [32–34], which is commonly used in park and outdoor recreation research (e.g., [25,45,50–52]) and as these example references indicate, increasingly in climate investigations within this research area. The question batteries immediately followed those for ecosystem services and asked: “Thinking about these favorite experiences and others you may have had in the” with the first question stem finishing with “outdoor recreation settings of Southeast Michigan” and the second question stem finishing with “Huron-Clinton Metroparks specifically” to assess the two different levels. Responses were on a 5-point Likert scale, from Strongly disagree (1) to Strongly agree (5). Items are listed in Table 2.

Table 2. Place attachment to outdoor recreation settings across southeast Michigan and in the Huron-Clinton Metroparks specifically, with paired samples *t*-test values and significance ($p < 0.05$), with Cohen’s *d* effect size. Responses are means on a scale of Strongly disagree (1) to Strongly agree (5). Asterisks indicate reverse-coded items. Shading indicates significantly lower (lighter shade) or higher (darker shade) values.

Thinking About These Favorite Experiences and Others You May Have Had in [Location]. . .	Location		<i>t</i> (<i>df</i>)	<i>p</i>	<i>d</i>
	Southeast Michigan	Huron-Clinton Metroparks			
These settings mean a lot to me	4.39	4.33	4.468 (3296)	<0.001	0.666
These settings are very special to me	4.21	4.17	3.178 (3286)	<0.001	0.659
These settings are the best place for what I want to do	4.04	3.81	17.187 (3299)	<0.001	0.756
I can’t imagine a better place than these settings for what I like to do	4.01	3.75	17.465 (3307)	<0.001	0.826
The time I spend in these settings could just as easily be spent somewhere else *	3.06	3.06	−0.098 (3289)	0.461	
Many of my friends/family would be disappointed if I were to start visiting other settings rather than these settings	2.73	2.41	20.171 (3285)	<0.001	0.910
If I were to stop visiting these settings, I would lose contact with a number of friends/family	2.26	2.20	5.618 (3273)	<0.001	0.745

2.2. Data Analysis

In total, 4069 valid responses were received across the two surveyed populations. Of these, 3862 (94.9%) of the respondents had both recreated outdoors in southeast Michigan and had visited one or more Metropark (i.e., selected a response other than “Never” to the two questions on frequency of visitation listed above). Therefore, we use this sample size of 3862 for analyses of ecosystem services and place attachment to the region and the Metroparks, as these respondents were able to answer for both geographic scales based on participation/visitation.

The analysis took place using the IBM SPSS statistical software version 28. Descriptive and bivariate statistics (ANOVA for comparisons of three means, paired samples *t*-test for comparisons of two means, or chi-square for comparisons of percentages of responses, each with the corresponding posthoc tests of effect size) were assessed. Place attachment was used as a grouping variable. To do so, we conducted a reliability analysis for each of the scales, to ensure responses were consistent regarding the items used to measure our latent concepts by using Cronbach’s alpha reliability coefficients [53]. Following this, we used a K-means cluster analysis for qualifying place attachment items (four of the seven items, vetted and reduced through a reliability analysis) to group respondents (please see Section 3.2 in the Results of a comprehensive listing of place attachment items). Cluster analysis categorizes responses into distinct groups maximizing similarities within and differences between clusters and is often appropriate in market or customer segments (e.g., visitor types) [25,53–55]. This is completed by using multiple variables, so we can differentiate the clusters. Measuring distance from the center of one cluster to another, K-means clustering can determine the similarity or dissimilarity of variables [56]. The three-group cluster results for both the region and the parks yielded the most logical groupings with sufficient sample sizes in each group. These clusters centered on responses of the midpoint, medium-high, and high values across the place attachment items and thus we labeled them as ambivalent, moderate, and strong attachments.

3. Results

3.1. Perceived Benefits of the Region and Parks

Respondents indicated the highest levels of agreement regionally of the positive contributions to their experience with the cultural ecosystem services of leisure time spent

outdoors ($M = 4.64$), an appreciation of beauty ($M = 4.51$), and physical/mental health benefits ($M = 4.44$) (Table 1). All ecosystem services had means above three, indicating general agreement of the contributions of each of the ecosystem services listed to their experiences outdoors across southeast Michigan. When asked of the ones they indicated agreement on, which three contributed the most to their positive experiences in the Metroparks, the same three cultural ecosystem services were highlighted with the most frequency of response: leisure time spent outdoors (50.7%), physical/mental health benefits (44.1%), and an appreciation of beauty (43.8%). Two cultural ecosystem services rounded out the top five for highest means regionally or most selected in the parks, both centering on the legal status of conserved and protected lands: the satisfying knowledge that this setting is protected ($M = 4.36$; 27.9%) and a sense of the conservation value for future generations ($M = 4.16$, 22.2%). Comparing the order of means for the region and percentages for the Metroparks, three cultural ecosystem services appear to be higher valued within the Metroparks than their regional ranking would suggest: connection to traditional places/ways of life ($M = 3.65$, 7.8%); social relationships formed as a result of this setting ($M = 3.63$, 7.4%); and connections to forces/spirituality larger than myself ($M = 3.57$, 6.6%). The remaining cultural ecosystem services and provisioning, regulating, and supporting ecosystem service single-item measures all follow the same pattern across scales.

3.2. Place Attachment to the Region and Parks

Respondents reported general agreement with many of the place attachment measures (Table 2). For all seven items asked, the same ordering of agreement was found across the scales. The most agreed-upon item was “These settings mean a lot to me” (regional $M = 4.39$; parks $M = 4.33$). Two items, both related to the place bonding dimension of place attachment, were disagreed with across both scales. Though the two scales followed the same pattern across place attachment items, the regional evaluations were significantly higher than those in the Metroparks for six of the seven items. While there was no statistical difference for “The time I spend in these settings could just as easily be spent somewhere else” ($M = 3.06$ for both scales, reverse coded due to negative phrasing), each of the remaining six items displayed a higher level of agreement on the regional scale than on the Metroparks scale. Reliability analyses generally confirmed the concept of place attachment for the region and for the park system (Table 3; Cronbach’s alphas of 0.88 and 0.87, respectively), with the two bonding items and one dependence item failing to meet standards for inclusion [53].

Table 3. Place attachment construct reliability analyses for outdoor recreation settings across southeast Michigan and for the Huron-Clinton Metroparks. For both scales, three items were removed for not meeting reliability requirements (see last three rows of Table 2 for items).

Thinking About These Favorite Experiences and Others You May Have Had in the:	Southeast Michigan			Huron-Clinton Metroparks		
	Item Total Correlation	Alpha If Item Deleted	Cronbach Alpha	Item Total Correlation	Alpha If Item Deleted	Cronbach Alpha
These settings mean a lot to me	0.76	0.84	0.88	0.69	0.85	0.87
These settings are very special to me	0.74	0.84		0.74	0.83	
These settings are the best place for what I like to do	0.75	0.84		0.75	0.82	
I can’t imagine a better place than these settings for what I like to do	0.71	0.86		0.72	0.83	

3.3. Relationship Between Perceived Benefits of and Place Attachment to the Region and Parks

K-means cluster analyses on the four qualifying items for place attachment (Table 3) resulted in three distinct clusters at both scales. One group exhibited strong attachment (48.9% southeast Michigan, 58.3% Huron-Clinton Metroparks), another exhibited medium attachment (38.7% southeast Michigan, 28.3% Huron-Clinton Metroparks), and a final exhib-

ited ambivalent attachment (12.4% southeast Michigan, 13.4% Huron-Clinton Metroparks). Comparisons among place attachment clusters and ecosystem services (Table 4) for southeast Michigan yielded a consistent pattern: each of the three attachment groups significantly differed ($p < 0.001$) from the next, and always with increasing agreement about the importance of an ecosystem service with increasing place attachment. For the Metroparks, this picture was more mixed. Significant differences ($p < 0.001$) were evidenced among place attachment clusters for the top seven most frequently chosen ecosystem services, which were all cultural ecosystem services. For these, there was less distinction among the three attachment levels, with the moderate group at times statistically indistinct from either the ambivalent or the strong group. Of note though is that those with strong attachment to the Metroparks were less likely to rate “leisure time spent outdoors” and “physical/mental health benefits” as a top three contributor to their positive experience than those with lower levels of attachment to the Metroparks. Significant differences were also seen among attachment groups for “inspiration to create art” ($p = 0.047$), with moderately attached respondents selecting this response in greater frequency, and the regulating ecosystem service measure ($p = 0.012$), with moderately and strongly attached respondents selecting this response in greater frequency.

Table 4. Importance of ecosystem service by place attachment levels for outdoor recreation settings in southeast Michigan and the Huron-Clinton Metroparks. Place attachment levels are abbreviated as follows: Ambivalent (Amb.), Moderate (Mod.), Strong (Str.), and Overall (Over.). Superscripts denote significant differences ($p < 0.05$) within locations (using ANOVA or chi-square, respectively). Shading indicates significantly lower (lighter shade) or higher (darker shade) values.

		Southeast Michigan (M)						Huron-Clinton Metroparks (%)					
		Place Attachment				<i>p</i>	η^2	Place Attachment				<i>p</i>	<i>V</i>
		Amb.	Mod.	Str.	Over.			Amb.	Mod.	Str.	Over.		
Cultural Services	Leisure time spent outdoors	3.92 ^a	4.60 ^b	4.87 ^c	4.65	<0.001	0.174	59.1 ^a	61.8 ^a	52.4 ^b	55.9	<0.001	0.084
	An appreciation of beauty	3.72 ^a	4.43 ^b	4.79 ^c	4.52	<0.001	0.138	40.1 ^a	46.9 ^b	52.2 ^c	48.7	<0.001	0.092
	Physical/mental health benefits	3.65 ^a	4.37 ^b	4.70 ^c	4.44	<0.001	0.173	41.6 ^a	53.5 ^b	48.6 ^c	48.5	<0.001	0.076
	The satisfying knowledge that this setting is protected	3.39 ^a	4.32 ^b	4.64 ^c	4.36	<0.001	0.189	21.7 ^a	34.0 ^b	32.4 ^b	30.9	<0.001	0.094
	A sense of the conservation value for future generations	3.21 ^a	4.06 ^b	4.50 ^c	4.17	<0.001	0.186	12.6 ^a	21.2 ^b	30.3 ^c	24.9	<0.001	0.159
	Connection to traditional places/ways of life	2.94 ^a	3.54 ^b	3.94 ^c	3.66	<0.001	0.110	4.1 ^a	5.1 ^a	12.0 ^b	8.9	<0.001	0.127
	A deep sense of connection to this setting/the geography it represents	3.12 ^a	3.90 ^b	4.58 ^c	4.14	<0.001	0.278	2.9 ^a	8.4 ^b	10.2 ^b	8.5	<0.001	0.098
	Social relationships I've formed as a result of this setting	2.88 ^a	3.40 ^b	4.03 ^c	3.64	<0.001	0.139	10.2	7.6	7.9	8.3	0.178	
	Connection to forces/spirituality larger than myself	2.76 ^a	3.35 ^b	3.95 ^c	3.57	<0.001	0.130	5.6	8.0	7.2	7.1	0.214	
	Opportunities for learning about this setting and/or its environmental processes	2.98 ^a	3.74 ^b	4.30 ^c	3.92	<0.001	0.193	4.2	5.0	5.5	5.2	0.451	
	Inspiration to create art	2.63 ^a	3.09 ^b	3.70 ^c	3.33	<0.001	0.107	3.2 ^a	5.9 ^b	4.1 ^c	4.4	0.047	0.044
	Greater understanding of myself in relation to this setting	2.87 ^a	3.52 ^b	4.08 ^c	3.71	<0.001	0.170	2.2	3.2	3.5	3.2	0.259	
	General or other personal/cultural benefits	3.04 ^a	3.67 ^b	4.23 ^c	3.86	<0.001	0.165	1.9	2.9	2.0	2.2	0.360	
	Reflection on different ways of living/different cultural practices	2.73 ^a	3.23 ^b	3.74 ^c	3.42	<0.001	0.110	1.5	2.2	1.7	1.8	0.536	
Different ways of knowing, such as traditional knowledge systems	2.76 ^a	3.26 ^b	3.76 ^c	3.44	<0.001	0.123	0.8	0.9	1.3	1.1	0.547		
Benefits supporting all life, such as nutrient cycling, soil formation, or habitat provision		3.00 ^a	3.84 ^b	4.45 ^c	4.03	<0.001	0.212	5.9	8.6	7.6	7.6	0.167	
Benefits for humans and nature, such as clean water, food, wood, or fuel		3.11 ^a	3.92 ^b	4.49 ^c	4.10	<0.001	0.214	8.1	7.4	6.3	6.9	0.258	
Benefits for natural processes, such as climate or flood regulation or water purification		2.89 ^a	3.69 ^b	4.34 ^c	3.91	<0.001	0.189	2.4 ^a	5.4 ^b	4.7 ^b	40.5	0.012	0.049

4. Discussion

The work examined three primary areas. We analyzed the relationships between residents and recreationists' perceived benefits of a region (southeast Michigan) and a park

system within that region (the Huron-Clinton Metroparks), using ecosystem services to detail these benefits. Next, we analyzed place attachments on these regional and park-based scales. Third, we compared the intersections between benefits and attachments on the two scales to identify patterns of response across benefits and within place attachment categorizations. From this, we highlight a few key areas for discussion pertaining to making meaning from these data and applying this meaning to research concepts and methods and climate action planning. Our work demonstrates the value of probing connections among place attachment, ecosystem services, and nested geographic scales. The Huron-Clinton Metroparks endeavors to provide for many different types of recreationists. Our research approach has highlighted interesting questions about the ways in which these concepts influence the benefits residents and recreationists derive from geography, and how park practitioners may communicate those benefits to increase stewardship across and within attachments.

For both the region and the Metroparks, the top ecosystem services were recreation, aesthetics, and human health (Table 1). However, there was a mismatch in the ratings of the contributions of cultural ecosystem services to positive experiences regionally and in the parks. There was particularly more emphasis on connection to traditional practices/ways of life (cultural heritage), social relationships formed because of this setting (social capital), and connections to forces/spirituality larger than oneself (spirituality) within the Metroparks as compared to southeast Michigan. This implies these may be particularly pronounced and valued toward positive experiences in the Metroparks. Though the percentages for these cultural ecosystem services are still low for the top three selections, these may represent an important area for consideration in planning and communication. All three concern relationships—to traditional practices, to other people, and to spiritual forces. This relationship-building aspect of the Metroparks may be an identity that enhances the sense of attachment and the benefits of the ecosystems there. Because they imply outdoor settings as facilitators of such relationships, practitioners' interpretation and programming on the connections between climate change and traditional, personal, and spiritual relationships may find a particular audience and stewardship avenue.

The higher place attachments to southeast Michigan than to the Metroparks are somewhat contradictory to the specificity of the scale of the Metroparks driving a more specific response [25,32–34,37]. However, it could be because of the variety of outdoor recreation settings available in southeast Michigan: more opportunities to engage across the recreation opportunity spectrum [34]. This diversity could also be influencing the disagreements with ecosystem services (means below 3, Table 4) within the lowest attachment level group: those who are ambivalent about attachment to a region's outdoor settings may also have fewer distinct focal points of benefits across this mixed landscape related to relationships (social, cultural heritage, and spiritual), learning (environmental, self, and traditional), or regulation. As a region though, the diversity of opportunities might appeal to someone's attachments across multiple dimensions of their life and experiences, whereas the opportunities within the Metroparks represent only a section of those experiences and life events (e.g., recreation, companions who want to recreate there). This is important to keep in mind with climate planning, as park-based experiences, though hopefully positive and contributory to someone's attachments to a place, are still just a portion of their overall experiences informing attachments to a broader region [11]. Thus, park climate planning efforts may want to relate this uniqueness of the recreation aspect of the Metroparks, while couching it as one portion of someone's vibrant life in the region, to more accurately portray the role of the parks. This could assist with emphasizing that, though limited, park connections are a specific and valued type of attachment.

There is generally a moderate to high level of place attachment for both southeast Michigan as a region and for the Huron-Clinton Metroparks specifically. Indeed, the average responses and cluster grouping suggest we lacked substantial disagreement with attachment items within our sample population. This may imply that, at least for this sample population, the Metroparks are a complementary part of the southeast Michigan

identity and that parks are embedded in considerations of regional attachments. Perhaps this would be different if the sample population included those who do not recreate in outdoor settings in the region and/or in the Metroparks, which future studies may examine. As such, it may imply that outdoor recreation and awareness about this recreation augments place attachment levels, which corroborates previous work on recreation experience use history and park system place attachment [25]. This strengthens the connection between place attachment and ecosystem services, as “recreation” is a noted crosswalk. This can serve as a point of entry for climate conversations with recreationists, bridging between their leisure pursuits outside, the attachments that these may strengthen, the ecosystem services that support such pursuits and attachments, and the volatile nature of these relationships with climate change.

An interesting pattern was shown in the comparison of place attachment and recognized benefits from specific ecosystem services. On the regional level, across ecosystem services, the more place attachment one had to the region, the more they agreed with the benefits provided by ecosystem services. However, the results were much more mixed, and often not significantly different among place attachment groups, at the Metroparks level. Of particular interest may be that those with strong attachment to the Metroparks were less likely to rate recreation (“leisure time spent outdoors”) or human health (“physical/mental health benefits”) as a top three contributor to their positive experience than those with lower levels of attachment to the Metroparks. Given that these cultural ecosystem services are within the top three most agreed upon and selected ecosystem services regionally and in-parks, it implies there might be a difference with the Metroparks’ strongly place-attached population. As their level of attachment to the Metroparks increased, there was an increase in conservation, bequeathment value, connection to place, and regulating services. Consequently, at lower attachment levels, more general recreation agreements were provided. This result corroborates pro-environmental behavior being linked with stronger place attachment [38]. Those with the stronger place attachments to the Metroparks selected more nuanced ecosystem services in their list of top three that the parks provide, perhaps indicating that recreation and human health are commonly selected by all but not specific enough points of resonance for those most attached. Improving the specificity of the recreation and human health cultural ecosystem services’ statement phrasings is worth examining in future studies to see if this pattern still holds. Given the range of potential benefits, especially breadth of cultural benefits that the Metroparks’ ecosystems provide, those with stronger attachments considered the strength of these attachments and selected more specific responses than recreation and human health, instead illuminating connections to cultural heritage, social capital, and spirituality, among other concepts. In discussing the impacts that climate change is and will be having across the park system, park managers could recognize two areas. First, there are generally accepted benefits of recreation, aesthetics, and human health within the parks that should be emphasized for broad messaging about climate impacts and actions, as these crosscut recreationist populations. Second, those with greater attachment are indicating a greater diversity and specificity of cultural ecosystem services that positively contribute to their Metroparks experiences, and thus messages relating a depth of attachment and these benefits could both further engage this segment of the population and potentially cultivate attachments and recognition of benefits with the lesser attached segments.

We expected a more heterogeneous population (e.g., outdoor recreation participation, place attachments) by using a panel sample from Qualtrics in Michigan’s most populous region, which represents a growing diversity of identities, and those who are on the Metroparks’ email list. The large sample size, however, suggests that the southeast Michigan community is concerned with the climate change-influenced future of the region and the Metroparks. Future studies should further itemize regulating, provisioning, and supporting ecosystem services (e.g., [23]), as was completed with cultural ecosystem services here, to examine specifics within them, differences across geographic scales, and potential relationships with place attachments.

5. Conclusions

These data (alongside other collections and analyses) helped inform the Huron-Clinton Metroparks' Climate Action Plan [13]. Testing relationships between concepts that are already in existence but not used together—place attachment and ecosystem services—helped the Metroparks frame their plan, down to specific actions that they believe will resonate with park users across the region. Specific actions, priorities, and partnerships were detailed for the next 5 years based on these results and the broader program of research from which they derive [13]. With the large response, community members showed their interest and support for the creation of a climate action plan to help prepare their community for what is to come with climate change manifestations. They also appeared to emphasize the relationship-building aspects of the Metroparks (cultural heritage, social capital, and spirituality) as particular cultural ecosystem services found in the park setting as compared to the larger southeast Michigan region. The language of the ecosystem services framework is embedded in this plan to facilitate these actions and relationships with the community and between the community and these ecosystem services. For example, the plan explicitly states that this type of consideration provides guidance for ensuring that a range of benefits are “considered, maintained, and enhanced” in the decision-making processes about responding to climate change [13]. Furthermore, the Metroparks' Climate Action Plan incorporated language about the importance of considering representation across a breadth of our interrelated and interdependent ecosystem services in climate planning, when stating:

“Climate change alters ecosystem services, and ultimately impacts the benefits people receive from their local and regional environments. The Ecosystem Services framework assists climate action adaptation and mitigation planning by providing guidance for planning teams to think about action across multiple areas of the environment, rather than concentrating action solely in a few parts. Using the Ecosystem Services framework throughout the Metroparks' [Climate Action Plan] creation process resulted in a well-rounded approach to climate action in Michigan.” [13] (p. 62).

Indeed, the 24 objectives of the Metroparks' Climate Action Plan did represent a breadth of ecosystem services [13]. Fifteen of the objectives work toward maintaining or enhancing cultural ecosystem services, fourteen toward regulating ecosystem services, six toward supporting services, and three toward provisioning services. Because concern was taken to have representation of ecosystem services throughout the objectives, communication about climate and benefits may be articulated in resonating ways based on the scale of discussion (regional or parks-based) and with differently attached audiences to these scales. This also aids in the eventual, inevitable updates to the Climate Action Plan, as these frameworks may be reassessed and areas of emphasis within populations or ecosystem services highlighted for future action.

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