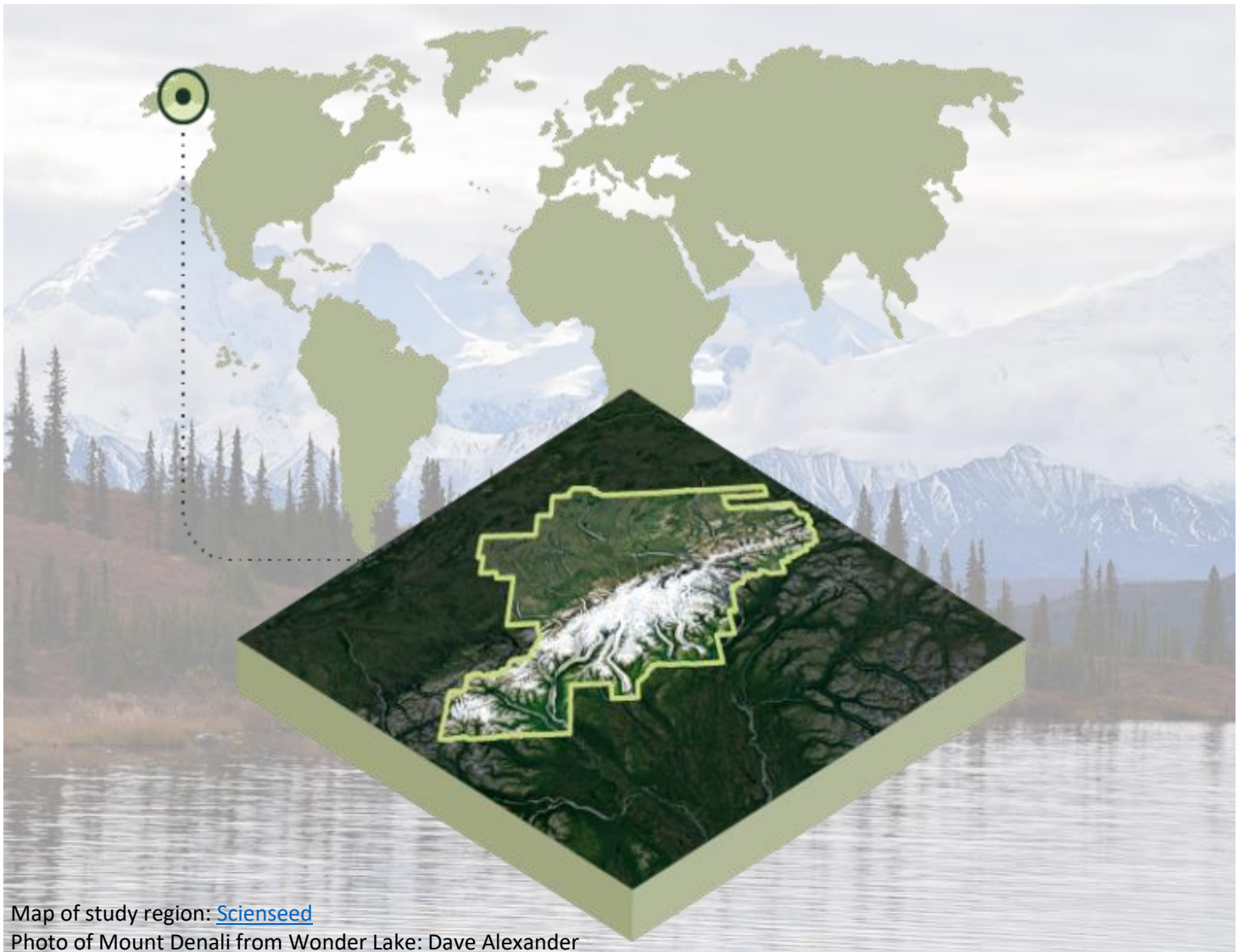




ENVISION

# A social-ecological inventory of the region surrounding Denali National Park and Preserve, Alaska

Deliverable 3.2



Map of study region: [Scienseed](#)

Photo of Mount Denali from Wonder Lake: Dave Alexander



ENVISION is a 3-year research project that develops an inclusive approach to the management of protected areas with the aim of improving biodiversity and human well-being. We engage diverse groups of stakeholders of a protected area, such as recreational users, local residents, local businesses, land owners, agriculture, researchers or local governments and protected area managers.

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Index..... 1

Executive summary ..... 2

1.Introduction ..... 2

2.Methods ..... 4

    2.1.Study area..... 4

    2.2. Data collection ..... 4

    2.3. Data analysis..... 5

3.Results ..... 5

    3.1. Key features of the regional map ..... 6

    3.2. Causal patterns across community maps ..... 7

4.Discussion ..... 10

    4.1. Comparison of the perceived structural patterns of social-ecological conditions ..... 10

    4.2. Implications for decision-makers..... 11

5.Conclusions ..... 11

6.References ..... 13

7.Appendices ..... 16

    Appendix A. Activity sheet provided to the fuzzy cognitive mapping focus group participants ..16

    Appendix B. A photograph of a completed fuzzy cognitive map ..... 19

    Appendix C. Semi-structured interview guide..... 20



## Executive Summary

This ENVISION deliverable presents results from a participatory process focused on evaluating how residents living around Denali National Park and Preserve and Denali State Park perceived changes to the social and ecological dynamics of protected areas in Interior Alaska, U.S. Using data from fuzzy cognitive mapping exercises held during six focus groups and 14 interviews, and guided by an exploratory resilience framework, we established a baseline understanding of the vulnerability and current state of conditions being influenced by drivers of change. Study participants identified 61 variables that characterized social and ecological conditions at a regional scale. Comparative points of agreement and disagreement showed how residents from six communities valued a variety of socio-cultural, socio-economic, and ecological features of the landscape. The region was predominantly characterized by *tourism*, *sense of community*, *subsistence*, and *Wilderness*. Management agencies and policy-makers should keep in mind that these features are fundamentally important for maintaining the structure and function of this social-ecological system. Findings indicated that *climate change* and *large-scale development* were the primary drivers of change. These features should also receive attention because they threaten the ability of residents to maintain the desired identity of the Denali region.

A deeper understanding of how residents characterize social-ecological systems surrounding protected areas is fundamentally important for understanding how places are changing and developing strategies that incorporate public viewpoints into decisions. In response to this research need, the ENVISION project provides a structured platform for building system resilience and discussing the similarities and differences in visions for the future of the Denali region. As one of the few remaining places in the world with intact ecosystems, Denali protected areas serve as high profile tourism destinations situated in a rural landscape inhabited by a diverse array of stakeholders. Public land management agencies in this context are faced with the challenging task of engaging rural residents in discussions about their relationships with a rapidly changing and contested landscape. Therefore, this study also guides resource management decisions about how to prioritize limited resources, represent a range of community interests, particularly among residents in the Denali region, and alleviate tensions through greater clarity in communication.

## 1. Introduction

Protected areas (PA) in the U.S. are increasingly recognized as complex and interdependent social-ecological systems that are difficult to manage given the competing objectives of environmental protection alongside the provision of opportunities for people to access natural resources<sup>1, 2</sup>. Further complicating the decision-making process are the challenges that come with suiting the needs of a diverse constituency that lives around and within PA boundaries<sup>3, 4, 5</sup>. Past research has posited that active community engagement in PA management can yield public support for decisions<sup>6</sup> and foster trust among stakeholders<sup>7, 8</sup>. However, collaborative management that embraces value pluralism is rare, despite the benefits that emerge from identifying solutions that will facilitate the long-term sustainability of social-ecological systems<sup>9, 10</sup>. In response to the shifts



that are occurring in how the public is engaged in PA decision-making, public land management agencies have moved beyond a traditional paradigm of ‘nature for itself’ toward one of ‘people and nature’ founded on resilience, interdisciplinarity, and stakeholder engagement<sup>4</sup>. This new conceptualization of human-nature relationships requires participatory approaches that provide insights into the multiple, competing interests of stakeholders for more effective engagement of local communities in PAs.

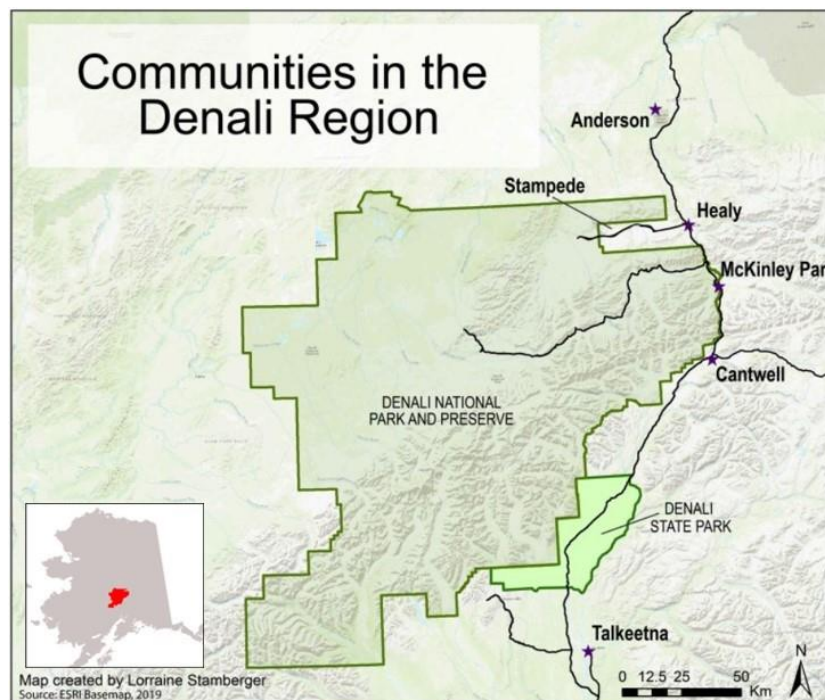
Participatory research has been advanced through the application of a semi-quantitative method known as fuzzy cognitive mapping, which measures community perceptions of dynamic systems<sup>11, 12</sup>. This methodology has developed ‘mental models’ of stakeholders and improved public involvement in environmental decision-making about agriculture systems<sup>13</sup>, fisheries<sup>14</sup>, lakes<sup>15, 16</sup>, coastal zones<sup>17</sup>, and wildlife management areas<sup>18</sup>. The fuzzy cognitive mapping approach is useful for modeling how people perceive the features and interactions of social-ecological systems, particularly those that are shrouded in complex dynamics and uncertainty<sup>14</sup>. Results of fuzzy cognitive mapping research has informed resource management decisions of the similarities and differences among different stakeholder understandings of a system, particularly when limited information is available<sup>19</sup>. Potential points of social conflict have also been identified using fuzzy cognitive maps, as well as avenues for communication among distinct stakeholder groups based on their beliefs<sup>20</sup>. Applications of fuzzy cognitive mapping in the context of PA management are rare but promising in their ability to elucidate local residents’ perceptions about PA social-ecological systems.

In this study, we investigated the similarities and differences in residents’ perceptions of the social-ecological relationships that exist across Interior Alaska, particularly surrounding Denali National Park and Preserve and Denali State Park. We adopted a modified exploratory resiliency framework to identify and parse out relationships among the key socio-cultural, socio-economic, and ecological elements that residents’ used to characterize the region<sup>21</sup>. Specifically, we utilized fuzzy cognitive mapping to graphically represent residents’ mental models related to Denali as a social-ecological system<sup>12</sup>. Unlike previous studies that have analyzed mental models across stakeholder groups, we compare perceptions of residents belonging to distinct geographically defined communities given the remote and vast regional scale of this research. Our research was guided by two objectives: 1) characterize residents’ perceptions of a social-ecological system through an analysis of fuzzy cognitive maps to define the Denali region; and 2) compare the perceived structural patterns of social-ecological conditions in the Denali region among different communities adjacent to protected areas. Our research process generated cognitive maps of distinct communities to inform management strategies that prioritize resilience<sup>22</sup>, advance community planning<sup>23</sup>, and increase the likelihood that communities would be better positioned to make change after the completion of this research.

## 2. Methods

### 2.1. Study area

We conducted this research with members from six communities adjacent to Denali National Park and Preserve and Denali State Park (Figure 1). The national park was established in 1917 and is home to the highest peak in North America, Mt. Denali (20,310'). Approximately 600,000 visitors went to Denali National Park and Preserve in 2019<sup>24</sup>. The state park was established in 1970 and is also a high-profile tourist destination. The national and state parks span 2,446,386.62 and 131,619.96 hectares, respectively<sup>25</sup>. During the “high use season” from June through August the population around the national park entrance nearly doubles to about 4,000 residents given an influx of seasonal employees. The infrastructure and opportunities for economic growth provided by tourism in the region are important. As such, local residents are invested in decisions being made about the protected area. Residents are also affected by decision-makers insofar as their personal attachment to places through recreation and activities such as subsistence use, defined as the customary and traditional uses of wild resources.



**Figure 1.** Study area

### 2.2. Data collection

Data for this study were collected from 2019-2020 to understand perceptions of social-ecological conditions in the Denali region. Building on past research that has used multiple methods to increase participation, we collected data through focus groups<sup>26, 18</sup> and interviews<sup>14, 27</sup> that included fuzzy cognitive mapping exercises. Our operative question asked, “how do local community members characterize Denali as a social-ecological system?” This was followed by a



discussion of social-ecological features of the landscape, individual mapping exercises, a group reflection on what was mapped, and then questions that called for anything missing from discussion.

To complete the individual mapping exercise, participants were provided with information sheets that included instructions for the activity and a list of 27 “features” coded from six semi-structured interviews conducted in an earlier phase of the study (Appendix A). Drawing from Cumming et al.’s (2005) framework, features were categorized by socio-cultural, socio-economic, and ecological aspects of the Denali region in both positive and negative ways, and “drivers of change” to current conditions. Participants completed the three-step mapping exercise by 1) recording significant features that characterized the region on sticky notes and placing them on the provided sheet of cardstock paper; 2) structurally linking the features using directed arrows that indicated positive or negative relationships; and 3) qualifying the strength of relationships by thickening arrows to indicate stronger relationships. A team of at least two researchers was present during all focus groups to guide and answer questions about the exercise. All focus group discussions were tape recorded and transcribed verbatim to generate qualitative data that complemented the semi-quantitative data derived from the final fuzzy cognitive maps.

### 2.3. Data analysis

Maps were digitized using a fuzzy cognitive mapping software, MentalModeler, and converted into adjacency matrices where the column and row labels represented the features and the value within a given cell represented the weighted directed relationship between two concepts. The interaction strengths between variables were then scored, with high interactions scored as (+/-) 0.75, medium as (+/-) 0.5, and low as (+/-) 0.25<sup>28</sup>. We also qualitatively aggregated features based on their frequencies of use<sup>14, 27</sup>. Variables with similar meanings (e.g., “subsistence” and “subsistence use”) were recoded to reduce redundancy.

Maps were aggregated into six community maps based on participants’ residence and one regional map that included all participants using RStudio Version 1.2.1335. An Excel-based program FCMapper<sup>29</sup> was used to calculate all graph indices using mathematical pairwise comparisons that included continuous indicators of strength from -1 to +1<sup>11</sup>. Centrality was used to identify the defining features of the region and determined the importance of each variable in a matrix, including outdegree centrality that indicated a variable’s cumulative effects on other variables, and indegree centrality that illustrated the cumulative degree of influence from other variables. Features with the highest outdegree centrality scores were considered drivers of change given their strong influence on other features<sup>30</sup>.

## 3. Results

A total of 51 fuzzy cognitive maps were collected from residents across six communities as part of the focus groups ( $n = 37$ ) and semi-structured interviews ( $n = 14$ ). The average number of participants in each focus group was between eight and nine ( $SD = 7.03$ ) and the average age across all participants was 52 ( $SD = 16.36$ ). Maps that were incomplete or non-compliant with instructions were removed, resulting in 38 maps that included 444 connections across 61 unique

features. These features spanned 29 socio-cultural, 23 socio-economic, and seven physical dimensions, in addition to two drivers of change (Figure 2). Once aggregated, there was an average of 27.83 features and 104.33 connections per community map (Table 1). All individual maps were combined into six community maps based on the household location of participants, in addition to one map of the pooled sample that reflected the mental models of all 38 participants.

**Table 1.** Graph indices and socio-demographics by community and at a regional scale

Graph indices & demographics	Anderson ( <i>n</i> = 2)	Cantwell ( <i>n</i> = 6)	Healy ( <i>n</i> = 5)	McKinley Village ( <i>n</i> = 11)	The Stampede ( <i>n</i> = 7)	Talkeetna ( <i>n</i> = 7)	Regional map ( <i>n</i> = 38)
Average age, M (SD)		52.83 (19.04)	80.50 (3.50)	47.57 (13.82)	45.67 (11.13)	63.25 (5.26)	51.77 (16.36)
Number of features	15	29	32	36	28	27	61
Number of connections	27	114	81	192	116	96	444

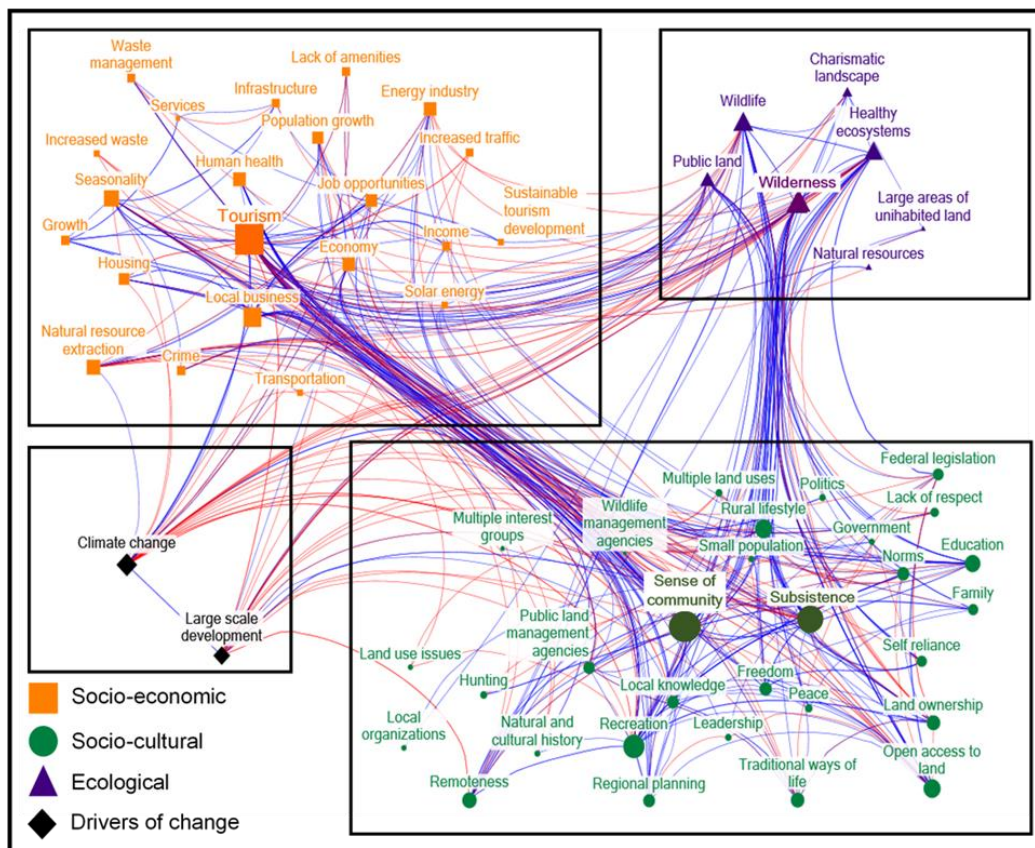
### 3.1. Key features of the regional map

Results showed a complex representation of social-ecological features at a regional scale, and centrality scores showed that the region was primarily characterized by *tourism*, *sense of community*, *subsistence*, and *Wilderness*. *Tourism* had relatively equal indegree and outdegree centrality scores (Table 2), indicating it could be interpreted as driving or receiving influence from other variables in the system. *Sense of community*, *subsistence*, and *Wilderness* also emerged as highly central variables in the regional map and were affecting fewer (outdegree) than they were affected by other variables (indegree) in the system. According to most participants, *climate change* and *large-scale development* were perceived as drivers of change given their stronger outdegree rather than indegree influences.

**Table 2.** Centrality scores from the aggregated community map including maps from all communities

Features	Centrality	Outdegree	Indegree
Tourism	10.13	10.24	20.37
Sense of community	6.43	10.46	16.89
Subsistence	6.15	10.37	16.52
Wilderness	8.43	7.84	16.27
Recreation	5.69	10.29	15.97
Climate change	9.63	5.42	15.05
Wildlife	5.63	8.55	14.17
Healthy ecosystems	3.10	9.82	12.92
Local business	4.24	6.64	10.88
Rural lifestyle	4.08	6.28	10.36





**Figure 2.** Results from 38 aggregated fuzzy cognitive maps produced by residents from the Denali region, AK. The mapped features spanned socio-cultural, socio-economic, and ecological dimensions of resilience theory, as well as key drivers of change. The lines connecting all features show negative relationships in red and positive relationships in blue. The size of the nodes illustrates the relative importance of each feature in characterizing the region. The four most features considered most central to the system (i.e., *tourism*, *Wilderness*, *subsistence*, and *sense of community*) are bolded.

### 3.2. Causal patterns across community maps

In line with our second objective to compare the perceived structural patterns of social-ecological conditions across the region, we reviewed the most central features across communities and qualitatively identified patterns of causal relationships among the four central features emerging from the regional map (i.e., *tourism*, *Wilderness*, *sense of community*, and *subsistence*). There were 13 central features across the six community maps, seven of which were shared by at least two communities. Across community maps, multiple land uses in the region (e.g., natural resource extraction, land ownership, public land management agencies) were of concern given their external influence on features that were vulnerable to change, including rural lifestyles, recreation, and healthy ecosystems (Table 3). Example quotations derived from focus group discussions are represented in Table 4 to show how the four central features identified from the regional map were connected and the variation in beliefs about key interactions among communities.



**Table 3.** Centrality scores for the top four features mapped by residents in six communities. Centrality is the sum of the indegree and outdegree for each category and is an index of its connectedness to other variables within the map.

Features	Anderson	Cantwell	Healy	McKinley Village	The Stampede	Talkeetna
Climate change	-	-	-	11.92	-	-
Traditional ways of life	-	6.38	-	-	-	-
Education	2.00	-	-	-	-	-
Healthy ecosystems	-	-	-	-	-	6.60
Open access to land	-	6.00	-	-	-	-
Recreation	-	7.00	-	-	-	-
Remoteness	5.63	-	-	-	-	-
Rural lifestyle	-	-	5.38	-	-	-
Sense of community	-	-	5.13	13.25	-	6.00
Subsistence	3.00	-	-	-	6.13	6.25
Tourism	-	7.21	5.88	14.88	7.08	6.14
Wilderness	-	-	4.75	8.46	6.75	-
Wildlife	4.00	-	-	-	7.00	-

**Table 4.** Example quotations about the four most central features and their interactions with other features of the Denali region. Quotes were drawn from qualitative data from focus groups that supplemented the individual mapping exercises.

<i>Dimension and feature</i>	<i>Example quotations</i>
<b><i>Socio-cultural</i></b>	
<i>Sense of community</i>	<p>“That we can come together and have these issues and, we got lots of them...It’s just part of being in a small community, but I love that we can come in, sit down, and work through some of these issues” [Cantwell resident]</p> <p>“It’s the people..that..drive me to areas you know not so much anymore but...you used to be able to drive around here and everybody you met would wave at ya you know? its still that way a lot but it’s just getting some many people that uh I don’t know any more” [Healy resident]</p>
<i>Subsistence</i>	<p>“...of course the subsistence is good for native Alaskans but tourism probably isn’t as good for you know the subsistence” [Healy resident]</p> <p>“I connected my subsistence with wildlife...cause like to subsistence live you got to have wildlife” [McKinley Village resident]</p>
<b><i>Socio-economic</i></b>	
<i>Tourism</i>	<p>“Tourism of course is this like ever present entity that’s here. And I do think that largely it’s positive, and a large positive impact on the community” [McKinley Village resident]</p> <p>“One of the biggest challenges for protecting Wilderness is the tourism and the impacts that it has on um the Wilderness landscape” [Stampede resident]</p>
<b><i>Ecological</i></b>	
<i>Wilderness</i>	<p>“Some would argue that [federal legislation] helps Wilderness but I can also see a lot of negatives with that.” [Cantwell Resident]</p> <p>“So it’s kinda like the Wilderness is pushing the tourism and the tourism is pushing back negatively on the um Wilderness and the access one is an interesting issue” [Talkeetna resident]</p>



*Tourism* emerged as a central feature in five out of six communities. Across many communities, *tourism* was perceived as beneficial for socio-economic features. *Tourism* behaved similarly within the Stampede, Cantwell, and Talkeetna community maps. In Cantwell, *tourism* benefited socio-economic features such as *local business* and *job opportunities*, but was seen as harmful to *traditional ways of life*. Cantwell residents identified *local knowledge* and *local business* as additional positive influences on *tourism*, whereas *large-scale development* was the only negative influence. Stampede and Talkeetna residents indicated that *tourism* was more harmful than beneficial for the system, given that it negatively influenced ecological and socio-cultural features. As a Stampede resident explained, the biggest challenge for sustaining *Wilderness* qualities in the region was related to impacts from *tourism*. These community maps included a stronger emphasis on *wildlife*, *public land management agencies*, and *waste management*. Healy and McKinley Village residents perceived *tourism* as a driver of change, including a relatively even mixture of positive and negative influences on the system. A McKinley Village resident explained the positive influence of *tourism* on *sense of community*. Like Cantwell, Healy residents perceived *tourism* as beneficial for the economy (e.g., *job opportunities*), but harmful for *large-scale development*, *rural lifestyle*, and *natural resources*. On the other hand, McKinley Village residents perceived *tourism* as positive for *large-scale development*, which differed from other communities. Like Stampede and Talkeetna, the McKinley Village map included several connections to *tourism* that were related to PA management including *public land*, *amenities*, and *recreation*.

*Wilderness* was another central and ordinal across Healy, McKinley Village, and the Stampede, exhibiting similar patterns including positive impacts on socio-economic and socio-cultural variables such as *tourism* and *sense of community*. Overall, distinct communities indicated that *Wilderness* was considered beneficial for features such as *wildlife*, *healthy ecosystems*, rural identity (e.g., *self-reliance*, *freedom*, and *remoteness*) and *tourism*. The Healy map included more positive than negative indegree connections, indicating that a *small population*, *rural lifestyle*, and *wildlife* benefited *Wilderness*. In contrast, the Stampede map included more negative than positive influences on *Wilderness*, including *large scale development*, *natural resource extraction*, and *subsistence*. Interestingly, one Cantwell resident indicated that *federal legislation* negatively impacted *Wilderness*.

*Sense of community* was particularly central among Healy and McKinley Village residents and included patterns of predominately indegree connections, thus, indicating vulnerability to change. *Sense of community* was influenced in positive ways by socio-cultural features including *local knowledge* and *education* by McKinley Village residents, and *rural lifestyle* by those from Healy. Healy residents indicated that *tourism* was beneficial for *sense of community*. Features considered harmful for *sense of community* in the McKinley Village map were those such as *climate change*. A resident of Healy did, however, note how *sense of community* had been diminished over the years due to population growth. While *sense of community* was central in the Talkeetna map, these residents identified less distinguishable causal patterns connected to *sense of community* and structural patterns indicated that this feature was relatively stable in the system. All outdegree connections were positive, indicating the *sense of community* was beneficial for the socio-cultural features of *rural lifestyle*, *subsistence*, *multiple interest groups*, and *recreation*.



*Subsistence*, as a central feature in the regional map and Stampede residents indicated that *subsistence* had more indegree than outdegree influences and was positively impacted by features such as *healthy ecosystems*, but negatively influenced by *natural resource extraction* and *tourism*. In contrast, residents of Talkeetna and Anderson indicated that *subsistence* was central and influenced more positively than negatively by ecological (e.g., *wildlife* and a *healthy ecosystem*) and socio-cultural characteristics of the region (e.g., *rural lifestyle* and *sense of community*). Across these maps, *subsistence* strongly and positively influenced *sense of community*, *self-reliance*, *rural lifestyle* with limited negative influence on other features of the system.

## 4. Discussion

This study advanced knowledge of how residents in communities surrounding Denali National Park and Preserve and Denali State Park characterized the region as a social-ecological system. The region was predominantly characterized by *tourism*, *sense of community*, *subsistence*, and *Wilderness*. Findings indicated that *climate change* and *large-scale development* were the primary drivers of change. Further, we observed that each community had unique understandings of how these factors were integrated into the system, though residents perceived the region as having many external controlling functions. Leveraging participatory tools such as fuzzy cognitive mapping in contexts defined by complexity and uncertainty like Denali can be a useful for elucidating key perceptions of a social-ecological system and inform decision-makers about the tradeoffs that may emerge from multiple decision outcomes.

### 4.1. Comparison of the perceived structural patterns of social-ecological conditions

*Tourism*, *Wilderness*, *sense of community*, and *subsistence* were the most important socio-economic, ecological, and socio-cultural features of the Denali region. *Tourism*, in particular, was important for maintaining the structure of this social-ecological system. All communities in the Denali region depended on *tourism* for *local business* and *seasonality*, particularly in McKinley Village, Talkeetna, and the Stampede. These communities characterized a system that incorporated features and interactions among features that are prominent in resource management plans, including *recreation*, *amenities*, *waste management*, and *traffic*. However, differences within these communities did emerge. Unlike in McKinley Village and Cantwell, residents of Talkeetna and the Stampede perceived *tourism* as more harmful than beneficial. These participants indicated that increases in *tourism* deplete ecological features (e.g., *wildlife*, *Wilderness*, *healthy ecosystems*) and may hinder socio-cultural experiences including *recreation*, *subsistence*, and preserving a *rural lifestyle*. Corroborating previous research, our findings indicate that residents position tourism as a tool for generating economic support for local livelihoods and use economic gains from *tourism* to support conservation initiatives<sup>31</sup>. It could be that residents in different communities have varying degrees of expertise in environmental management, and therefore, knowledge of how to leverage funding to advance conservation initiatives. Further, residents saw *tourism* as a catalyst in landscape change, but expressed ambiguity in their attitudes toward the cascading impacts of



*tourism* on the social-ecological features that characterized the region. This result aligns with previous findings that greater knowledge of PA management problems and solutions influence residents' attitudes toward tourism<sup>32, 33</sup>.

Our results revealed tensions from competing land uses and visions for the future of the Denali region. Across communities, different preferences for subsistence use were expressed by residents. This variation should be interpreted within the context of the unique dual management of Alaska's public lands, wildlife, and resources shared by federal and state agencies<sup>72</sup>. The approach to managing natural resources in Alaska has led some residents to feel disenfranchised. While subsistence use has been described as a way of life for Native and non-native residents, non-native subsistence use has been characterized with roots in recreation or sport<sup>34</sup>. Historically, many Alaskan Natives, have expressed preferences for subsistence rights being given to Natives over rural residents and disapproved of ANILCA<sup>35, 36</sup>. Extending this finding, earlier phases of this research pointed to concerns around unilateral decisions being made about subsistence use across native and non-native people, and regulations on subsistence use as limiting recreation. There is also a legacy of mistrust between indigenous groups and management entities in Alaska, indicating that indigenous concepts about public land management priorities need to be more effectively engaged and incorporated in decision-making<sup>9, 37</sup>.

## 4.2. Implications for decision-makers

Our findings may be of interest to PA managers and practitioners seeking to improve participatory engagement strategies. We identified points of synergy and discrepancy among residents' perceptions of the Denali region, which can be helpful for developing communication strategies that are tailored to meet the needs of different communities. For example, *tourism* was a clearly defined and central feature of the Denali region, but there was variation in how residents in different communities positioned *tourism* in relation to other social-ecological features. Residents of Cantwell championed the economic benefits of *tourism* as outweighing its impacts, while residents of Talkeetna and the Stampede expressed more concern that *tourism* may diminish ecological health and integrity. Our results also highlight the key issues driving change, particularly *large-scale development* and *climate change*. Management attention, and possibly, intervention to address these issues may be received well by local residents. Decision-makers can use the results from this study as a roadmap for understanding what is threatening residents' desired sense of place. This place-based knowledge of local landscape conditions thus provides guidance for decision-makers on how to more effectively foster trust and enhance communication with a diverse constituency.

## 5. Conclusions

The ENVISION project has created multiple opportunities for expanding future research and guiding decision-making about PAs across the globe. The results presented herein elucidate how communities surrounding Denali National Park and Preserve and Denali State Park characterize the region as a social-ecological system. Through the application of an exploratory resiliency



framework<sup>38</sup>, our results indicate that *tourism*, *Wilderness*, *sense of community*, and *subsistence* are the most important features for maintaining the function and structure of the system, while *climate change* and *large-scale development* are the primary drivers of change. A comparison among communities indicated that residents across the Denali region consider decisions related to land use as drivers of change, and that these drivers are subject to external control. Variation across communities can be attributed to the different interactions between residents and natural resource management agencies. Our study adds to a growing body of work related to community engagement in PA decision-making processes and we contend that participatory approaches such as this one carry great potential to reveal the multiple and sometimes competing perspectives among stakeholders.

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## 7. Appendices

### APPENDIX A. ACTIVITY SHEET PROVIDED TO THE FUZZY COGNITIVE MAPPING FOCUS GROUP PARTICIPANTS

#### **SECTION A: Features of the social-ecological landscape in the Denali region**

This list was derived from preliminary research with the local community focused on understanding how the Denali region is characterized. These features represent the major components of people's lives and the natural environment surrounding Denali National Park and Preserve. Please read through this list, revise the material we have already developed, and add any other features that we might have overlooked.

#### **Social-cultural features of Denali**

1. **Open access to land:** Freedom to roam across the landscape and access to public or private land.
2. **Regional planning:** Planning for efficient placement of land-use activities, including laws for zoning, and land use regulations at a regional scale.
3. **Public land management agencies:** Agencies that manage or administer public land (e.g., Bureau of Land Management, National Park Service, and Alaska Department of Natural Resources).
4. **Wildlife management entities:** Agencies, departments, and boards that manage for the protection and maintenance of fish and wildlife (e.g., Alaska Department of Fish and Game)
5. **Sense of community:** An overall feeling of closeness to other members of a community as evidenced by frequent interactions, meaningful relationships, and shared understandings.
6. **Subsistence use:** Use of natural resources as a means of obtaining the necessities of life.
7. **Traditional ways of life:** Customs or practices that are characteristic of native groups of people and have been passed down for several generations.
8. **Education:** Organizations that provide education to members of the local community.
9. **Rural lifestyle:** The way of life in a small community located in a remote setting.
10. **Recreation:** Leisure activities such as rafting, hiking, and dog mushing that are experienced and enjoyed by residents and visitors.
11. **Local knowledge:** An understanding of the relationships between humans and their environment from experience and observation, including traditional ecological knowledge.
12. **Norms:** Informal rules that distinguish between acceptable and unacceptable behaviors.
13. **Land ownership:** Ownership of land by different interest groups (e.g., Native land corporations, Alaska Department of Natural Resources, private land ownership, the railroad, or mining claims)
14. **Federal legislation:** Legislation at the federal level that influences Denali residents (e.g., Alaska Native Interest Lands Conservation Act [ANILCA], National Environmental Policy Act [NEPA]).
15. **Local organizations:** Organizations that aim to improve social, economic or environmental wellbeing (e.g., Denali Borough Assembly, Denali Citizens Council, Denali Chamber of Commerce).



### Physical features of Denali

1. **Wilderness:** Land that is used by people in a way that leaves it unimpaired for future generations and provides opportunities for solitude.
2. **Charismatic landscape:** Scenic and aesthetic qualities of the Denali landscapes such as mountain ranges, diverse ecosystems, the Aurora Borealis, and undeveloped land.
3. **Healthy ecosystems:** Ecosystems that have the ability to maintain their structure and function over time in the face of external stressors.
4. **Public land:** Federally owned land in the Denali region that is managed by federal and state agencies.
5. **Wildlife:** Wild animals living in the region.
6. **Climate variability:** Changes in the long-term patterns of the climate.
7. **Natural resource extraction:** Extraction of natural resources from the environment by industries.

### Socio-economic features of Denali

1. **Seasonality:** Population fluxes associated with tourism, particularly increased populations of seasonal employees and visitors during peak seasons.
2. **Tourism:** Commercial operation of vacations that provides some opportunities for local business and industry to generate income from visitors across seasons.
3. **Energy industry:** Organizations involved in the production and distribution of energy (e.g., Usibelli Coal Mine, Golden Valley Electric Association).
4. **Local business:** Small-scale businesses owned by members of the local community.
5. **Large-scale development:** Increases in commercial and industrial developments in the Denali region

**Other:** \_\_\_\_\_

### SECTION B: Individual mapping exercise and personal information

Now that we have discussed how the region is characterized, we would like to learn more about your views on the relationships among features of the Denali landscape.

Please use the blank sheet of paper that we have provided to draw connections among the social-ecological features of Denali landscape. Please follow the steps below:

1. **Step 1:** On the blank sheet of paper, please identify the features from Section A that are most important for characterizing the Denali region. Write each feature on a post-it note.
2. **Step 2:** Place the post-it notes on your sheet of paper and draw connections between them using directed arrows. The connections can be either positive or negative.
  - a. Use a **black pen** to indicate *positive* relationships (i.e., one component increases another)
  - b. Use a **red pen** to indicate *negative* relationships (i.e., one component decreases another)
3. **Step 3:** Review your map and weight the influence of features on one another:
  - a. Weak: Thin arrow
  - b. Medium: Regular arrow
  - c. Strong: Thick arrow



**SECTION C: Personal information**

In the last section you told us how the key features of the Denali region are connected as a system. Now we would like to learn more about how you identify as an individual, and your interests in staying in touch.

We would like to better understand how you identify as an individual. We have heard people describe many different groups in the local community that people associate with such as education, local government, environmental management, indigenous people, industry, tourism, local businesses, mushing, recreation, subsistence use, and long-term residency. In the space below, please describe the groups that define you.

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**We have just a few remaining questions about how you would like for us to stay in touch:**

1. Would you like to be receive a copy of the transcript from our group conversation?  Yes  No
2. Would you like to participate in the next stage of our research?  Yes  No
3. Would you like a copy of the report and findings from our group discussion?  Yes  No

If you answered “yes” to any of these questions, please provide your contact information here:

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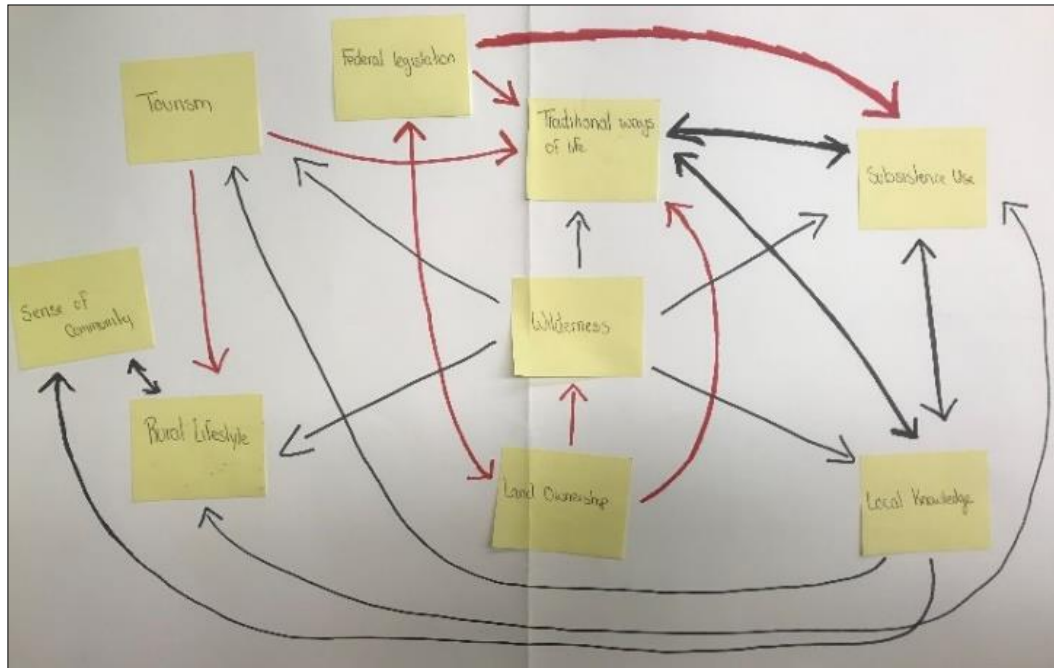
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APPENDIX B. A PHOTOGRAPH OF A COMPLETED FUZZY COGNITIVE MAP





## APPENDIX C. SEMI-STRUCTURED INTERVIEW GUIDE

### Interview Questions

The tone of the interview will be conversational and relaxed. The questions do not need to be asked in the order below. Prior to starting the interview I will (a) provide an introduction to the study objectives and methods, and (b) walk through the “consent form” to ask if you would mind the interview being audio-recorded.

#### 1. Identify special places in the region.

- a. How long have you lived in the area? You’ve purposely chosen to live here, in ways that many others would have moved on. Could you talk about your care about this place? What makes this place special/unique?
- b. Are there any places in the Denali region that are important to you? Your family? Your community? Your nation/state?
  - i. Have these places changed over the years? Will they change in the future?
- c. Do you ever take your family or friends to these places? Where? Why? When people come to visit you, what do you want them to remember when they leave?
- d. What relationship between you and your community would you like others to know about?

#### 2. Describe key issues pertaining to resource management and conservation.

- a. What are the current resource management challenges that influence the environment and local communities in the Denali region? Are these good or bad changes? How do you shape these challenges?
- b. How does what you do relate to conservation? Could you talk about what you’ve learned from your experiences? Are you doing anything differently now due to something you’ve learned over the years?
- c. What are the most important organizations in the Denali region for conservation? Do you work with any of these groups? How often do you engage with these groups and what do you discuss?
- d. When thinking of resource management organizations, is there anything you would change about the way they do things? How could they make these changes?



### 3. Discuss how places are changing in the Denali region.

- a. How is the Denali region changing? Why have changes occurred over the past 10 years?
- b. Are there “hotspots” of change in the Denali region? What are these changes and where are they occurring?
- c. Are there places in the region that have not changed over time? Where are these places? Do you see them changing in the future, or is there pending change on the horizon?
- d. What are the effects of landscape change in the region on your lifestyle? Quality of life or professional work? For communities who live nearby?
- e. Please characterize your vision of how the region *should* change in the future. In other words, are the current changes good or bad?
- f. To what extent would other residents agree with some of your thoughts about landscape change and caring for the land? Have you learned about changes on the land from other people, and if so, what have you learned?

### 4. Final questions

- a. Are there people you think are especially knowledgeable about landscapes of the region who we should contact?
- b. Did we miss anything in our discussion? Are there things that are essential to resource management that we have not covered?
- c. Any questions for us?
- d. Would you be interested in participating further with this study?