

PLANTS AND FOODWAYS OF THE STANDING ROCK NATION:
DIVERSITY, KNOWLEDGE, AND SOVEREIGNTY

A Thesis

Presented to the Faculty of the Graduate School
of Cornell University

In Partial Fulfillment of the Requirements for the Degree of
Master of Science

by

Morgan Laurent Ruelle

January 2011

© 2011 Morgan Laurent Ruelle

ABSTRACT

Communities throughout the Standing Rock (Sioux) Nation in the northern Great Plains are suffering from diet-related diseases. Community members identify specific traditional foods that they know can treat and prevent these diseases. Traditional foods often rely on plants that are found within the Standing Rock landscape, and many elders know how to gather these plants in accordance with cultural values. Interviews with elders reveal a diversity of knowledge about plants. Elders know about different plants, and also hold different knowledge about the same plants. These differences are explained by variation in use. Elders' knowledge about the seasonal availability of plants varies according to microclimatic variables at specific gathering locations, preferences for plants at different stages of development, and gathering strategies for multiple species. Differences in knowledge within communities can represent an adaptive asset. Interviews confirm that elders have adapted to social and ecological change in the past, and that their knowledge is inherently responsive to highly variable weather patterns in the Great Plains. The diversity of knowledge within communities is a source of adaptive capacity that should be reinforced in the context of global climate change.

Many elders and other members of Standing Rock communities share a concern that younger generations are not learning to practice traditional foodways. Tribal agencies and local organizations facilitate gathering trips for youth to gain ecological knowledge from elders. A coalition of these groups also began organizing workshops for elders who wished to share their knowledge about traditional foodways with each other. The potential and probable roles of local organizations are often overlooked in studies of indigenous knowledge transmission. Reflective interviews with elders and organization staff investigated changes in perception, human

ecological relations, context specificity, and practical wisdom. This approach identified important dimensions of knowledge transmission that can guide similar collaborations in other indigenous communities.

Efforts to increase the availability of local food plants on Standing Rock are an attempt to reclaim food sovereignty. Food sovereignty has been asserted as a right to protect local food systems from global trade agreements, but exercises of this right require renewed capabilities to produce and distribute culturally-significant foods. An innovative food assistance program for elders administered by the Standing Rock tribal government helped revitalize local markets and increase the availability of fresh, local gathered and garden produce within communities. As participation in this voucher program and the local food economy expands, organizers considered the spatial arrangement of new food system components. Spatial analysis of voucher issuance and redemption reveals that minimum cost-distances to market explain 33% of the variance in voucher redemption of Standing Rock districts. Cost-distance analysis was also used to compare the effects of potential new market locations on program equity and efficiency for elders and market vendors. The analytical tools that were developed can help planners evaluate spatial factors as they decide where to locate new markets and enhance food sovereignty.

Although analyzed as distinct projects for the sake of clarity, the three components of this research were implemented concurrently and specific outcomes were critical to the success of other components. An integrative model was developed to understand these interactions and demonstrate linkages between diversities of knowledge, local organizations' efforts to facilitate knowledge transmission, and the growth of local food systems.

BIOGRAPHICAL SKETCH

Morgan Ruelle grew up in West Bolton, Vermont. Morgan studied ecology and evolutionary biology at Yale University. His senior thesis, supervised by professor Adalgisa Caccone, measured change of intron spacers in the nuclear genome of Galapagos tortoises (*Geochelone nigra*). During college, Morgan worked for Olympic National Park and the Nature Conservancy of Wyoming, and spent a semester studying with the School for Field Studies in Kenya. After graduating with his B.S. in 2001, Morgan moved to Ridgecrest, California, where he worked as a wildlife biologist for the Bureau of Land Management Desert Monitoring Team. His projects measured the effects of off-highway vehicle recreation on desert tortoise (*Gopherus agassizii*), Mohave ground squirrels (*Spermophilus mohavensis*), wintering songbirds, and bats. In 2004, Morgan joined the U. S. Peace Corps and served as an environmental education volunteer in Gyumri, Armenia. He developed teacher training programs with a local NGO and taught environmental English for after-school programs. In 2007, Morgan became an Americorps*VISTA volunteer with the National Society for American Indian Elderly and began his work in the Standing Rock Nation. In 2008, Morgan joined the Department of Natural Resources at Cornell University to study with professor Karim-Aly Kassam. He returned to Standing Rock in 2009 to conduct his Master's thesis research.

In memory of
Patricia Herron,
Victoria “Zona” Loans Arrow,
Marcella Rose Buckley,
and Byron Olson

ACKNOWLEDGEMENTS

This research would not have been possible without Luella Harrison, the director of Nutrition for the Elderly and Caregiver Support (NFE). I am in awe of her organizational agility and her devotion to elders. I am thankful for her constant guidance, support, and friendship.

I am equally grateful for my major advisor, professor Karim-Aly Kassam at Cornell University. As a friend and mentor, he has unmistakably changed the way I approach this work. I am also appreciative of the other members of my committee - Professors Stephen Morreale, Timothy Fahey, and Kurt Jordan - for guiding me, raising important questions, and contributing valuable insights. Professors Steve DeGloria, Scott Peters, Rebecca Schneider, and Bernd Blossey also reviewed and strengthened various iterations of my research proposals.

My first year working in Standing Rock communities was sponsored by the National Society for American Indian Elderly. Thanks to director Victoria Collins and VISTA supervisor Dollie Chauvin for their support.

Thanks to current and past NFE employees Helen White, Cheryl Antelope, Autumn Grey Bull, Charmayne Eagleman, and Wilbur Pleets, who all made significant contributions to this work. Thanks to all the district cooks who fed me while I was working in their communities.

Thanks to Aubrey Skye at the Native Gardens Project (NGP), his faithful volunteer Linda Skye, and rest of the Standing Rock Diabetes Program, including director John Buckley, Amanda Tesch, Gerald Iron Shield, Elizabeth White, Marilyn Sandland, Sheridan Sea Boy, and Errol (Doug) Crow Ghost. As a program evaluator for the NGP, Aiko Allen provided inspiration and literature recommendations.

The Elder Advisory Council has guided and inspired me, and many of its members led and participated in activities described herein. I am indebted to chairwoman Shirley Marvin, as well as current and former members Mary Jane Tiokasin, Pearl Day, Thelma Shelltrack, Blanche Lawrence, Immogene Taken Alive, Iyonne Bear Ribs, Lillian White Temple, Joyce Hollow, Calvin Hoisington, Charmayne Eagleman, Rosa Wilson, Jeanette Cluett, Maxine White Bull, and Virginia Walking Bull.

In addition to elders mentioned above, I am thankful for my visits with many others, particularly Stella Whitesell Guggolz, Florence McLaughlin, Helmina Makes Him First, Leonard Village Center, Sidney Eagleshield, Sr., Therese Martin, and Vernon and Theo Iron Cloud.

Thanks to the staff of Sioux County Cooperative Extension (North Dakota State University) for your energy and dedication, including county agent Sue Isbell, Mary Jean Hunter, Cassie Deneen, and Cindy Dunn. Thanks to all of the elders and others who participated in the Standing Rock Winter Market Education Series at the Old District Building in Fort Yates, particularly Loretta Yback and Rita Loon for leading workshops.

Thanks to the youth at the Grand River Boys and Girls Club Teen Center who were excited to travel all over Standing Rock in search of healthy foods. I am indebted to Diana Shippentower, Aubrey and Linda Skye for making those outings possible. We appreciate that the Porcupine Boys and Girls Club joined us when they could. Thanks to the third, fourth, and fifth grades and their teachers at the Standing Rock School Night Lights Program who prepared chokecherry patties for the elders last Christmas. I appreciate Charmayne Eagleman, Isaac Dog Eagle, Winona Eagleshield, Helen White, Wilbur Pleets, and Loretta Yback for sharing your knowledge and memories with all of us during those trips and workshops.

I am grateful for the gardeners and gatherers who participated in the Standing Rock Farmers Market including Basil Two Bears, Sam and Twyla Rough Surface, Allison Two Bears, Pat Elk, Jeff McLaughlin, Dana Yellow Fat, Paul Schuh, Alberta Condon, and Don White. Thanks to farmers from other parts of North and South Dakota who participate in the Standing Rock Senior Farmers Market Nutrition Program, particularly Dwight and Patsie Duke for bringing vegetables to McLaughlin.

Thanks to former Standing Rock Chairman Ron His Horse is Thunder, current Chairman Charles Murphy, and the Standing Rock Tribal Council Members (particularly members of the Health, Education, and Welfare Committee) who support this work. Thanks to Joe Dunn and Linda Different Cloud Jones at Sitting Bull College; Joe Smith at Standing Rock Land Management; Dwight Teske at the Natural Resources Conservation Service; Ladonna Brave Bull Allard at Standing Rock Tourism; Wasté Win Young, Tim Mentz, Sr., and George Ironshield at the Standing Rock Tribal Historic Preservation Office; Randy Bear Ribs, John Eagleshield, and Arleata Ironshield in the Tribal Health Department.

I am indebted to Kimberly Sturm and Pat Poitra for taking me into their home, feeding me, sharing their dogs, and teaching me about herbs, fish, and live auctions.

The research conducted in June through December 2009 was supported by a Graduate Research Fellowship from the National Science Foundation. Additional travel grants to conduct this research were provided by the Cornell American Indian Program and North Dakota Sustainable Agriculture Research and Education. My service as an Americorps*VISTA volunteer was supported by the Corporation for National and Community Service. The Senior Farmers Market Nutrition Program is funded by the U.S. Department of Agriculture, Food and Nutrition Services Division.

Finally I am grateful for my parents who make everything much possible. Kevin and Neidi, thank you!

TABLE OF CONTENTS

BIOGRAPHICAL SKETCH.....	iii
DEDICATION	iv
ACKNOWLEDGEMENTS	v
LIST OF FIGURES	ix
LIST OF TABLES	x
INTRODUCTION	1
CHAPTER 1: KNOWING MANY WAYS, DIVERSITY OF PLANT KNOWLEDGE WITHIN COMMUNITIES AS AN ADAPTIVE ASSET	9
CHAPTER 2: THE ROLES OF LOCAL ORGANIZATIONS IN KNOWLEDGE TRANSMISSION, A HUMAN ECOLOGICAL PERSPECTIVE	39
CHAPTER 3: PRACTICING FOOD SOVEREIGNTY, SPATIAL ANALYSIS FOR AN EMERGENT FOOD SYSTEM.....	72
CONCLUSION	103
APPENDIX A: DESCRIPTIONS OF KNOWLEDGE DOMAINS	110
APPENDIX B: PLANT KNOWLEDGE BASE	113
APPENDIX C: SEASONAL AVAILABILITY OF FRESH PRODUCE AT THE STANDING ROCK FARMERS MARKET IN 2009	128
REFERENCES	130

LIST OF FIGURES

Figure 1. The Standing Rock Nation and its communities.....	12
Figure 2. Seasonal round of elders' use of key non-cultivated food plants.	26
Figure 3. The cycle of phronesis (practical wisdom).	48
Figure 4. Locations of knowledge transmission activities organized in Standing Rock in 2009.	51
Figure 5. Number of vouchers redeemed at markets and roadside stands.	84
Figure 6. Cost-distance per trip to markets within Standing Rock.....	86
Figure 7. Effect of minimum cost-distance to market on voucher redemption rates per district.	87
Figure 8. Cost-distances to market for Standing Rock in 2009.....	90
Figure 9. Comparison of changes in cost-distances to market with the addition of markets in Porcupine, Cannon Ball, and Wakpala communities.	91
Figure 10. Conceptual diagram of interactions between knowledge sets, community actions, and supply and demand for fresh food.	108

LIST OF TABLES

Table 1. Land cover and use in the Standing Rock Sioux Reservation in 2001.....	15
Table 2. Non-cultivated plants discussed by elders during interviews.	24
Table 3. Standing Rock elders’ knowledge about non-cultivated food plants within selected knowledge domains.	25
Table 4. Comparison of elders’ salient plant knowledge within habitat classes 1990- 2010.	31
Table 5. Participation by organizations and communities in inter- and intragenerational activities.....	52
Table 6. Organizational associations and roles of interviewees in intergenerational and intragenerational knowledge transmission events.	53
Table 7. SFMNP participation and voucher redemption rates per district.	83
Table 8. Summary of markets authorized to participate in SFMNP during the 2009 season.	84
Table 9. Changes in cost-distance per community with the addition of new markets.	89
Table 10. Summary of effects of new markets on cost-distances for previously authorized and potential market vendors.....	92

INTRODUCTION

The following chapters describe three interrelated projects aimed at promoting traditional foodways in the Standing Rock Nation of the northern Great Plains. As a researcher, I played a role in events I describe, and I have a particular perspective on them. At the same time, this research reflects the knowledge and interpretations of research partners who have dedicated time and energy to meaningful community actions and agreed to talk about what we have accomplished together. I hope that partners in Standing Rock agree that our work together, including this publication, belongs to them.

My research process began before I knew it had begun; the work that I conducted on the Standing Rock Sioux Reservation in 2009 was only possible because of relationships I had developed there earlier. In February of 2007, I moved to Standing Rock as an Americorps*VISTA volunteer with the National Society of American Indian Elderly (NSAIE). NSAIE works in partnership with Native Americans throughout the United States. They offered me a one-year position with Nutrition for the Elderly and Caregiver Support (NFE), a government agency within the Standing Rock Tribal Health Department. NFE serves hot meals to over 400 elders at “nutrition sites” located across a vast (2.3 million acre) reservation. NFE also conducts home visits, trains caregivers, and provides assistive technologies. NFE works closely with the Elder Advisory Council (EAC), a tribal non-profit organization that includes elder representatives from each of the eight administrative districts of Standing Rock. The EAC meets each month to review NFE activities and discuss issues pertaining to elders, including crime and security, health care services, and water resource management. As a VISTA volunteer, my role was to identify and develop opportunities to improve services for elders; NFE staff and EAC members guided my work.

One of my first projects was to help design a needs assessment for reservation elders, which is required for funding that NFE receives from several federal sources. In the past, this assessment had been conducted by a university research group, but elders felt that some of the questions were not culturally appropriate, many responses were taken out of context to facilitate comparison with elders elsewhere, and the future use of potentially sensitive information was unclear. I worked with EAC members to develop an assessment to be conducted by NFE staff that would meet the federal requirements but also gauge interest in new services and projects that NFE and the EAC were considering.

The needs assessment (NFE 2007) confirmed that Standing Rock elders suffer from a number of diet-related diseases, including diabetes, obesity, hypertension, and heart diseases. Although elders understand that these diseases are diet-related, most said they do not follow the dietary recommendations provided by their doctors. Interviewers did not ask elders why they choose not to follow these diets, but several elders mentioned that the foods that are recommended are unfamiliar or the restrictions are not culturally appropriate. Alternatively, many elders repeated that “traditional foods” are healthy for them. The needs assessment did not raise the next question: if elders know that traditional foods are healthy, why aren’t they consuming more traditional foods? As I continued my work in Standing Rock, I discussed a number of hypotheses with NFE staff, elders, and other community members:

1. *Populations of plants and animals needed for traditional foods are smaller than in the past.* Many of the traditional foods described by elders require plants and animals from the Standing Rock landscape. Changes in the Standing Rock landscape have reduced the populations of some of those plants and animals. For example, “mouse beans” and other important food plants were reduced or eliminated from Standing Rock when the Oahe

Dam permanently inundated most of the floodplain forests (Jones 1998). Elders told me that most of the food plants that they know how to use are abundant in Standing Rock, but some individuals are concerned that new environmental changes (including water pollution and climate change) will impact those populations in the future.

2. *Plants and animals needed for traditional foods are difficult to access.*

Even if populations of plants and animals are large enough to be sustainably gathered or hunted, changes in land ownership can reduce access for families. Many elders say that there are more fences on Standing Rock than when they were young. Some historically important gathering areas (e.g. west of Porcupine community) are now privately owned and access is denied. On the other hand, many families without land can access relatives' land or develop informal arrangements with other private landowners.

3. *Some elders don't know how to practice traditional foodways.* The needs assessment showed that 71% of elders said they knew how to gather plants for food (NFE 2007). Interviewers did not ask elders whether they know how to hunt or prepare traditional foods. Many elders attended boarding schools as children, and this reduced the amount of time they could spend with parents and grandparents learning to gather, hunt, or prepare traditional foods. Although no quantitative data are available, many elders say that they remember their family members preparing traditional foods, but don't know how to do these things themselves.

4. *Many young people don't know how to gather or hunt food for their families.* Although many elders still gather plants or hunt animals, many cannot engage in strenuous physical activity. Many elders say they have

taught their children and grandchildren to gather plants and hunt, but the same elders often express concern that other young people have not developed these skills. Elders say that a significant number of young people do not have knowledgeable parents and grandparents who can teach them to gather and/or hunt.

5. *Young people lack interest in traditional foodways.* Although many elders talk about the benefits of modern technologies, they express concern that televisions and computers dominate young peoples' lives. Many young people aren't as interested in traditional foodways as they are in other activities. Some elders are doubtful that young people will learn to gather, hunt, or prepare food, and will choose to eat convenient foods instead. Other elders are confident that if young people learn about traditional foodways, they are more likely to practice them.
6. *Although elders know that traditional foods are healthier, they simply prefer other foods.* Standing Rock families are not alone in choosing to eat unhealthy foods; dramatic changes in American food supplies and consumption are responsible for doubling the national obesity rate since 1970 (Wells and Buzby 2008). Nutrition experts believe Americans are eating too many added fats, refined grains, and added sugars and sweeteners and too few fruits, vegetables, lean meats, whole grains, and low-fat milk products (Kantor 1998; Wells and Buzby 2008). Food system critics are calling on all Americans to eat the foods our parents and grandparents ate (Pollan 2008). The cultural significance of traditional foods may be an alternative to the convenience of highly-processed foods. Elders often express excitement about traditional foods and the practices associated with them.

7. *The ingredients needed to prepare traditional foods are more expensive than those needed for other foods.* Traditional foods often rely on plants that are gathered from the landscape. Gathering can require significant investments of time, and local gatherers value these plants accordingly. Although they may be interested in purchasing them, many elders cannot afford to purchase plants from local gatherers. Federal and local food assistance programs provide many elders with much of the food they need. Although this assistance benefits many elders, it may also serve as a disincentive for elders to purchase other foods, even when they know other foods are healthier for them. Food assistance programs that include non-cultivated plants could make them available to more elders and their families.

During the remainder of my service as a VISTA volunteer, I began developing proposals for an applied research project on Standing Rock that would help elders and local organizations promote traditional foodways. I refined these proposals during my first year of graduate study at Cornell University. At first I was interested in developing habitat models for food plants in order to predict their occurrence in the landscape and help local gatherers manage their populations. When I returned to Standing Rock in March 2009, gatherers told me that most of the food plants they gather are fairly easy to locate because they are found along rivers or wooded ravines, which are highly visible in an otherwise open landscape. Gatherers told me that they didn't need maps to find plants, and were concerned that maps would only make it easier for those gatherers who are not interested in the long-term abundance of local food plants. In addition, conversations about access indicated that gatherers were uncomfortable discussing their arrangements with landowners.

I continued a search for research questions that would have meaningful answers. As I discussed my research process with NFE staff and elders, I clarified the goals of my master's research. First, I was clear that I needed to complete my research in the course of six months on Standing Rock. Next, I was committed to helping elders share their knowledge about plants with young people. My focus on intergenerational activities gave me a reason to learn about local food plants from elders, their seasonal availability, and their use in a diversity of foodways. In order to promote the consumption of healthy foods in Standing Rock communities, I also wanted to help organizations expand local markets for food plants.

My research process therefore sought to answer three questions:

1. What do elders know about local food plants?
2. What roles can local organizations play in the transmission of indigenous ecological knowledge?
3. How can contemporary spatial analysis tools contribute to the development of a local food economy?

I began by interviewing several members of the EAC to determine what they know about food plants. In place of habitat mapping, the elders expressed interest in developing a seasonal round of non-cultivated food plants that could be used as a planning tool by gatherers and educators. Since the seasonal round was the center of an otherwise open-ended discussion of food plants, we discussed the seasonal availability of plants in the most depth. **Chapter 1** is the result of those conversations. I found that elders within the same community can hold a diversity of knowledge about plants. Elders not only know about different plants, but also hold distinct knowledge about the same plants. By linking these differences in knowledge to variations in practice, we make the case that a diversity of knowledge is an adaptive asset rather than a threatening lack of consensus.

While I was conducting those first interviews, I was also developing partnerships with the Native Gardens Project (NGP), the Grand River Boys and Girls Club (BGC), and Sioux County Cooperative Extension (SCCE). With NGP and the BGC, I helped organize gathering trips for elders and young people that served as intergenerational knowledge transmission activities. With SCCE, I facilitated after-school programs at the Standing Rock School, in which elders taught students from grades 3-5 to prepare chokecherry patties for other elders in their communities. At the same time, I worked with NGP and SCCE to organize workshops about traditional foods at the Standing Rock Farmers Market. We set out to create another set of intergenerational activities, but found that elders were as eager to learn from each other as they were to teach young people. Unexpectedly, workshops focusing on intragenerational knowledge transmission between elders were as meaningful (as indicated by elders' feedback) as the activities targeting youth. In **Chapter 2**, I focus on the role of local organizations (such as NGP, BGC, and SCCE) in facilitating knowledge transmission based on interviews with elders and organizers as they reflected on all of these community actions.

During my previous service as a VISTA volunteer, I had worked with NFE and the Standing Rock Conservation District (SRCD) on a grant for a Senior Farmers Market Nutrition Program (SFMNP) that would be administered by these two tribal agencies. SFMNP is a national program sponsored by USDA Food and Nutrition Services and administered by state and tribal agencies that provides low-income seniors with vouchers that can be exchanged for fresh locally-grown and unprocessed fruits, vegetables, herbs, and honey at authorized farmers markets. The SRCD led efforts to develop the Standing Rock Community Farmers Market in Fort Yates in 2007. A change in leadership at the SRCD coupled with declining vendor participation meant that market activity and income generation waned in 2008. In

2009, NFE, NGP and SCCE assumed responsibility for the market. For the first time, elders could redeem SFMNP vouchers at the market, and this promised to increase interest and participation of local gatherers and gardeners. **Chapter 3** assesses the contribution of the Standing Rock SFMNP to food sovereignty, which is both the right and capacity of communities to choose their food and food practices. We also show that the spatial arrangement of markets impacts the ability of communities to access fresh foods. Although we believe that specific methods for developing local food systems should be determined by community members based on a number of additional factors, we propose three approaches to determine new locations for markets based on the equity and efficiency of their spatial arrangement.

Although we can think of these three chapters as distinct, they are deeply interrelated. Observations of the diversity of knowledge within the community (Chapter 1) impacted knowledge transmission activities described in Chapter 2. Knowledge transmission projects described in Chapter 2 contribute to the practice of food sovereignty, including the demand for fresh foods, discussed in Chapter 3. In the **Conclusion**, I link these applied research components together by developing a model that may be useful in other communities.

CHAPTER 1

KNOWING MANY WAYS: DIVERSITY OF PLANT KNOWLEDGE WITHIN COMMUNITIES AS AN ADAPTIVE ASSET

Introduction

Indigenous knowledge systems are increasingly appreciated for their ability to anticipate, recognize, and respond to change (Berkes, Folke, and Gadgil 1995; Nyong, Adesina, and Osman Elasha 2007; Turner and Clifton 2009). Some researchers have documented mechanisms within indigenous knowledge systems that facilitate adaptation and contribute to resilience (Berkes, Colding, and Folke 2000; Berkes and Turner 2006; Kassam 2010). Of particular interest are the contributions of biocultural diversity to adaptive processes. Biocultural diversity, which includes the diversity of life in all of its manifestations, is a source of adaptive capacity because it represents the range of possibilities for humans to sustain their communities in challenging dynamic landscapes (Harmon 2002). Investigations of biocultural diversity have been conducted on global, national, and regional scales (Nabhan, Pynes, and Joe 2002; Loh and Harmon 2005; Maffi 2005). However, less attention has focused on differences within cultural groups. Since biocultural diversity is critical to human adaptation, the survival of particular communities may rely on diversity at local scales (Kassam 2009a).

In contrast, ecologists study biological diversity at a range of scales, from the genotypic variation within a population to the global diversity of ecosystems (Noss 1990). According to evolutionary theory, a population is able to respond to selective pressures when it contains enough phenotypic variations for some individuals to survive changing conditions (B. R. Grant and P. R. Grant 1993). In a similar fashion, humans may rely on diversity within their cultural groups to respond to change (P. J. Pelto and G. H. Pelto 1975). This is not to imply that all valuable diversity arises from

within a given cultural group; exchanges with other groups are important sources of innovation. Nevertheless, as indigenous communities respond to the multiple impacts of colonialism, globalization, violent conflict, and climate change, they draw upon context-specific knowledge to survive (Kassam 2010). Different ecological knowledge held by individuals within indigenous communities is fundamental to community adaptation.

Studies of indigenous knowledge often rely on interactions with a few community members to characterize knowledge held by entire communities (Davis and Wagner 2003). However, when researchers assume that the knowledge of “local experts” represents a consensus within the community, the research process obscures important differences (P. J. Pelto and G. H. Pelto 1975). Of additional concern is the assumption that indigenous communities prefer consensus to intellectual plurality, when in fact communities might value different ecological knowledge (Kassam 2010). Hence, communities may have an interest in research that investigates differences within their knowledge and identifies the possibilities that arise from that diversity. Engaging a broader range of knowledge holders in the research process is an opportunity to examine the diversity of experience within a community and the roles it plays in adaptation.

In the study that follows, a community of elders living on the Standing Rock Nation explored their knowledge of non-cultivated food plants¹. During interviews, elders shared stories that contain a diversity of plant knowledge. These stories reflect individuated ecological relations between elders and plants in their landscape. Our

¹ Most of these plants are commonly described as wild despite a body of documented evidence that indigenous communities play key roles in the growth and development of such plants (K. Anderson 2005). The distinction we make between cultivated and non-cultivated plants refers to different modes of management. Cultivated plants are typically placed (as seeds, rootstocks, or transplants) in home gardens and tilled fields where soils are managed to promote their growth. Non-cultivated plants grow in places where soils are not managed in these ways, such as forests and prairies but also roadside ditches.

research interrogates linkages between differences in knowledge, elders' personal experiences with plants, their adaptations to past social and ecological changes, as well as their ability to respond to uncertainty in the future. By focusing on the diversity of the knowledge of elders, we investigate a potential source of adaptive capacity for their communities.

Context

The Standing Rock Sioux Nation extends west from the Missouri River as it flows across the border of North and South Dakota (see Figure 1). The reservation boundaries encompass 2.3 million acres. In 2007, the population of Standing Rock was projected at 8116 persons, of which 77.3% are Native American (U.S. Census Bureau, Population Estimates Program 2008). Most Native Americans living in Standing Rock are enrolled in the Standing Rock Sioux Tribe, which includes descendents of the *Ihąŋkthūnwaŋna*² (Upper Yanktonai, “Those dwelling at the end”) and *Húŋkpatina* (Lower Yanktonai, “Campers at the horn”) groups who speak the Dakota language, as well as *Húŋkpaŋhǎ* (“Head of the camp circle”) and *Sihásapa* (“Blackfeet”) groups who speak the Lakota language (Barrett et al. 1995; Ullrich 2008). Fort Yates, North Dakota, is the seat of the tribal government, including the offices of the Standing Rock Tribal Chairman and Tribal Council. The reservation is divided into eight administrative districts that each elects a representative to the Tribal Council and a chairperson who oversees district business. Standing Rock districts own and manage community centers, social programs, range and agricultural lands, cattle operations, and bison herds. Whereas identities have historically been linked to

² Although the author acknowledges important local differences in the spelling and pronunciation of Dakota and Lakota words, the spelling and orthography used here are taken from Ullrich (2008) for purposes of consistency and comparability.

oyáte (tribe or people) and *thiódspaye* (extended families), Standing Rock residents often also identify with their district of origin (Barrett et al. 1995).

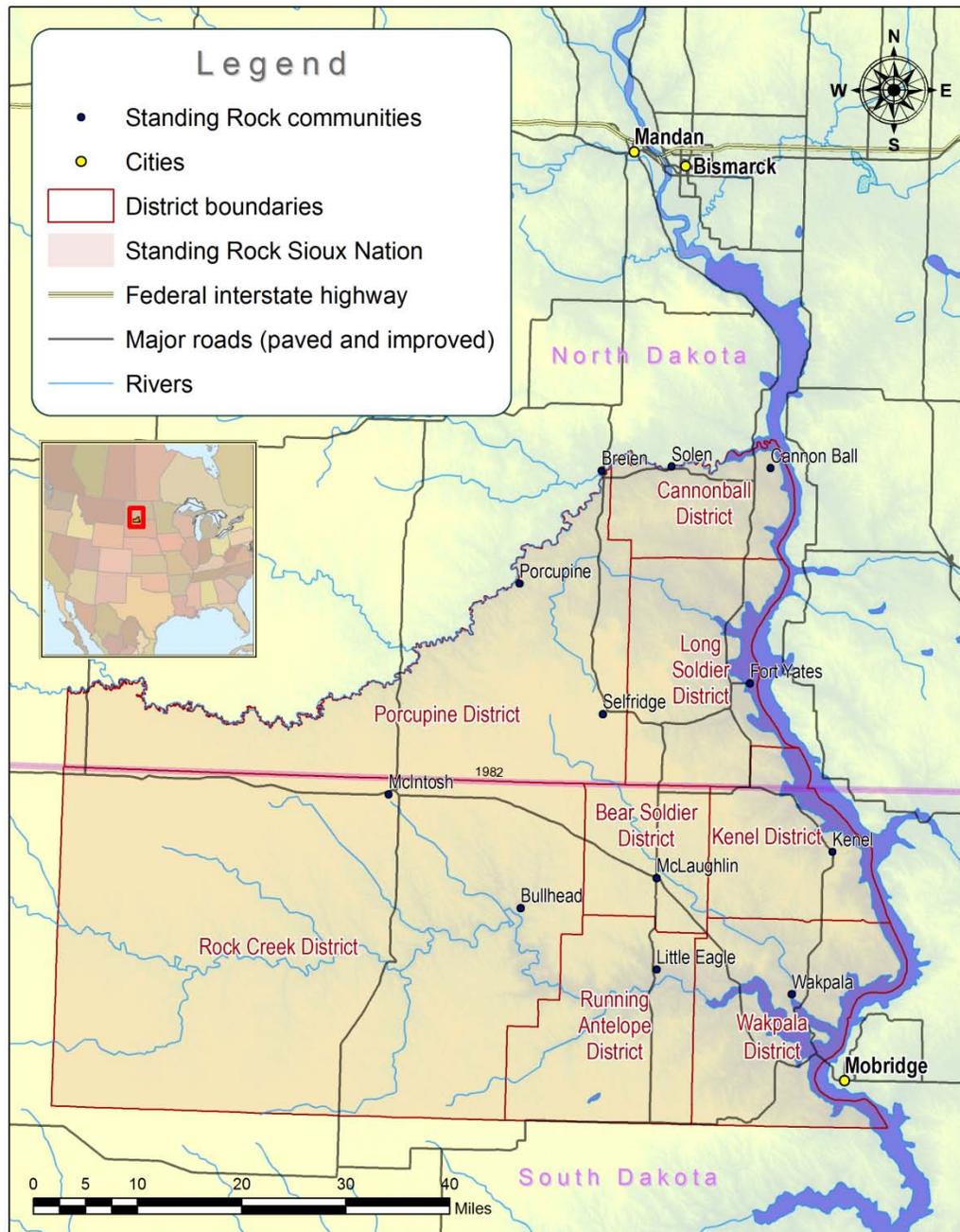


Figure 1. The Standing Rock Nation and its communities.

Elders³ in each district select a representative to the Elderly Advisory Council (EAC), a non-profit organization founded in 2001 to guide tribal government programs that serve elders. The EAC was convened by Nutrition for the Elderly and Caregiver Support (NFE), a tribal agency that provides elders throughout the reservation with food assistance and other services. A needs assessment conducted by the EAC and NFE confirmed that the majority of Standing Rock elders suffer from diet-related diseases (NFE 2007). Most alarming is that the incidence of diabetes among Standing Rock elders is approximately twice the rate for the rest of the United States (46% as compared to 23% nationally, CDC 2007). Despite the prevalence of diet-related diseases, interviews revealed that most elders choose not to follow diets recommended by their doctors⁴. Elders were not asked why they do not follow these diets, but several stated that recommended foods are unfamiliar or that suggested dietary restrictions are culturally inappropriate. Many elders told interviewers that they know that traditional foods can improve their health⁵, but that their consumption of these foods has lessened.

When elders speak about traditional foods, they do not imply that these foods should be prepared precisely as they were in some historical period; Dakota and Lakota traditions are dynamic. Long before their forced removal to reservations, Native people in the Great Plains reshaped their traditions to fit new social and ecological contexts. As examples, the aridity of the Little Ice Age in the 14th-19th centuries (Fritz, Engstrom, and Haskell 1994), the arrival of Spanish horses in the 16th century (Hämäläinen 2003), and the annihilation of the bison by the U.S. military in

³ Defined here as by tribal resolution to be any individual aged 60 and older.

⁴ 69.3% of elders identify Indian Health Service hospitals and clinics located in Standing Rock as their primary health care providers, 20.9% identified hospitals in Bismarck and Mobridge, 6.6% Veterans Health Administration facilities, and 2.2% private clinics (NFE 2007).

⁵ Although the nutritional values of traditional foods prepared on Standing Rock are not well-studied by nutritionists, most of these foods are derived from lean meat, fruits, and vegetables, and are therefore likely to be healthier for most adults than other foods that are available and affordable, as indicated by research conducted on other reservations in South Dakota (Harnack, Story, and Rock 1999).

the 19th century (Smits 1994) each required innovative adaptations. After Dakota and Lakota families were moved to Standing Rock in the 1870s and 1880s, Indian agents coerced them into adopting European-American farming systems (Pfaller 1992) and began issuing rations of meat, coffee, flour, and sugar (Jackson 1994). As communities came to depend on these new ingredients, traditional foods were again modified, and some entirely new practices emerged. To dismiss these changes as acculturation is to disregard many creative responses of indigenous peoples to colonialism. Traditions reflect constant tension between cultural change and continuity (Silliman 2009) that claimants to that tradition must negotiate. For the purposes of this study we identify traditional foods based on elders own indications.

Many of the traditional foods known by elders require plants and animals that live within the Standing Rock landscape. Throughout their histories in this area Native and settler communities have shaped their landscape, but in the memories of elders living today the most dramatic social and ecological changes resulted from completion of the Oahe Dam in 1959. Despite the protestations and legal actions of the Standing Rock tribal government, Congress authorized the U.S. Army Corps of Engineers to build a dam on the Missouri that permanently inundated 55,993 acres of Standing Rock land (Lawson 1994). We estimate that the dam destroyed at least one half of all forests in Standing Rock⁶, including most of its floodplain forests. Before 1959, floodplain forests had been the primary sources of food, medicine, fuel, fiber, fodder, and construction materials for reservation residents (Jones 1998; Kraft 1990; Lawson 1994). The dam also forced the relocations of nearly 200 families from their homes (Kraft 1990). Families that had lived in relative isolation along the river were relocated into government-built communities on the open prairie. Once again, the

⁶ This estimation is calculated by dividing the 55,993 acres lost by the current total cover of deciduous forests and woody wetlands shown by the National Land Cover Database in 2001 added to those lost acres, resulting in 55.8%.

people of Standing Rock were thrust into challenging new social and ecological contexts.

Table 1. Land cover and use in the Standing Rock Sioux Reservation in 2001.

Land Use/Land Cover Classification	Percent of total land cover
Open water	0.6%
Developed	1.3%
Barren Land (Rock/Sand/Clay)	0.1%
Upland forests (deciduous, conifer, and mixed)	0.9%
Grasslands (mixed-grass prairie)	78.5%
Pastures/Hayfields	3.5%
Cultivated crops	13.6%
Floodplain forests and other woody wetlands	1.1%
Emergent herbaceous wetlands	0.3%
TOTAL	99.9%

Source: U.S. Geological Survey, National Land Cover Dataset 2001

Although we recognize the importance of animals to traditional foods on Standing Rock, this paper focuses on food plants. At the beginning of the 21st century, Standing Rock is dominated by grasslands, cultivated crops, pastures, and hayfields (see Table 1). Those forests that were not destroyed by the Oahe Dam, located in wooded ravines and floodplains of the Missouri’s main tributaries, are a small part of the reservation land base (2%, Table 1). Interviews indicate that 71% of elders know how to gather plants for food (NFE 2007). At the same time, elders expressed concern that younger people are not learning how to use plants, and so their roles in the treatment and prevention of diet-related diseases are not fully realized.

The objectives of this research were to document plant knowledge held by Standing Rock elders and develop research products that effectively communicate that knowledge within their communities. Because community partners were wary about documenting the spatial distribution of food plants, we focused on their seasonal

availability. As differences in knowledge became apparent, we recognized a need to document the diversity of knowledge and investigate its role in adaptation.

Methods

Interviews were requested with the district representatives and alternate members of the EAC. These elders had worked closely with the author on previous projects and were deemed most likely to participate in subsequent research stages or related community actions. In order to engage a broader range of knowledge holders including men⁷, other elders were invited based on recommendations from within the EAC or by the NFE director. Although not a criterion for selection, all 13 participants had grown up in Standing Rock communities or lived on the reservation for at least 50 years.

From June through November 2009, semi-structured interviews with 13 elders (3 men and 10 women) were conducted in their homes and at district community centers. Seven interviews were conducted individually, while three were conducted with two elders at the same table. The first set of interviews focused on the seasonal availability of plants used for food, with the explicit goal of creating a seasonal round to document elders' use of local food plants during the year. The seasonal round was described as a practical planning and educational tool that could be used in subsequent knowledge transmission activities that include elders (see Chapter 2). Participants reviewed an example of a seasonal round published by Kassam and the Wainwright Traditional Council (2001). Elders themselves determined the focus of interviews; although the aim of interviews was to produce seasonal rounds, discussion included many other domains of plant knowledge, particularly the use of non-cultivated plants

⁷ As of 2009, all members of the EAC were women, with the exception of one alternate from Long Soldier district.

to prepare traditional foods. Interviews were documented with field notes rather than video or audio recordings.

Field notes and seasonal rounds were validated during a second meeting with each participant. Field notes were presented as a table containing the plants they had discussed and the knowledge they had shared. Participants were provided an individual seasonal round that contained the information shared during the first interview, as well as a compiled seasonal round in which previously generated individual rounds from all participants were printed as transparent layers. Participants were therefore able to revise individual seasonal rounds based on contributions of other elders. Whenever changes to field notes or seasonal rounds were requested, a follow-up phone conversation was conducted to validate revisions.

Validated field notes were coded according to plant name and 27 knowledge domains that were documented during interviews (see Appendix A). Most of these knowledge domains correspond to the stages of traditional foodways. For our purposes, foodways are the social and ecological processes that move plants and animals through an ecosystem until they are consumed by humans, including: naming, locating, monitoring, gathering, hunting, conserving, honoring, processing, preserving, storing, preparing, distributing, and sharing. Knowledge domain codes were used to organize a “knowledge base” containing all notes from interviews (Appendix B). A community report including the complete knowledge base was provided to all research participants and members of the EAC for review. Just as the field notes and the community report were reviewed by community members, the current publication was reviewed by key contributors and partner organizations in Standing Rock.

The knowledge base and this publication refer directly to participants by first and last name. During interviews, all participants provided written informed consent agreeing to the use of their names in this and other publications. The use of

participant names is a sign of gratitude and honors personal contributions of participants to the research process. The use of names also strengthens the internal validity of this work; Standing Rock community members who read the knowledge base will often know something about the life experiences of the research participants. For Standing Rock community members, the knowledge each elder has shared can be understood with reference to its source.

Analysis

During our first interview, Shirley Marvin (the chairperson of the EAC) said that when she was growing up in Fort Yates, individuals within her community held different knowledge about different plants. When someone in the community needed medical attention, family members found a community member who knew how to locate and use a specific plant for treatment. Marvin's insight, which in large part inspired this paper, contradicts the popular notion that a community's plant knowledge is either held by the entire community or limited to a single local healer who knows how to use all plants. Marvin suggests that in the past, knowledge about plants was dispersed among community members. Marvin was speaking about medicinal plant knowledge, and it was not certain that the same pattern extended to food plants. In the past, food plants were presumably more frequently used than medicinal plants, so knowledge about their use may have been more widely distributed. In the current context, given less frequent consumption of traditional foods and high incidences of diet-related diseases, food plants have become important medicine for Standing Rock elders and their families. Knowledge about food plants may be as diverse within communities as knowledge about medicinal plants was in the past.

During interviews elders discussed 33 plants, including 15 names that can be linked to a Western-botanical species name and 16 that are associated with Western-

botanical genera (see Appendix A). Two medicinal plants (“sore medicine” and “toothache medicine”) were not definitively linked to a Western-botanical taxon. In some cases, a plant was discussed as a category by most elders but with references to variety within that category by some elders. “Sage” (*Artemisia* sp.), for example, was discussed by many elders, but some elders differentiated between “man’s sage”, “woman’s sage”, and “prairie sage”. A similar pattern was observed for “*čheyáka*” (*Mentha* sp.). At other times the plant names used by elders could not be differentiated according to Western-botanical taxonomies, so “juniper” and “cedar” (*Juniperus* sp.) were combined for analysis, as well as “gooseberry” and “currant” (*Ribes* sp.). “Wild mushrooms” were also discussed by several elders and have been included in our analyses as non-cultivated food plants, even though elders know these are not plants. Most elders stated that there is one type of mushroom used for food, but further research is required to determine the corresponding species name due to a lack of consensus in the literature (Gilmore 1991; Kraft 1990; Jones 1998).

Of the 33 plants and fungi discussed in interviews, 31 are primarily gathered and not cultivated. Elders maintain knowledge of cultivated plants, including corn and *wagmú* (squash and pumpkin), which were mentioned during interviews. Elders chose to focus on plants associated with traditional foods and medicines, and most of these are not cultivated. Non-cultivated plants are often tended, conserved, and honored by elders, so gathering represents interdependent relations between people and plants that may be as complex and sophisticated as relations with cultivated plants (K. Anderson 2005). Of the 31 non-cultivated plants discussed, two species were discussed by all participants: chokecherries (*Prunus virginiana*) and *thiŋpsinŋla* (prairie turnip, *Pediomelum esculentum*) (Appendix B). These two plants have been staple foods for Dakota and Lakota people for centuries (Kindscher 1987; Gilmore 1991; Phillips

2003) and continue to be used to prepare a number of traditional foods, as well as for medicine and ceremony.

Knowledge from narrative

When asked about plants, elders shared stories. These stories include personal narratives about specific experiences and broader narratives about social and ecological change. It is clear that these narratives contain ecological knowledge, but attention to narratives themselves may clarify why plant knowledge is diverse in Standing Rock. Because they integrate selective details, stories reveal how elders make sense of personal experiences with plants. Although elders also generalized or theorized about plants, narratives communicated context-specific practical wisdom derived from personal experience.

The meaning of experiences evolves through iterative performances of stories for different audiences (Berger and Quinney 2005). This means that the plant knowledge expressed in elders' stories is not only highly individualized, but linked to the relationship between elders and their audience. The researcher is therefore not a passive observer of storytelling, but an active participant in its process. Interviews are therefore unique interactions, but common themes can emerge through common purpose. Elders participating in this research had agreed to develop specific research products that will convey their knowledge of food plants to their communities.

The stories shared by elders were consolidated and reorganized before they were shared with communities in the form of a printed knowledge base (Appendix B). Details from stories were organized by plant and knowledge domain. The knowledge base generated by elders contains an entry for each of the 33 plants and fungi discussed by elders. As an example, the entry for wild grapes (*Vitis riparia*) is one of

the shortest in the knowledge base, but demonstrates the diversity of knowledge each entry contains:

Wild grapes – čhuŋwíyapehe – *Vitis riparia* Michx.

The elders who described these plants called them “grapes” or “wild grapes”. The Lakota name (čhuŋwíyapehe) is from the *New Lakota Dictionary* (2008).

Mary Jane Tiokasin said that the wild grapes hang just like “real grapes”. Iyonne Bear Ribs said that they grow along the Grand River. She said she had some relatives who lived down there and they grew around their place. She said her uncle picked them.

Mary Jane said that grapes are harvested in August and September. Florence McLaughlin said that grapes are harvested just before the buffaloberries, so just before the first frost. Iyonne said they are ripe in fall, so people bring them in with the mushrooms. Vernon Iron Cloud and Pearl Day said that if you eat them after the first frost they are juicier and sweeter. Helmina Makes Him First and Blanche Lawrence said that they are ready in September.

Helmina and Blanche said that they seem to hide under the vines. They said you don't see them at first until you walk under the tree. They said they use a long stick with a hook on it to pull down vines, but later they put the vines back up at least halfway so that they can grow back.

Iyonne said that the grapes taste really bitter, but you can make something out of them.

Helmina and Blanche said that nobody seemed to gather grapes this year even though there were a lot of them according to some people. They said the Hutterites didn't come to buy them this year either. They said that one time someone was selling them for \$10 a bushel and that ruined it for everyone else (it was too little money for the work involved). (Appendix B)

Even within this short entry, the diversity of individuals' knowledge is salient. Each paragraph in the entry represents a distinct knowledge domain, and each of seven elders who discussed wild grapes contributed different knowledge to our understanding of their practices. There are points in the entry where participants confirm each other's knowledge, as where Pearl Day and Vernon Iron Cloud agree that grapes are sweeter after the first frost. There are also important points of difference, e.g., the optimal month or season for harvesting grapes. The most striking difference is the harvest of grapes in relation to the first frost (McLaughlin harvests before, Iron Cloud and Day after). It is clear that knowledge about wild grapes is diverse within this community of elders.

Differences in knowledge

Since elders chose which plants to discuss, the fact that a particular plant was not mentioned by an elder is not strong evidence that he or she has no knowledge of that plant. Participants were afforded a considerable amount of time (up to four hours) to share their knowledge about plants, but elders dedicated variable amounts of time to interviews (between 30 minutes and 4 hours). Some elders were wary of sharing knowledge of some medicinal plants, but all elders expressed support for the research objectives and their interest in speaking about the plants that they know how to gather for food.

We are therefore confident that elders know about different plants. Most plants were not mentioned by all elders or even a majority of elders. 23 of 31 plants were discussed by less than one half of the elders, and 13 plants were mentioned by only one or two elders (Table 2). No single elder discussed all of the non-cultivated plants known to their community. Elders mentioned between 6 and 20 non-cultivated plants, averaging 11.7 plants discussed over the course of two interviews (± 4.5 st. dev.).

Differences in plant knowledge among elders are more striking when plant knowledge is analyzed by knowledge domain. Table 3 illustrates differences in elders' knowledge about the *same* plants. Often only one elder shared knowledge of a plant pertaining to a particular knowledge domain. Knowledge pertaining to a given plant within a specific knowledge domain was often contributed by only one elder, as indicated by a matrix value of "1" (41% of cells with matrix values, Table 3). This means that elders often contributed unique knowledge to the research process. Where multiple elders revealed knowledge about the same plant within the same knowledge domain (i.e. all matrix values >1 , Table 3) elders' knowledge is most often different

yet complimentary (yellow cells, 53% of all cells with matrix values >1). Only 31% of knowledge shared by multiple elders in the same knowledge domain is commensurate (green cells). Together, these observations indicate that knowledge held by elders is often relatively unique.

Finally, the knowledge spoken by elders within the same domain for the same plant is sometimes seemingly contradictory (red cells, 16% of matrix values >1). Seemingly contradictory knowledge was provided within several knowledge domains, but most often for knowledge pertaining to the seasonal availability of plants (calendar availability and seasonal cues). Since seasonal patterns of plant use were the primary focus of interviews, these are the knowledge domains with the highest number of contributions and therefore the most likely domains for contradictory knowledge to accumulate. Seasonal rounds generated by elders allow us to examine these differences more closely.

Table 2. Non-cultivated plants discussed by elders during interviews. Shaded cells indicate that an elder chose to discuss that category of plant during either of two interviews conducted in 2009. Blank squares are not evidence for a lack of knowledge about that plant

Common plant name(s) used by elders	Latin name of associated botanical taxon	Elder 1	Elder 2	Elder 3	Elder 4	Elder 5	Elder 6	Elder 7	Elder 8	Elder 9	Elder 10	Elder 11	Elder 12	Elder 13
		Bitterroot	<i>Acorus calamus</i>	X		X	X			X	X		X	X
Buffaloberry	<i>Shepherdia argentea</i>	X	X	X	X	X		X	X			X	X	
Burr oak/acorn	<i>Quercus macrocarpa</i>							X	X					
Cattails	<i>Typha</i> sp.										X	X		
Cedar/juniper	<i>Juniperus</i> sp.		X		X									X
Čheyáka/wild mint	<i>Mentha</i> sp.	X	X			X	X	X	X					X
Chokecherries	<i>Prunus virginiana</i>	X	X	X	X	X	X	X	X	X	X	X	X	X
Crabapples	<i>Malus ioensis</i>													X
Dandelion	<i>Taraxacum officinale</i>													X
Elm	<i>Ulmus</i> sp.													X
Goldenrod	<i>Solidago</i> sp.		X											
Gooseberries/currants	<i>Ribes</i> sp.	X	X		X			X	X					X
Horsetail	<i>Equisetum</i> sp.		X											
Juneberries	<i>Amelanchier alnifolia</i>	X					X	X	X	X		X		X
Milkweed	<i>Asclepius</i> sp.											X		
Mouse beans	<i>Amphicarpa bracteata</i>			X						X	X			X
Poison ivy	<i>Toxicodendron rydbergii</i>		X											X
Prickly pear	<i>Opuntia</i> sp.													X
Sage	<i>Artemisia</i> sp.		X	X	X	X	X	X	X					X
Sandcherries	<i>Prunus pumila</i>	X	X			X		X	X					X
Soapweed	<i>Yucca glauca</i>		X								X			
Sore medicine	unknown							X	X					
Sweetgrass	<i>Hierochloe odorata</i>			X	X									X
<i>Thiopsis</i> sp.	<i>Pedimelum esculenta</i>	X	X	X	X	X	X	X	X	X	X	X	X	X
Toothache medicine/ <i>poipi</i>	unknown	X				X	X	X	X					
Wild grapes	<i>Vitis riparia</i>	X	X				X	X	X			X	X	
Wild mushrooms	unknown	X			X	X	X	X	X	X	X			X
Wild onions	<i>Allium</i> sp.	X	X			X	X					X	X	
Wild plums	<i>Prunus americana</i>	X	X	X	X	X	X	X	X			X	X	X
Wild rose/ <i>unzinzintka</i>	<i>Rosa</i> sp.	X	X		X			X						
Wild strawberries	<i>Fragaria</i> sp.			X				X	X					
Willow	<i>Salix</i> sp.										X			

Table 3. Standing Rock elders' knowledge about non-cultivated food plants within selected knowledge domains (see Appendix A for descriptions of those domains). Numbers in this matrix indicate the number of elders who included knowledge within a particular knowledge domain. Colors indicate whether knowledge provided by multiple elders was the same (green), different yet complimentary (yellow), or contradictory (red).

Common name(s) of plant used by elders	Latin name of associated botanical taxon	D/Lakota name	Varieties	Regional distribution	Habitat	Specific locations	Ecological relations	Life history	Calendar availability	Seasonal cues	How to locate	How to identify	Evaluate ripeness	How to gather	How to conserve	How to honor	How to prepare	How to store	Medicinal uses
Buffaloberry	<i>Shepherdia argentea</i>			2	1	2			7	3		2		3	1		1	1	
Burr oak/acorn	<i>Quercus macrocarpa</i>						2										2		
Čheyáka/wild mint	<i>Mentha</i> sp.	7	4		4			1	4		2	5	1	2	2		2	1	
Chokecherries	<i>Prunus virginiana</i>				2	2	2	1	8	1	2		2				7	6	
Crabapples	<i>Malus ioensis</i>							1									1		
Dandelion	<i>Taraxacum officinale</i>																1		
Elm	<i>Ulmus</i> sp.								1								1		
Gooseberries/currants	<i>Ribes</i> sp.					3			4			3	2				1		
Juneberries	<i>Amelanchier alnifolia</i>					1	2	1	7		1						1	1	
Mouse beans	<i>Amphicarpa bracteata</i>	1			2	2	4	2	2	1				4		3			
Prickly pear	<i>Opuntia</i> sp.								1								1		
Sage	<i>Artemisia</i> sp.	3	5		1	2		2	5	1		6	1			1	1	1	1
Sandcherries	<i>Prunus pumila</i>				2	1		1				3		5					
Thinpsinla	<i>Pediomelum esculentum</i>	11		1	2	1			9	4	3	3	6	2	3		3		1
Wild grapes	<i>Vitis riparia</i>					1			3	4	2	1			2		1		
Wild mushrooms	unknown	3			4	5	5		7	4		3		1			4	1	1
Wild onions	<i>Allium</i> sp.				1	1	1		5									1	
Wild plums	<i>Prunus americana</i>				1	1	1	3	8	3							4	4	
Wild strawberries	<i>Fragaria</i> sp.				1				1										
Willow	<i>Salix</i> sp.																		1

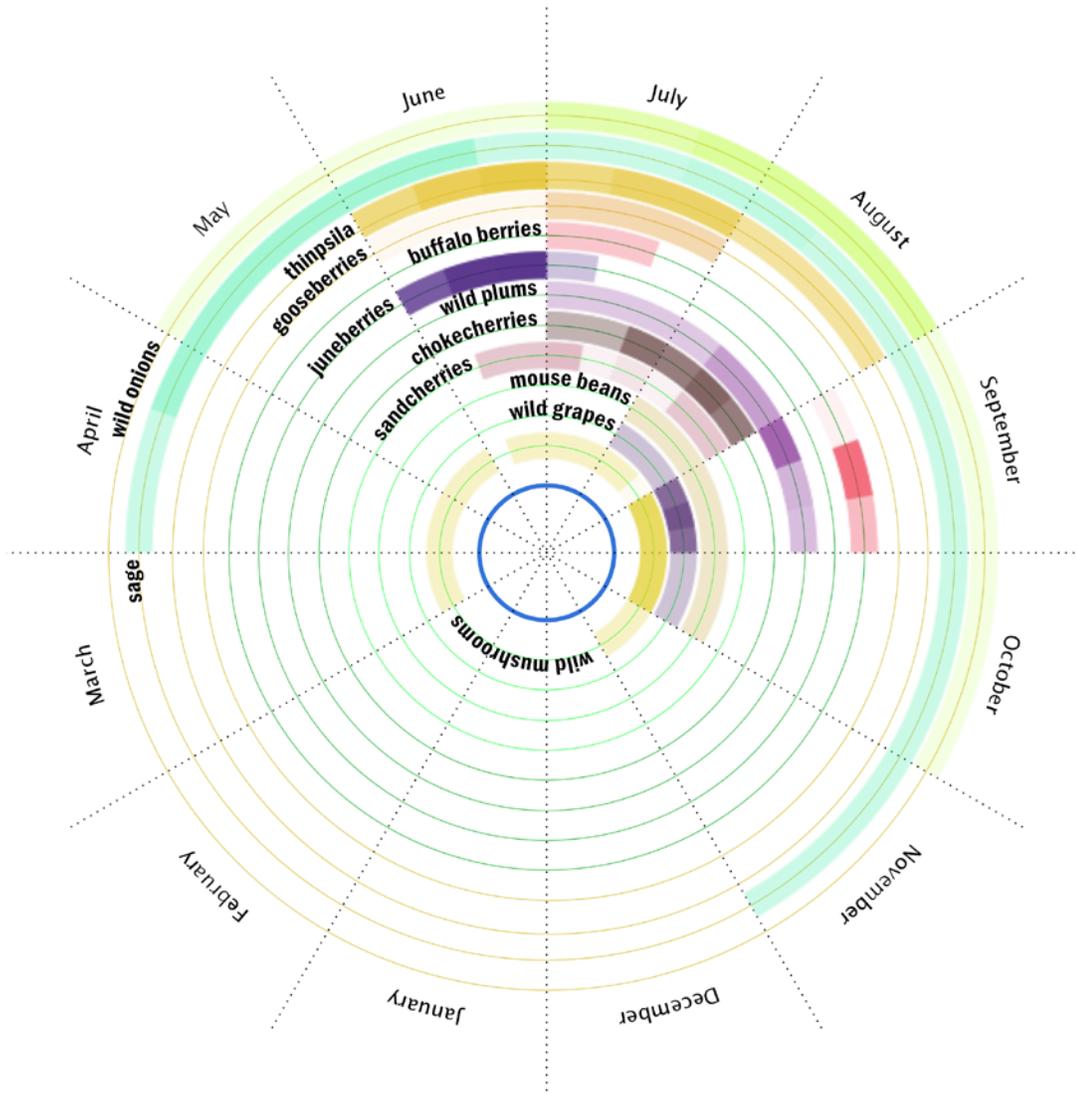


Figure 2. Seasonal round containing elders' knowledge about the seasonal availability of non-cultivated food plants. Plants are located on the round according to the habitat requirements described by elders; plants located in wetter parts of the landscape (floodplain forests) are located closer to the center of the round, while plants found in prairies and other dry areas are located at the periphery.

Seasonal rounds focused on the 12 non-cultivated food plants that were discussed by the most participants. The compiled seasonal round (Figure 2) represents the combination of 10 seasonal rounds produced by seven individuals and three pairs of elders. These individual seasonal rounds were overlaid with 25% opacity so that viewers can identify periods of time where knowledge of seasonal availability

corresponds (seen as darker shades) and periods of time where knowledge differs (seen as lighter shades). The compiled seasonal round represents the diversity of knowledge pertaining to seasonal availability, but also the complexity of human ecological relations between people and plants through time.

If our aim is to evaluate the value of knowledge diversity, we cannot dismiss the possibility that some differences in knowledge are attributable to human error. By validating our data with project participants, we have attempted to minimize the possibility for errors in transcription or interpretation. As mentioned earlier, our research process included opportunities for elders to compare their knowledge with those of others, and to alter their own contributions based on observations of those differences. In all cases, elders confirmed these differences during validation interviews. Elders were sometimes surprised by the knowledge of others, but they understood that other elders had cumulative empirical evidence to support their knowledge claims. Elders evaluate knowledge based on its applicability in specific contexts, and therefore trust that differences in knowledge reflect differences in experience.

Differences in ecological experience

Patterns within the compiled seasonal round reveal different knowledge about the seasonal availability of the same plant species. These differences represent complex patterns of use of the same plant species in time and space. Elders occupy different areas in the landscape and gather food plants at different locations, and the phenology of the same species differs based on latitude, elevation, slope-aspect, rainfall patterns, and edaphic variables. Elders often speak about seasonal availability in terms of specific plants in particular locations. When they talked about the availability of currants, for example, Blanche Lawrence and Helmina Makes Him First

talked about the currants behind the school in Little Eagle that were so sweet that all the children watched them ripen until they were eaten in one day. Therefore knowledge of seasonal availability can be derived from interactions with individual plants and observations of development determined by conditions at specific sites.

Differences in elders' knowledge also reflect uses of the same plant in different foodways. The compiled seasonal round shows that wild plums are gathered in July through September, but elders often focused on a more specific period within that range. In this case, difference in gathering times is linked to differences in use at various stages of maturation for the fruit. Elders talked about eating hard, tart plums as children, using slightly-ripened plums in jelly, boiling ripened plums into plum butter and jam, and sun-drying well-ripened plums to be used for *wóžapi* (pudding) in the winter. Some elders only remember eating wild plums as children, some still gather them every year with their families, and some regularly prepare *wóžapi* for community meals. The fact that elders engage different foodways that utilize this plant at different stages of maturation may explain why elders have different knowledge of its seasonal availability. Similar patterns can be observed for chokecherries, sage, and wild mushrooms, which are additional points of seemingly contradictory knowledge about calendar availability (Table 3).

Another basis for plant knowledge diversity are the strategies gatherers use to maximize the variety of plants harvested during particular gathering trips. Gatherers can locate several plants in the same trip by following a route through a number of different landscape zones. Sidney Eagleshield, Sr. reported that chokecherries, wild plums, Juneberries, buffalo berries, and *thinpsinla*, are all ready to harvest after the 5th of July. When other elders reviewed his contributions to the compiled seasonal round, they were surprised that he thought Juneberries were available so late and buffalo berries so early in the year. One explanation for his knowledge is that he reduces the

number of gathering trips by focusing on a time of year when the likelihood of gathering the greatest variety of food plants is highest. Even without Eagleshield's contribution to the compiled seasonal round, other elders' knowledge confirms that early July is the season with the greatest diversity of plants is potentially available. In addition, over the course of 80 years gathering plants, Eagleshield may have experiences when buffalo berries came early or Juneberries appeared late.

Plant knowledge held through social relations

In addition to sharing their own experiences, elders shared stories about the way other people relate to plants. Although these stories reveal ecological knowledge, elders emphasized the sources of knowledge: a friend, a living relative, or an ancestor. Plant knowledge is therefore held through social relations, and elders acknowledge and honor these sources in stories. Elders know that the relevance of such knowledge can be assessed if the listener knows something about the person who used that knowledge. Stella Guggolz, for example, described the wisdom of her mother and attributed much of her own knowledge to her, including the observation that roses bloom when "all the frost is out of the ground," and it is safe to plant a garden. Rather than share this knowledge as her own, Stella attributes it to someone who lived in a different time and place. This acknowledges that people generate knowledge in different contexts, and that knowledge may not be relevant given different conditions. Many stories about forest plants attribute knowledge to parents and grandparents who gathered plants along the Missouri before the loss of those forests following dam construction. These stories convey the possibilities of practice, because they contain the knowledge that a particular plant can be found or used in specific ways, but the listener must evaluate whether the same possibility exists in a different context.

The diversity of knowledge held by elders, in combination with the social relations through which elders access this diversity, enables communities to transform ecological knowledge in response to change. Diversity is a requirement for adaptation, but the movement of knowledge through social relations allows individuals to engage others' knowledge whenever personal experiences become less relevant. "Knowing who knows" facilitates adaptation; when new knowledge is required, elders can bypass time-consuming and sometimes dangerous processes of personal experimentation by drawing on another elder's knowledge. During interviews, elders often attribute knowledge to other elders, indicating that participants have access to others' knowledge should they need to respond to different social and ecological realities. Elders are therefore aware of differences in knowledge within their community and know how to benefit from those differences when necessary.

Evidence of adaptation

Elders' stories contain evidence that their knowledge has evolved in response to dramatic social and ecological changes, which has allowed them to maintain knowledge about a diversity of plants. The impoundments that transformed the hydrologic regime of the Missouri, the subsequent loss of most floodplain forests, and the abrupt relocations of families into government-built communities all posed threats to plant knowledge in Standing Rock. In the late 1980s, Kraft (1990) conducted interviews with Standing Rock elders to document the loss of culturally-significant species after the Oahe Dam was completed. As elders, Kraft's informants were at least 30 years old in 1959, so she was not surprised by their considerable knowledge of floodplain forest plant populations that had been eliminated or significantly reduced by the dam. By contrast, most elders in the current study were children (younger than

18) in 1959, so one might presume that elders know less about plants that are found in floodplain forests.

However, a comparison of the plants described by Kraft’s participants and the elders interviewed in this study does not provide strong evidence that plant knowledge has shifted toward prairie plants as a result of the loss of forests (Table 4). The most compelling result of this comparison is that elders have maintained some knowledge of the plants found in floodplain forests. This indicates that knowledge of plants has persisted despite reductions in plant populations due to loss of their habitats on Standing Rock.

Table 4. Comparison of elders’ salient plant knowledge within habitat classes 1990-2010.

	Kraft⁸ (1990)	Ruelle (2010)	Change / turnover
Number of participants (aged 60 and over)	15	13	All new participants
Number of plants discussed that occur in:			
Floodplain forests (moist)	11	11	-1,+1
Stream banks	16	17	-2, +3
Herbaceous wetlands	3	3	0
Prairie/plains	6	7	+1
Wooded ravines (dry)	11	13	+2
Dry rocky hillsides	6	5	-1
Disturbed areas and roadsides	5	4	-2
All habitat types (ubiquitous)	0	2	+2
TOTAL number of plants discussed	32	33	-5, +6

It is important to note that many floodplain forest plants are also found in other parts of the landscape. Of the 12 plants described from floodplain forests, 6 are also

⁸ This analysis is limited to plants that elders discussed with Kraft. Plant use descriptions obtained through literature review were not included.

found in wooded ravines. Elders are able to maintain knowledge of many floodplain forest plants because they are still available in other places. Yet in other cases, elders maintain knowledge of a plant despite the fact that it is no longer found in Standing Rock. For example, elders remember their parents and grandparents gathering mouse beans (*makhátomniča*, or *Amphicarpaea bracteata*) from rodent caches in the floodplain forests, and some remember that gatherers would replace beans with corn to ensure that the mice would survive the winter. Although a few elders have heard that populations of mouse beans are still found in Standing Rock, none of the elders said they had observed them after 1959, and the plant has not been documented since the completion of the Oahe Dam (Jones 1998). Yet elders know about this plant even though they have been unable to gather it themselves. If current efforts to restore mouse bean populations succeed, elders' knowledge can still guide future gathering practices. Stories, including meaningful memories, can therefore contribute to long-term adaptation by conveying knowledge through times when ecological practice is not possible.

Memories of mouse beans may be exceptionally long-lasting because of the story associated with them, but knowledge about the other plants that have been reduced or eliminated seems to survive in other ways. Some elders travel away from Standing Rock to find plants that are no longer found on the reservation. For example, bitterroot (*Acorus calamus*) is known and used by most elders even though it is rare on the reservation. Many elders discussed purchasing it at regional powwows and church meetings, but Helmina Makes Him First regularly travels over 200 miles to gather it from wetlands in eastern South Dakota. Makes Him First's personal commitment to continuing this practice contributes unique practical wisdom to her community.

Innovations within local foodways are further evidence that plant knowledge has adapted to different contexts. Elders have incorporated many technologies,

including their own inventions, into foodways. As an example, many elders use cast-iron meat grinders to process chokecherries for chokecherry patties and then dry them in electric dehydrators. Also, *pápa* (dried meat) soup is prepared in electric “slow-cookers”, and Juneberries are stored in freezers to use for *wóžapi* in the winter. One elder designed a tool for digging *thinpsiŋla* that is welded out of metal fence posts. Technological changes and innovations allow elders and their families to gather and prepare plants and animals more efficiently.

On the other hand, some elders resist technologies out of concern that they change the taste, nutritive value, or cultural meaning of foods. Vernon Iron Cloud said he uses a “pounding stone” rather than a cast-iron grinder to make chokecherry patties, and he and other elders agree that his patties are preferable because the chokecherry pits are broken into smaller pieces and the grinding stones contribute a different taste (perhaps minerals) to the patties. Elders therefore engage in different practices, and this is both a source of diversity of knowledge (elders know how to prepare chokecherries using different technologies) and evidence that traditional foodways (and thus plant knowledge) are dynamic. Most importantly, elders exercise their own agency within processes of adaptation, so they decide how to use plants. Tradition is not bound to historical practice and can transform to fit new contexts without losing cultural significance.

Evidence that diverse knowledge can respond to climate change

Differences in plant knowledge may be an asset that contributes to the adaptability of community ecological knowledge in response to change. Elders’ individual plant knowledge also demonstrates an ability to respond to uncertainty. Of particular interest are elders’ strategies to predict the temporal availability of food plants given highly variable weather patterns observed in this region. These strategies

may be particularly relevant given the predicted impacts of climate change on the northern Great Plains, which include warmer mean temperatures in winter and spring, higher daily minimum temperatures throughout the year, increases in annual precipitation, and decreased soil moisture due to increased evaporation (Joyce et al. 2000).

In the production of seasonal rounds, elders were encouraged to describe their use of plants in terms of the fixed Gregorian or Lakota calendars, but in many cases elders referred instead to variable seasonal events and natural cues. In the future, the seasonal development of plants might be more accurately predicted with reference to temperature and precipitation patterns than a fixed solar or lunar calendar. Many elders referred to the first frost as the end of the plum and mushroom season and the date when wild grapes and buffalo berries sweeten. By watching for the frost rather than following a calendar, elders will change their gathering dates in unusually hot or cold years. Several elders also mentioned that in the midst of the *thinpsiŋla* harvest, rain can turn the *thinpsiŋla p̃hophó* (soft and spongy), so gatherers must give them some time to dry before they start harvesting again. In these cases, elders know the direct impacts of weather events on plant quality, so they are prepared to modify their practice in particularly wet or dry years. Elders' adaptive knowledge can therefore help their communities respond to new climate variability.

In other cases, the developmental signals of plants themselves are cues for other seasonal events. As long as signals and events remain in synchrony, this knowledge can help communities respond to climate change. Pearl Day remembered her mother saying that it wasn't safe to swim in the Cannonball River until goldenrod blooms. As described earlier, Stella Guggolz's mother said that when wild roses bloom, it is time to plant a garden. Shirley Marvin remembered that the release of cottonwood seeds along the river signals that *thinpsiŋla* are ready to dig on the prairie.

Marvin's example is important because it links the timing of events that occur in different parts of the landscape. If cottonwoods and *thinpsinla* respond similarly to the same changing weather patterns, this knowledge reduces the likelihood that gatherers will make unsuccessful *thinpsinla*-gathering trips from the river to the prairie.

Finally, many elders describe the seasonal availability of food plants within a narrative that traces plants through the months or seasons of harvest. In this narrative, the disappearance of one plant is linked to the appearance of another, so that gathering activities make sense in relation to other plants. Iyonne Bear Ribs described the appearance and disappearance of Juneberries, gooseberries, chokecherries, plums, and wild grapes over the course of the summer and fall. This sequence of availability is based on ecological reality, but the narrative conveys a perception of order in the availability and harvest of particular plants. When discussing additional plants, Iyonne linked them back to this narrative, describing the availability of wild mushrooms, for example, as coincident with wild grapes. The use of a relative schedule is adaptive because the timing of plants and harvests follow an order whether or not specific events occur at the same time every year. In certain years (such as 2009), the entire schedule established by the seasonal narrative can be delayed due to a cold, wet spring. In this way, seasonal narratives will help make sense of climate change impacts, by understanding plants in relation to themselves within a flexible time frame.

As discussed earlier, knowledge about the seasonal availability of plants is often complimentary or seemingly contradictory, so specific knowledge about seasonal cues and relative schedules of plants is distinct between elders. In the context of climate change, each elder can therefore pose different responses to unusual weather patterns as they emerge. Modifications in gathering times will likely vary based on microhabitat variables, so adaptation cannot be uniform. Different

knowledge about seasonal availabilities leads elders and their families into different parts of the landscape at different times, and this constitutes a form of monitoring as the developmental stages of plants are reported back to communities. In these ways the diversity of knowledge about plants can continue to evolve and present effective responses to new challenges.

Conclusion

The methodologies that researchers use to document knowledge need to account for diversities of knowledge within communities. Rather than resort to reductionist summaries, researchers can promote the diversity of knowledge as a community asset for adaptation. Towards this end, seasonal rounds can help visualize patterns of human ecological relations in time, including differences in personal practices. As a static representation of dynamic systems, documentation can obscure adaptive elements that might be present in a narrative. Even the current iteration of the Standing Rock seasonal round is limited in its ability to illustrate the variable seasonal cues elders use to anticipate plant development. An animated, interactive version of the seasonal round might demonstrate the effects of spring precipitation patterns or frost events on elders' knowledge of plant phenology. Researchers need innovative tools to communicate the diversity and adaptability of knowledge held within communities.

A knowledge base that acknowledges the individual contributions of participants can integrate information derived from personal ecological relations. If a knowledge base highlights differences rather than attempting to resolve them, it can demonstrate the value of diverse experiences. For youth and others who are establishing relations with plants, such a knowledge base can communicate the range of experience within their community and identify local sources of wisdom. On the

other hand, as notes made on specific plants are recombined for the sake of continuity and comparison, the narrative contexts of ecological knowledge is transformed. When ecological wisdom is extracted from narratives, the nuances of stories are lost, and important details about contextual applicability can be obscured.

There may be cases where a developing a consensus is preferable to maintaining diversities of knowledge and practice. For example, one can imagine that certain plant conservation techniques employed by gatherers are more effective than others, and a community concerned about a declining population of a plant may wish to initiate research comparing these practices. If the community determines that a particular practice is most effective, they may decide that a continued diversity of practices poses a threat to plant populations and that a consensus about conservation practices is warranted. Therefore, the possibility that certain knowledge is not effective in a specific context cannot be ignored. On the other hand, it is important to remember that a diversity of knowledge, including knowledge that is not workable at this time, may prove useful given contextual change.

For community participants, the research process may be as significant as research products, including this publication. When researchers express interest in elders' stories and let participants determine the course of discussion, interviews can become a mutually beneficial conversation. Susan Chase writes that "recounting itself is a particular kind of social action, a process of constructing and communicating self-understanding, of making experience intelligible and meaningful" (1995, 31). Elders re-encounter the meaning of plants in their stories, and they may come to a new understanding of their relations with plants during the research process. Research is an opportunity to reexamine past experience and consider implications for the future. Ideally this process would result in community actions based on renewed commitments to specific values. In this case, discussions revealed the unique

knowledge of individuals about food plants, and therefore, key contributions each elder can make to prevention of diet-related diseases in their communities.

Despite dramatic changes in the landscape, relations between Standing Rock elders and plants have persisted. The meaning of plants extends beyond their practical use as food and medicine to a role in maintaining social structures and cultural values. Elders' stories integrate ecological knowledge with social and cultural meaning. Ultimately, the diversity of plant knowledge within Standing Rock elders is derived from differences in use. These differences emerge from individuals' interactions with and interpretations of their landscape. Moreover, the differences in knowledge that accumulate from personal experiences multiply the possibilities for communities to confront and adapt to challenges of the 21st century.

CHAPTER 2

THE ROLES OF LOCAL ORGANIZATIONS IN KNOWLEDGE TRANSMISSION: A HUMAN ECOLOGICAL PERSPECTIVE

Introduction

Indigenous people throughout the world have developed intimate knowledge of landscapes and systems to communicate that knowledge to future generations (Ruddle and Chesterfield 1977; Ohmagari and Berkes 1997; Lozada, Ladio, and Weigandt 2006). Many conservationists recognize the value of indigenous peoples' ecological knowledge, not only at local scales where it is already meaningful, but also where information and insights pertain to broader socio-ecological processes (Moller et al. 2004; IPCC 2007; Berkes 2008). Indigenous knowledge is appreciated as a resource that can improve humans' ecological interactions and the chance to survive the consequences of environmental crises (Kimmerer 2000; McGregor 2004). However, centuries of violent conflict and colonialist abuses have traumatized indigenous peoples, and multiple effects of globalization and climate change pose new challenges for the social-ecological systems of which indigenous communities are a part (Kassam 2009a). Just as we realize the need for ecological intelligence, scientists are raising the alarm that indigenous knowledge is imperiled in the communities where it is borne (Benz et al. 2000; Cox 2000).

Narratives about the endangerment of indigenous knowledge, meant to compel its conservation, reveal persistent misinterpretations of indigenous knowledge as unchanging (Agrawal 1995). In order to preserve indigenous wisdom and convey it to broader audiences, researchers have focused their efforts on documentation of knowledge. But documentation can obscure the dynamism of knowledge within indigenous communities. Furthermore, when researchers interpret all changes in

knowledge as cultural loss, we ignore the value of dynamic practice and delegitimize adaptive innovations within indigenous communities. In fact, modifications of ecological knowledge can enable its relevance in evolving social and ecological contexts. Whenever elders share knowledge with children, they have an opportunity to reevaluate or anticipate the relevance of their knowledge in the future. Knowledge transmission can therefore facilitate adaptation. Applied research that directly engages knowledge transmission processes is necessary to understand how indigenous communities carry ecological knowledge forward and ensure its relevance in a rapidly changing world.

Concerns about the loss of indigenous knowledge have motivated a number of organizations to initiate projects to restore, recover, or revitalize indigenous knowledge and knowledge systems (LaDuke 2005; Pilgrim, Samson, and Pretty 2009). However, the roles organizations play within knowledge transmission processes remain unclear, and concerns about unintended consequences of organizational interventions deserve some attention. Action research (Greenwood and Levin 1998) methodologies can provide unique insight into processes of knowledge transmission, as well as the potential role of organizations in those processes. By engaging communities in action and systematically reflecting on activities with participants, researchers can interpret the meaning of organizational involvement. This approach can develop insights for organizations and communities working to promote indigenous knowledge and knowledge systems.

A coalition of tribal agencies and local organizations within the Standing Rock Nation (a Native American reservation in the northern Great Plains of the United States) are learning to promote indigenous knowledge of traditional foodways to reduce incidences of diet-related diseases in their communities. Traditional foodways, defined as such by elders, include the sophisticated processes communities use to

derive food from their landscape, including locating, tending, gathering, hunting, cultivating, harvesting, honoring, preparing, preserving, storing, consuming, trading, marketing, and distributing plants, animals and their associated products. Previous research documented elders' concern that younger generations are not learning how to participate in traditional foodways (NFE 2007). At the urging of elders and other community members, the coalition organized intergenerational and intragenerational knowledge transmission events focusing on various stages of local foodways.

In this paper we investigate knowledge transmission as it is facilitated by local organizations in Standing Rock. We examine this process through a human ecological lens developed by Kassam (2009a) in partnership with other indigenous communities. This lens engages four interrelated concepts: diversity and perception, relations, context, and practical wisdom (or *phronesis*). Interviews with elders and organizers focused on these concepts to produce insights about knowledge transmission activities. Although a strong theoretical framing is necessary, the objective of this paper is to generate practical recommendations for organizations working to facilitate the transmission of indigenous knowledge within their communities.

Context

The Standing Rock Sioux Nation extends west from the right bank of the Missouri River as it flows across the border of North and South Dakota (see Figure 1). The reservation boundaries encompass 2.3 million acres. The population of Standing Rock in 2007 was estimated at 8116 persons, of which 77.3% are Native American (U.S. Census Bureau, Population Estimates Program 2008). Most Native Americans living in Standing Rock are enrolled in the Standing Rock Sioux Tribe, which includes descendents of the *Iháŋkthūnwaŋna* (Upper Yanktonai, “Those dwelling at the end”) and *Húŋkpatina* (Lower Yanktonai, “Campers at the horn”) bands who speak the

Dakota language, as well as *Húŋkpaŋhá* (“Head of the camp circle”) and *Sihásapa* (“Blackfeet”) bands who speak the Lakota language (Barrett et al. 1995; Ullrich 2008). Fort Yates, North Dakota, is the seat of tribal government, including the offices of the Tribal Chairman and the Tribal Council.

Complex socio-ecological changes have challenged the transmission of knowledge pertaining to Standing Rock foodways. Beginning in the late 19th century and continuing into the 1980s, many Standing Rock children were taken to boarding schools and spent the majority of their time away from their families (Barrett et al. 1995). For many children, opportunities to learn about traditional foodways from parents and grandparents came during short intervals at home with families. Many religious practices were banned by the federal government until 1978, but the use of specific foods in ceremony was maintained through religious practice that was concealed from the government and its agents (W. K. Powers and M. N. Powers 1990). In 1959, despite the protestations and legal actions of Standing Rock communities, the U.S. Army Corps of Engineers completed the Oahe Dam on the Missouri, which permanently inundated 55,993 acres of reservation land (Lawson 1994). According to analysis of the National Land Cover Database (2001), this loss represents at least one half of all forests in Standing Rock; including most of the floodplain forests. Prior to dam construction, floodplain forests were primary sources of food, medicine, fuel, fiber, fodder, and construction materials for most reservation residents (Jones 1998; Kraft 1990; Lawson 1994). In addition, close to 200 families were evacuated from their homes along the river and relocated into government-built communities on the open prairie (Kraft 1990).

Research with elders indicates that they have retained ecological knowledge about forest plants (see Chapter 1), but elders are concerned that younger people have not learned to gather these and other plants for food. In 2010, regional and national

food distribution systems provide most of the food consumed in Standing Rock, and traditional foods are eaten on special occasions. These changes in diet have clear negative implications for community health. A needs assessment conducted in 2007 showed that the incidence of Type II diabetes among elders is twice the national average (46%, NFE 2007, as compared to 23% nationally, CDC 2007). Incidence of several diet-related diseases (including hypertension, cardiovascular diseases, and obesity) are also higher among Standing Rock elders compared to national averages (NFE 2007). Despite the prevalence of diet-related diseases, interviews reveal that most elders choose not to follow the diets recommended by their doctors. Some elders explain that the foods recommended by their doctors are unfamiliar or that the dietary restrictions they suggest are not culturally appropriate. Alternatively, elders propose that traditional foods can improve their health, but that their consumption of those foods depends on the availability of specific plants and animals in their communities. Many elders feel that younger people need to learn how to hunt these animals or gather these plants in order to improve the health of their communities.

A number of local organizations have developed innovative programs to treat and prevent diet-related diseases with traditional foods. Nutrition for the Elderly (NFE) prepares traditional meals for elders, including *pápa* (dried meat) soup, fry bread, and *wóžapi* (chokecherry pudding). The Standing Rock Diabetes Program provides diabetics with *wasná* (dried meat pounded with dried fruit, usually berries). More recently, these organizations are drawing on elders' knowledge about traditional foodways and starting programs to facilitate knowledge transmission within Standing Rock communities. In 2008, the Diabetes Program received a five-year grant from the Centers for Disease Control and Prevention to start the Native Gardens Project (NGP), which provides resources and services to families who want to grow or gather food. One of NGP's many projects in 2009 was a partnership with the Grand River Boys

and Girls Club (BGC) to organize gathering trips for elders and youth. At the same time, Sioux County Cooperative Extension (SCCE) partnered with the Standing Rock Night Lights program and elders to lead after-school activities focusing on indigenous foodways. Both of these projects focused on intergenerational knowledge transmission between elders and young people.

In 2008, NFE received a grant from Food and Nutrition Services of the U.S. Department of Agriculture to start a Senior Farmers Market Nutrition Program (see Chapter 3). In 2009, NFE joined with NGP and SCCE to revitalize the Standing Rock Farmers Market in Fort Yates. At the request of elders, organizers began conducting workshops on market days to demonstrate the use of market produce in foodways. Responding to increasing participation and enthusiasm of elders, the market organizers continued these workshops into the winter months as the Long Soldier Winter Market Education Series. Although some young people attended these events, the primary objective was to facilitate intragenerational knowledge transmission between elders.

Conceptual Framework

Two classic studies of knowledge transmission in indigenous communities established the framework for most investigations since their publication. First, Ruddle and Chesterfield (1977) provided empirical evidence from the island of Guara (Venezuela) that knowledge transmission can be highly structured, and they challenged previous assumptions that indigenous systems are largely informal. By demonstrating the sophistication and efficacy of existing knowledge systems, Ruddle and Chesterfield convinced local and international development institutions to engage indigenous knowledge transmission processes rather than work to replace them with Western education models. Building upon this understanding of knowledge transmission within communities as “formal”, Cavalli-Sforza and Feldman (1981)

developed a quantitative model of transmission within communities. They defined three vectors of knowledge transmission: “vertical” transmission from parent to child, “horizontal” transmission within a generation, and “oblique” transmission from an adult to children not his or her own (as in a classroom). Their model asserts that knowledge is more likely to be conserved during vertical transmission as compared to horizontal or oblique transmission. In other words, the authors contend that knowledge transmitted within a family serves to maintain traditions, whereas knowledge transmission within peer groups or from a teacher to students tends to spread innovations.

More recent studies compared the knowledge of children and adults in order to infer the relative strength of vertical and horizontal transmission vectors (Ohmagari and Berkes 1997; Lozada, Ladio, and Weigandt 2006). Often such studies measure the distribution of knowledge within a community to imply the strength of transmission signals, rather than observing the mechanisms of knowledge transmission directly. For example, Reyes-Garcia et al. (2009) measured the “ethnobotanical competency” of children, their parents, and other adults within the parental cohort. They found stronger correlations between the botanical knowledge of parents and their children than between those children and other adults; they attributed this difference to a strong, conservative vertical transmission vector within the study community. These and other studies (e.g., Garcia 2006) are explicitly concerned with the loss of indigenous knowledge and therefore measure knowledge transmission within families as a source of cultural continuity. In this view there is limited opportunity for organizations to conserve indigenous knowledge systems without imposing on family life.

Alternatively, a human ecological approach can reveal additional dimensions of knowledge transmission processes and the roles organizations might play within

them. Human ecology remains a contested discipline (Bruhn 1974), but the field offers an important transdisciplinary view of human communities within their biophysical reality. Kassam (2009a) has reconceptualized human ecology in his work with indigenous communities of the Arctic and sub-Arctic (Kassam and Soaring Eagle Friendship Centre 2001; Kassam and The Wainwright Traditional Council 2001) and the Pamir Mountains of Central Asia (2009b). Whereas many human ecologists have carried ecological concepts into their analyses of social systems (e.g. Park 1952), Kassam abandons any dichotomy between human culture and nature. Culture is one aspect of nature, but clearly not only a function of it, since humans consistently reshape their biophysical reality. In this new view of human ecology, human adaptations are not understood as simply reactions, but as creative responses to existing and emergent perceptions and realities.

Kassam's human ecological lens asserts that humans and all other beings perceive the world by recognizing differences within it. The fundamental ability to differentiate enables all beings to survive, but modes of perception differ between and within species. A honey bee can see patterns of reflection of ultraviolet light on the petals of flowers; a good hunter can recognize the size and speed of an animal from its tracks. Life experience can increase our ability to recognize specific kinds of difference. Knowledge we receive from others can enable new perceptions of difference. An individual's ability to pick berries, weed a garden, or add spices to a soup are a few of the infinite practices that rely on our learned abilities to perceive difference. Since knowledge enables our perceptive abilities, knowledge transmission is essential to seeing, both in a literal sense and in the sense of a world view.

Ecology is a science of connectivity that studies dynamic, multidimensional relations between beings (Ingold 2000). Beings are defined in relation to other beings (Kassam 2009a). Human ecological relations are therefore a source of individual and

communal identity within complex networks of beings. This thinking aligns with many indigenous views that all beings are kin (Salmón 2000) or kindred (Kassam 2009a) that challenge us to integrate the study of relations between humans and those with other beings. Many indigenous people feel a responsibility to maintain relations through specific ecological practices, including traditional foodways (LaDuke 2005). Derived from the accumulation of interactions, relations are inherently dynamic, and constantly transformed by new knowledge. Since ecological relations and knowledge are interdependent, knowledge transmission can be understood as the conveyance of relations between individuals.

Human ecological relations exist in particular contexts. Context is frequently interpreted as the determinate background of human experience. Because human ecologists investigate the interactions between humans and all other beings in an ecosystem, no component of that system can be categorically excluded from the foreground. In Lakota world views, for example, many inanimate elements are honored as beings (Walker 1980; Bucko 1998), so distinctions between biotic and abiotic elements of ecosystems do not necessarily apply⁹. In a more integrated approach, context can be understood as the set of dimensions in which human ecological relations are possible. The Greek *oikos*, which means house, is at the root of the terms ecology and economics (Aristotle 1976), and can be thought of as the multidimensional space in which humans maintain relations. As changes occur within this house or habitat, specific relations are lost, gained, or transformed, leading to the constancy of change in human experience. It follows that contextual changes require transformations of knowledge in order to maintain human ecological relations.

⁹ Most ecologists and evolutionary biologists distinguish between those components of ecosystems that are subject to evolution by natural selection (biotic components or organisms) and those that are not (abiotic components that are the organisms' environment). While this distinction has proven useful for certain kinds of analyses, it is not relevant in contexts in which inanimate entities (e.g. rocks or water) are contemplated as beings with whom humans maintain ecological relations.

These transformations of knowledge reflect practical wisdom, or *phronesis*, first described by Aristotle (1976) and elaborated by philosophers (Ryle 1984) and social scientists (Dreyfus and Dreyfus 1986; Flyvberg 2001). Kassam understands *phronesis* as an interaction between knowing *that* something is the case and knowing *how* to act in a particular context (Figure 3). As an individual develops practical wisdom, his or her ability to perform a certain action (knowing *how*) is enabled by knowledge of potentials and possibilities (knowing *that*). Knowing *that* and knowing *how* are not binary, but are constantly interacting. Knowing *how* includes the ethical dimensions of action, and cultural values therefore shape wise practice. Where many previous models of learning are linear¹⁰, Kassam’s conceptualization of *phronesis* is cyclical and multidimensional because learning *that* is facilitated by knowing *how*. In other words, context-independent knowledge must have been practicable in some context before it was knowledge that something is more generally the case.

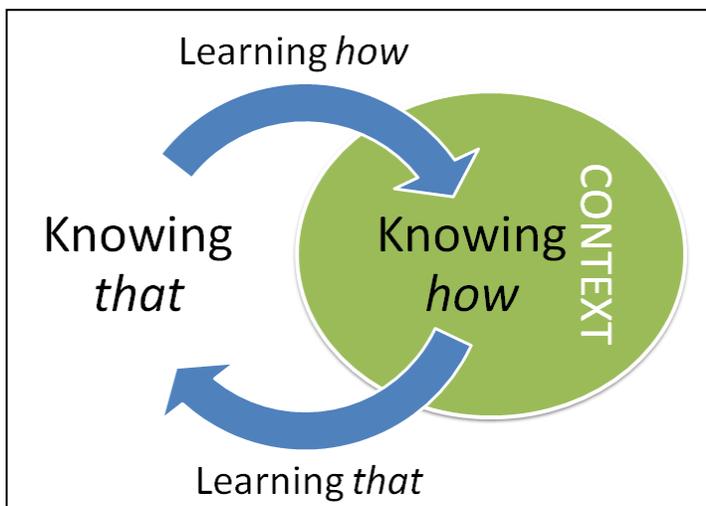


Figure 3. The cycle of *phronesis* (practical wisdom) adapted from Kassam (2009a).

¹⁰ The stages of instruction described by Ruddle and Chesterfield (1977) focus on learning *how*, although “familiarization” may involve learning *that* something is possible. “Experimentation” may also involve testing the relevance of knowing *how* in new contexts.

It is important to distinguish between knowledge transmission and knowledge transformation described by *phronesis*. Knowledge transmission occurs when an individual makes it possible for another individual to learn *that* and or learn *how*. Knowledge transformation refers to the processes of learning *that* or learning *how*. Based on knowing *that* something is the case, an individual can learn *how* to engage a specific practice in a particular context. As a result of knowing *how* to engage a practice in a particular context, individuals can learn *that* something is more generally the case in other contexts. The case study that follows is a demonstration of this principle that “the universal may only be approached through recognition of the particular” (Kassam 2009a, 73). The applied research experience in a particular setting can reveal knowledge that is applicable in other contexts. Cycles of knowledge transformation allow humans to respond to changing contexts so that practical wisdom remains relevant.

Methods

From June through December, 2009, the author worked in partnership with NFE, NGP, BGC and SCCE to create opportunities for knowledge transmission within Standing Rock communities (Table 5). The majority of these activities focused on locating, gathering, preparing, or preserving non-cultivated plants. Participating youth were aged 4 to 18, whereas elders were at least 60 years old. The author had been conducting participatory research with elders about the seasonal availability of local food plants (see Chapter 1) and helped NGP and SCCE identify elders who were motivated to share knowledge and lead these events. Leaders were provided with a cash honorarium by NGP or NFE.

Semi-structured interviews were conducted with elders and organizers as they facilitated or led intergenerational activities and/or intragenerational workshops,

including six elders and the three employees from NGP, SCCE, and the BGC Teen Center (Table 6). Interview questions directly addressed the elements of Kassam's human ecological lens, including perception and diversity, human ecological relations, context, and practical wisdom. Interviews included discussion of challenges and opportunities for local organizations as they engage knowledge systems. Interviews required reflection on the deeper past as well as recent events, but participants were asked to consider the meaning of the past for future community actions.

Interviews were not recorded with audio or video equipment. Detailed field notes were used to construct interview narratives that included some of the author's interpretations of statements made by participants during interviews. To ensure that interview narratives were not conflicting with the views of individuals, each interview narrative was read and revised by the participant. All requests for changes in the text of the narratives were made until the content and language of each narrative was approved by the participants. Except for one research participant (who chooses to remain anonymous), all participants agreed to the use of their names in association with all research products, including this publication. Participants' names are used to acknowledge and honor the individuals who contributed their knowledge and insights.

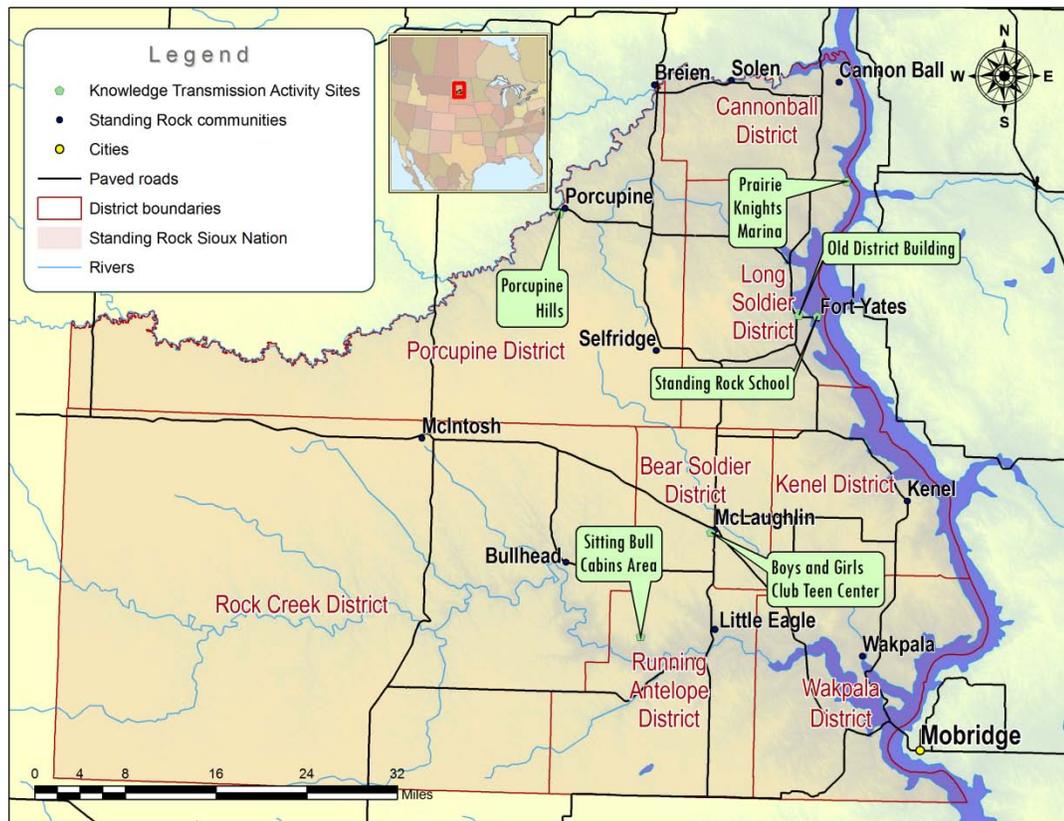


Figure 4. Locations of knowledge transmission activities organized in Standing Rock in 2009.

Table 5. Participation by organizations and communities in inter- and intragenerational activities.

	Indigenous foodway practice	Location*	Organizational participation			Community participation			Author
			NGP	SCCE	BGC	Elders (age 60+)	Youth (age 4-18)	Other ages	
Intergenerational Activities	<i>Digging thinjpsinla</i>	Porcupine Hills	L (1) F (1)	-	F (1)	L (1)	P (3)	-	F (1)
	<i>Gathering chokecherries and wild plums</i>	Porcupine Hills	F (2)	-	F (2)	L (1)	P (31)	-	F (1)
	<i>Gathering chokecherries and wild plums</i>	Sitting Bull Cabins Area	-	-	F (1)	L (2)	P (8)	-	F (1)
	<i>Gathering chokecherries and buffalo berries</i>	Prairie Knights Marina	F (2)	-	F (2)	-	P (8)	P (2)	F (1)
	<i>Preparing buffalo wasna</i>	Long Soldier District Building	F (2)	F (1)	F (1)	L (1) P (3)	P (10)	-	F (1)
	<i>Preparing chokecherry patties (3 sessions)</i>	Standing Rock School	-	L (1)	-	F (3)	P (50)	F (2)	F (1)
	<i>Preparing chokecherry patties</i>	BGC Teen Center	-	-	F (1)	-	P (10)	-	F (1)
Intragerational Activities	<i>Preparing chokecherry patties</i>	Old District Building	F (2)	F (2)	-	P (6)	-	-	F (1)
	<i>Preparing wild plum butter and jelly</i>	Old District Building	F (2)	F (2)	-	P (4)	-	P (1)	F (1)
	<i>Preparing and preserving salsa</i>	Old District Building	F (2)	F (1)	-	P (4)	-	-	F (1)
	<i>Preparing pumpkin bars and pies</i>	Old District Building	-	-	-	F (1) P (2)	P (1)	-	F (1)
	<i>Preparing corn wasna and corn bread</i>	Old District Building	F (2)	F (2)	-	L (1) P (10)		P (5)	F (1)
	<i>Preparing kabubu bread</i>	Old District Building	F (2)	F (2)	-	L (1) P (10)	P (4)	L (1) P (10)	F (1)
	<i>Preparing elderberry cough syrup</i>	Old District Building	L (2)	-	-	P (20)	-	P (10)	F (1)

* See Figure 2 Key: L = leader, F = facilitator, P = participant; (Number of individuals)

Table 6. Organizational associations and roles of interviewees in intergenerational and intragenerational knowledge transmission events.

	Name	Organizational association	Role(s) in intergenerational activities	Role(s) in intragenerational workshops
Elders	Charmayne Eagleman	none	Leader	Participant
	Loretta Yback	none	Leader	Leader, participant
	Rita Loon	none	N/A	Leader, participant
	Therese Martin	none	Consultant*	N/A
	Wilbur Pleets	none	Leader	Participant
	<i>anonymous</i>	<i>anonymous</i>	Leader	Participant
Organizers	Aubrey Skye	Native Gardens Project	Facilitator	Facilitator, leader
	Diana Shippentower	Grand River Boys and Girls Club Teen Center	Facilitator	N/A
	Sue Isbell	Sioux County Cooperative Extension	Facilitator	Facilitator

*Therese Martin did not attend activities but reflected on her teaching experiences in the past in order to guide the intergenerational activities organized in 2009.

Results and Discussion

Perception and diversity

During intergenerational and intragenerational activities participants engaged a diversity of cultivated and non-cultivated plants. When youth attended gathering trips, they learned to differentiate plants with similar appearances. Elders who led these trips taught youth to identify useful food plants, but also plants that can be mistaken for food plants, such as *wanáǵi thinpsinla* (trans. “spirit prairie turnip”, *Pediomelum* sp.), which can easily be confused with edible *thinpsinla* (prairie turnip, *Pediomelum esculentum*). The process of identification through comparison enabled youth to appreciate the diversity within landscapes that at first appear homogenous. Aubrey Skye, the director of the Native Gardens Project, explained that as people learn to recognize plants as food, they begin to see “value” in their landscape, rather than seeing “just another tree or bush”. This change in perception is fundamental to many of the social transformations that organizations and elders aim to bring to their communities.

The ability to differentiate between other beings is enabled by language; naming plants allows children to distinguish them. In observing and describing differences through time, children become aware of ecological processes and long-term changes, including those in which humans play a role. Whereas the English and German languages of nineteenth-century colonists evolved to name the plants and animals of the Great Plains (usually by comparison with species they had encountered elsewhere), Lakota and Dakota names contain more specific ecological details derived from thousands of years of accumulated observations and interactions. Perhaps because of this, Therese Martin encouraged organizations to introduce children to plants in the Lakota or Dakota language. In her decades of experience as a teacher, Martin timed the introduction of Lakota vocabulary to coincide with seasonal

ecological processes. In September, for example, she would teach children to say “it is getting hot”, “the cherries are getting black”, or “the plums are turning red”. Martin hopes that children can learn the Lakota or Dakota language by describing changes they see in the world, and believes that these languages are sacred because they reveal the wisdom of ancestors. In effect, language contains systems of perception and differentiation. As younger generations learn to name plants in English rather than Lakota or Dakota, these systems are transformed and children’s perceptions of the diversity of plants, animals, and foods become different from their elders’.

Perceptions of difference are linked to language shared by cultural groups, but they also reflect unique personal experiences. As elders prepared traditional foods during intragenerational workshops, they discerned the quality of foods based on memories of tastes, textures, smells, and appearances. Given the diverse personal experiences of elders, it is no surprise that they expected different qualities of traditional foods. One elder remembered that she “couldn’t even taste a seed” in her grandmother’s chokecherry patties because her grandmother had used a grinding stone to crush the cherry pits into undetectable pieces. This memory underlies her personal preference that chokecherries should be processed with a grinding stone, rather than a cast iron meat grinder, which several other elders use. When she tasted the chokecherry patties prepared with a cast iron meat grinder during workshops, she said she could detect small fragments of cherry pits. Elders therefore evaluated the quality of chokecherry patties based on different perceptions of difference. Elders’ perceptions of the qualities that make a high quality chokecherry patty vary, and different processes are necessary to attain the qualities that different elders recognize. Some elders prefer the taste of chokecherries gathered in remote ravines while others opt for those growing in town; some elders dry their patties in the hot August sun, while others choose to use electric dehydrators. In discussing traditional foodways,

we cannot assume a consensus about particular processes and must appreciate the diversity of perceptions of the same foods.

The fact of diversity within traditional foodways might complicate the knowledge transmission objectives of local organizations, particularly if a lack of consensus is interpreted as evidence for a loss of knowledge within communities. Elders interviewed in Standing Rock did not interpret differences in knowledge as problematic. Rather, even when they didn't agree with the methods demonstrated during gathering trips and workshops, most elders emphasized their respect and even gratitude for differences in knowledge. Loretta Yback, for example, expressed her thanks that an elder from another district had demonstrated a way to prepare buffalo *wasná*, even though she prefers a different set of methods. If elders recognize the diversity of knowledge within their community as an adaptive asset (see Chapter 1), organizations should help them conserve this diversity as they facilitate knowledge transmission.

In organizing intergenerational activities, organizations usually invited one or two elders to share knowledge with children, and these elders communicated specific knowledge and perceptions to younger generations. Given that these activities are a primary source of indigenous knowledge for many children, how can organizations facilitate the continuance of the broad range of knowledge held within communities? Charmayne Eagleman identified two practical approaches to conserving the diversity of knowledge within her community. First, Eagleman engages children by telling them personal stories about the ways her own parents gathered and prepared traditional foods, and avoids speaking more generally about historical practices of Lakota people. Children can appreciate the specificity of her experiences and can compare her stories with others' to recognize differences in knowledge. Secondly, Eagleman makes the case that the ratio of elders to children needs to be high so that

elders can work with small groups of children. This not only facilitates the development of relations between elders and youth, but promises to conserve a broader subset of community knowledge through increased participation by elders. In vector-based models, as organizations facilitate oblique, one-to-many knowledge transmission across family lines, it is important to ask, “one to how many?” in order to ensure that such activities do not diminish the diversity of community knowledge moving forward.

Interviews with organizers and elders indicate that organizations can reinforce the diversity of knowledge within communities and avoid reconciling important differences in perception. During early workshops, before they had realized the diversity of knowledge among elders about the same foodways, organizers decided not to designate workshop leaders (see Table 5), and expected that all participants would contribute knowledge as attendees prepared foods together. Elders said that it was difficult to follow multiple elders’ recommendations simultaneously, and the resulting food didn’t meet anyone’s expectations. In other words, different elders’ knowledge about the same foodways could not always be incorporated into a single practice.

After several such experiences, elders and organizers agreed that one elder should lead each workshop. At the same time, both groups expressed an appreciation for the diversity of knowledge among the elders. As elders worked to reconcile their various methods, they had realized how many ways they could prepare traditional foods. The decision to follow a leader did not represent a desire for consensus about how a food should be prepared, but an understanding that recipes are integrated and difficult to recombine. Rita Loon, who led several workshops, said that she told other elders, “I do it this way”, but emphasized that other participants can prepare the same foods differently. Sue Isbell was pleased that although elders chose to follow one leader, they continued to discuss alternative methods throughout the workshops.

These discussions identified not only different traditional practices, but also possibilities to reduce fat and sugar content for diabetics or others with diet-related diseases. As elders discovered differences in their knowledge, they came to appreciate a new range of possibilities for traditional foodways to meet the needs of their families.

Human ecological relations

Standing Rock residents often remember their relatedness to other beings in prayers and public statements, opening and closing by acknowledging “all my relations” or “*mi takuye oyasin*” in Lakota. Relations with plants, animals, spiritual and inanimate beings are fundamental to a diversity of spiritual and religious practice in Standing Rock, and are understood as sources of ecological wisdom. Knowledge is not an object that is received and held by the mind; rather, knowledge lives within relations with other beings and requires practice to remain relevant.

During interviews, elders and organizers discussed how knowledge transmission activities increased awareness of relations with other beings. Aubrey Skye explained that “once you get out in a natural environment, that serves as a catalyst” and people begin to realize that “we have all these connections here... we are connected to everything.” Skye hopes that as communities reengage traditional foodways, youth and others will realize that identity and values rely on relations within in their landscape, both within human communities and with plants and animals. These relations are sources of well-being, particularly physical health.

The concept of reciprocity within relations was emphasized in several interviews. Rita Loon talked about the practice of harvesting mouse beans (*makhátomniča*, or *Amphicarpaea bracteata*), which are stored in caches made by rodents (Jones 1998). Loon said that she has been taught that “animals prepare these

things for us”, and as gatherers collect beans from the caches, they provide corn in return so that the mice will not starve during winter. Although most elders agree that this plant has not been observed on Standing Rock since the Oahe Dam, this tradition indicates that gathering is not understood as an extraction of resources from the landscape, but as engagement that can mutually benefit plants, humans, and in this case, other animals. Based on his own conversations with elders, Aubrey Skye said he had heard that “people need to go out and pick things, because then they will come back even more”. Academic plant ecologists confirm that certain plants increase growth in response to herbivory (e.g. McNaughton 1983), and it appears a safe assumption that gathering techniques may induce similar compensatory responses. Based on their understanding of these responses, elders feel certain obligations to gather plants so that important food sources will remain available. One aspect of knowledge transmission is that it represents the conveyance of ecological relations to young people so that future generations honor ethical commitments to other beings in the landscape.

Elders and organizational staff also discussed reciprocity between elders and youth during knowledge transmission activities. Charmayne Eagleman remembered that during one of the intergenerational gathering trips, a young girl gave her a bag of the wild plums she had gathered. “That is *really* part of our culture,” she said. Eagleman interpreted this act as more than an exchange of food for knowledge, because gifting the plums was a sign of gratitude for relations that enable this young girl to develop practical wisdom. Eagleman also talked about how adults learn from their interactions with young people. Eagleman often asks children to teach her what they know so that she understands what they have already learned. Previous assumptions that vertical transmission is a unidirectional vector (Cavalli-Sforza and Feldman 1981; Reyes-Garcia et al. 2009) overlook the possibility that parents receive

wisdom from their children. However, as children recombine the diversity of knowledge available to them in their communities, they can offer new insights to older generations. For example, young people on Standing Rock are teaching their elders to use computers, demonstrating that grandchildren can offer grandparents new knowledge and skills.

Of particular note, relations between elders and young people may develop slowly, and elders who participated in intergenerational activities felt they didn't have enough time to forge relations with youth. If strengthening human ecological relations is an objective of knowledge transmission activities, organizations need to overcome expectations that activities are completed within specific timeframes. Pickering (2004) writes that Lakota communities on the Pine Ridge reservation demonstrate a "task orientation" in their work, whereby individuals focus on completing a task rather than working "by the clock". Pickering makes a strong case that this time sense facilitates the integration of labor and social activity. Elders say that in the past, knowledge transmission occurred within families, and time with the family was seldom limited. Elders therefore indicate that organizers need to overcome their clock orientation to facilitate the social relations that are fundamental to knowledge transmission.

The intragenerational workshops conducted in Standing Rock facilitated knowledge transmission among elders, but also strengthened the relations that form knowledge networks within communities of elders. Rita Loon expressed her excitement that when she shares her knowledge at a workshop, elders share it again with their families and friends. One of the outcomes of the workshops is that community members are learning *who* holds wisdom about traditional foodways and other practices. Sue Isbell said that before the workshops, SCCE did not know *who* knows *how* to braid sweetgrass, and the workshops connected her to a network of

elders who can help her teach children. In other words, new relations allow individuals to access specific knowledge when it becomes relevant to new experience. Hence, knowledge transmission models need to account for changes in social connectivity as human ecological relations develop. Local organizations, by facilitating events where elders meet and discuss their personal practices, can help such networks grow.

Context

Elders discussed dramatic changes that have shaped the context of their human ecological relations and knowledge systems. Wilbur Pleets said that the greatest changes were brought about by the Oahe Dam. Pleets said there had been a “whole food system” before the dam, and that families knew when and where to gather plants for food. The dam forced the relocation of families who lived along the Missouri River and required them to find plants within the vicinity of their new communities, which were located in quite different parts of the landscape. Loretta Yback, Charmayne Eagleman, and other elders were children when their families were relocated out of the Missouri floodplain. They remembered that before the dam, their parents had taught them to haul water, tend to animals, and prepare food. Eagleman said that children “all had duties and we *needed* to know [how to perform them]”. Highly-structured knowledge systems were interrupted by specific contextual changes, including forced relocations into government-built communities and later to off-reservation boarding schools. Yback, for example, said that as a child she knew how to make oven bread, *kabúbu* bread, yeast bread, and fry bread, and also helped her mother with canning. But after her family was relocated and she left Standing Rock to attend a boarding school, she stopped preparing most of these foods. For many elders,

the practical wisdom they received from their families, including knowledge about traditional foodways, was not relevant in new social and ecological contexts.

Nevertheless, elders and organizers insist that traditional foodways remain relevant in Standing Rock. Individuals frame the need to restore traditional foodways through knowledge transmission projects differently. Rita Loon said that “the whole goal is for health... and to keep traditions ongoing for future generations”. Charmayne Eagleman said that there are more convenient ways to get food, but people gather food “to keep the tradition alive”. Therese Martin emphasized the need for children to reconnect with their landscape and their culture through the Dakota or Lakota language. Wilbur Pleets said that future generations will need to assert tribal sovereignty by sustaining their nations from within by recovering local food systems based on traditional foodways. Diana Shippentower works with many youth that don’t have parents or grandparents and has learned “there is a need” for knowledge transmission projects because many young people don’t have families that teach them to gather plants. Loretta Yback emphasized the emotional benefits for elders who participate in their communities and learn something new. Sue Isbell talked about integrating research-based information about nutrition and diabetes with elders’ knowledge. Aubrey Skye identified opportunities for traditional foodways to contribute to local economic development while at the same time promoting “sustainable living practices”. For a variety of reasons, interviewees feel that traditional foodways are still relevant in Standing Rock. Historical and recent contextual changes do not seem to have diminished the importance of traditional foodways to community life.

While they expressed appreciation for knowledge transmission projects led by local organizations, elders also talked about the changes in the contexts of knowledge transmission as organizations become involved. Elders confirmed that in the past,

ecological knowledge was shared within families, and none of the elders recalled learning about traditional foodways in school or other formal community programs. Loretta Yback said that she had learned about all of the traditional foodways discussed in workshops before she was twelve years old from her mother and other family members. Charmayne Eagleman remembered that when she was a child, her family had gathered food as a necessity, but gathering was not a “big, laborious job” because the children enjoyed spending time with their family. Although many of the elders said that they teach their own children and grandchildren about traditional foodways, they also expressed concern that most families are not communicating their knowledge to children. Although knowledge transmission facilitated by organizations rather than families may not be ideal, elders indicated that these are opportunities for communities to conserve their knowledge, if not their knowledge systems.

When asked about the context of activities facilitated by organizations, Charmayne Eagleman and others drew on memories of past contexts to recommend program improvements. For example, Eagleman remembered that when her family went to gather chokecherries and discovered that the water in a nearby creek was warm, they would take time to go swimming. In the past, according to Eagleman; “people around here never knew what to expect, what would happen, so they didn’t make a lot of plans, they responded to what came to them.” Elders and organizers agreed that although organizations need to be well-prepared, activities need to be responsive and adaptive so that participants do not feel trapped in a highly-programmed and predictable experience. Diana Shippentower remembered the excitement during a trip to gather wild plums, when participants discovered that buffalo berries were ready to gather more than a month earlier than usual. By preparing for possibilities but not planning all the elements of knowledge transmission

activities, organizations allow elders and children to discover their landscape and take advantage of such unexpected opportunities.

Elders also recommended that the physical space for intergenerational workshops should mimic the context in which elders normally meet: in each other's homes. One elder thought the community building where workshops were held could be made to feel more "homey" so that elders were inspired to socialize and prepare foods as they would in their own houses. Most elders and organizers agreed that intragenerational workshops should be "elder focused" but that youth were always welcome if they wanted to attend. One elder observed that at the only food preparation workshop where youth and elders were of equal number, elders "sat back" and chose not to participate as much as usual. The presence of youth may have changed the context of the workshop, but elders preferred to extend an open invitation to the whole community, as they do for other social events.

Finally, when asked about the context of knowledge transmission, elders and organizers also discussed the spatial arrangement of individuals and its impact on relations between participants. Therese Martin said that with younger children you have to make them feel comfortable, so you shouldn't "sit on top of a desk" or assume another posture that represents strong authority. Sue Isbell said she never chooses to "stand at the front of a room and profess", but prefers to sit "with everyone at the same level". Wilbur Pleets, Aubrey Skye, and Isbell recommended that elders and youth sit in a circle so that people can express themselves freely and participants can address topics of their own choosing as the opportunity to speak rotates. Pleets added that the circle has symbolic meanings that youth already understand. For one, the circle represents equality among participants; although elders are respected, they are not physically elevated and their authority is deemphasized to encourage youth to participate as equals in knowledge transmission activities. The context established by

this spatial arrangement can facilitate communication between younger to older generations and encourage the reciprocal relations that are the source of ecological knowledge.

Phronesis

According to elders interviewed, Standing Rock youth sometimes learn about traditional foodways in school, but rarely participate in them. Children might learn *that* specific plants can be located and gathered for food, but rarely learn *how* to do so unless their families teach them. Charmayne Eagleman agreed that “to know [something], you have to have to have experienced it.” She talked about her grandson, who lives near the Black Hills of South Dakota, but gathered berries for the first time during an organized trip in Standing Rock. Eagleman understands that in the Black Hills, a region considered particularly sacred by tribes throughout the northern Great Plains, there is an abundance of food plants available, but Native people aren’t gathering them. During her interview, she paused to consider whether this decline in the use of traditional foodways represents a lack of interest, a loss of ecological knowledge, complex problems of access, or some other contextual change. Finally, she asked, “How are [children] going to learn if we don’t teach them?” Eagleman and other elders feel an obligation to help their children learn *how* to practice traditional foodways.

During intragenerational workshops, most elders were familiar with the foods that were made, but many had never prepared these themselves or had forgotten how to do so. For those elders, the ultimate goal of intragenerational workshops is the transformation of knowledge *that* traditional foods can be made from local plants into knowing *how* to practice those foodways. Learning *how* to prepare traditional foods often brought back memories of parents and grandparents. One elder described the

process as being “reminded” rather than “learning again”. “Things come back into my mind.” she said, and the memories feel good because “everything is so different now.” Diana Shippentower remembered watching two elders make *wakáphapi* (pounded meat) and how the process seemed to bring back their memories about how to prepare it. Sue Isbell was excited about elders who had seen grandparents prepare certain traditional foods but hadn’t known how to make them themselves until the workshops. Those elders, said Isbell, were “reliving their culture”.

Aubrey Skye said that becoming an elder isn’t accomplished by simply surviving to a certain age. An elder holds practical wisdom that he or she can convey to others. Wisdom comes with age, but individuals can act as an elder in their communities if you have significant life experiences. On the other hand, when an older person doesn’t find opportunities to share knowledge with youth, his or her full potential as an elder is unrealized. Participating in knowledge transmission events can empower elders as teachers and dignify their place in society; several of the elders who learned *how* to make certain foods at workshops began teaching others the same skills at subsequent workshops. One elder remembered a woman who came from northern North Dakota to attend a workshop she was leading. The visitor said she had chokecherries stored in her freezer but didn’t know what to do with them. After the workshop, the visitor told the leader that she was going home to try and make her own chokecherry patties. This story not only communicated the potential impact of the workshops, but demonstrated that elders find meaning in their roles as teachers and sources of ecological knowledge.

Over the course of several workshops, elders and organizers began to formulate guidelines for learning *how*. Aubrey Skye said that learning *how* begins with explanation, so that the group learns *that* a process will require certain steps. Secondly, Skye and other elders agreed that participants need to watch a leader

demonstrate all the steps that make up the particular practice. Third, each participant needs to try the practice on his or her own. One elder said that during the *kabúbu* bread workshop, for example, it was important that everyone make their own batch to learn *how*. Rita Loon said that she encourages anyone who is learning to prepare a food to try and make it themselves.

Often elders wrote down the recipes demonstrated by leaders during workshops, but when asked if their knowledge of foodways could be recorded this way, they said that recipes only serve as reminders, and that knowing *how* is achieved through repetition. Rita Loon agrees that “practice makes perfect”. Loretta Yback even suggested that organizers repeat workshops so that elders could prepare the same foods again and improve the recipes. She said that repetition would make elders more confident and “more aware of what they’re doing”. Each time an elder prepares a certain food, he or she must adapt his or her practice to account for slight changes in context. Rita Loon normally uses corn meal to prepare corn *wasná*, but organizers brought local parched corn to the workshop and ground it with a meat grinder. The ground corn that Loon was asked to use was much coarser than corn meal, but she was able to adjust the ratios of water, kidney fat, sugar, and raisins to make good corn *wasná*. Although knowing *how* is context-specific, understanding the relationship between context and practice enables an expert to improvise and adjust a recipe based on their understanding of new conditions. In the context of high rates of diet-related disease, for example, workshop leaders might attempt to reduce the fat and sugar content of traditional foods. Knowing *how* includes knowing where changes can be made to a particular practice, in this case specific ingredients or their ratios, without losing the essential meaning of that practice (the defining flavors and textures, for example).

Modifications of traditional foodways may not always succeed, and the results may disappoint participants. Sue Isbell said that learning *how* requires empowering people within their learning process and letting them fail. She told a story about some of her students building a marble track and running into a situation where things weren't working as expected. Her students told her "it doesn't work," but Isbell decided not to fix the track for them. Instead she asked, "What's the problem?" and provided some reassurance, saying "you can figure it out". She sees the same opportunity in the intragenerational workshops, where elders might be unhappy with some of the foods they prepare, but the chance to try again will offer a more important learning experience than a success during the first attempt. In learning *how* to engage a traditional practice, elders need to experiment in order to determine how that practice can stay relevant in new contexts.

The cycle of *phronesis* (see Figure 3) includes the incorporation of new context-independent knowledge (knowing *that*) to shape context-dependent knowledge and practice (knowing *how*). Organizers and elders can introduce new knowledge to communities as they adapt practical wisdom to new contexts. Aubrey Skye hopes to organize a farming conference where he invites Native and non-Native speakers from throughout the upper mid-West to talk to elders about their gardening practices. Sue Isbell believes she can help elders improve food safety within traditional foodways by providing research information. For example, she supposed she could ask elders, "How do you keep flies off the meat when you are drying *pápa*?" Elders might tell her they use nets or turn the meat or swat at the flies. Isbell says she could research the question on the internet, investigate the results of controlled experiments, and offer the information she finds to elders who share her concern about food safety. Elders did not express anxiety that organizational involvement will transform traditional foodways based on knowledge developed in other contexts. The

foodways demonstrated during workshops included many recent adaptations, including the incorporation of newly available technology and ingredients.

Practical wisdom reflects cultural values, and much of the ecological knowledge shared during gathering trips and workshops is linked to ethical commitments. Aubrey Skye said that the goal of knowledge transmission is to teach practical skills, but the practices themselves communicate cultural values, including caring about the community and respect for the environment. Sue Isbell says that there are certain practices that Standing Rock youth need to learn *how* to do, but they also need to understand *why* certain protocols are followed. If it is important to hold a ceremony when you kill a buffalo, she explains, children should know *why*. Knowing *how* and knowing *why* are linked through cultural values and ethical practice. Diana Shippentower told a story about coming to a place where people had been digging for *thinpsinla* but hadn't replaced the soil when they were finished. She felt "outraged" at what "showed a lack of respect." The gatherers who had visited this site were able to locate and dig *thinpsinla*, but did not take care to gather the plant according to Lakota or Dakota values. These values underlie a variety of specific protocols to maintain relations with plants and other beings. Elders described different ways to conserve *thinpsinla* as the root nodules are collected, including replacing the tops of the plants in holes and covering them with soil or carefully lifting and replacing the plant and sod around the plant with a digging tool. Although the long-term effectiveness of these conservation practices should be investigated by elders and researchers, the point is that families absorb important cultural values as they engage either of these practices. Both of these practices are expressions of respect and gratitude. In the future, new information may lead to changes in specific practices, but the underlying cultural values endure.

Conclusions

The human ecological lens developed by Kassam is a powerful conceptual tool that can guide investigations of social and ecological change in indigenous communities. Applying the interrelated concepts of perception through diversity, human ecological relations, context, and practical wisdom can inform a fresh understanding of knowledge transmission in Native American communities. In Kassam's previous applications of this lens in other contexts, subsistence living through hunting, gathering, and agro-pastoralism is the norm (2001; 2009a; 2009b). By contrast, regional and national distribution networks now provide the vast majority of food to Native American communities in the continental United States, and subsistence activities represent a minor, albeit culturally-significant, set of food procurement strategies. Community members attribute alarming rates of diet-related disease to these changes, and identify elders' knowledge of traditional foodways as a potential source of well-being.

In Standing Rock, elders express concern that young people are not learning *how* to participate in traditional foodways. In this and similar cases, organizations can play key roles in organizing and facilitating intergenerational knowledge transmission activities, particularly for young people who are not learning about traditional foodways from family members. Learning to recognize differences between plants and animals in the landscape and developing human ecological relations with other beings are important conceptual goals of knowledge transmission. Elders recommend that events include a number of elders so that the diversity of knowledge held by their community is communicated to young people. Working in small groups for extended periods of time can foster reciprocal relations between individual elders and youth. In preparing for activities, organizations should remember that learning *how* includes discovering and responding to the changing landscape, so organizers should be ready

and willing to respond to unanticipated conditions. Learning *how* does not entail following a set of rules, but requires understanding the cultural values that underlie specific protocols. Knowing *how* includes an ability to modify traditional practices based on new information in evolving contexts.

The need for *intragenerational* knowledge transmission within communities is not widely appreciated and was not anticipated in Standing Rock. Some elders may know *that* certain traditional practices are possible, but do not know *how* to engage these practices, let alone teach them to younger generations. Organizations can create opportunities for elders to explain, demonstrate, and practice local foodways together. Given that elders appreciate the diversity of knowledge within their community, participants may not aim to achieve consensus about traditional foodways. Although elders may opt to designate workshop leaders, organizations can facilitate discussions that emphasize the diversity of knowledge within the community and build local knowledge networks based on renewed social relations. Organizations can work with elders to design a physical context conducive to knowledge transmission. Based on their own objectives, organizations might also introduce new information that elders can decide to incorporate into their dynamic practices.

Finally, widespread concerns about the disappearance of indigenous knowledge may compel researchers to interpret all cultural change as cultural loss. Research on knowledge transmission might valorize knowledge conservation and undervalue the capacities of individuals and communities to reshape knowledge and practice as they encounter social and ecological change. Investigations of knowledge transmission processes, rather than measurement of outcomes, will help researchers and community partners differentiate between failures to convey wisdom into the future and successful efforts to keep wisdom relevant.

CHAPTER 3
PRACTICING FOOD SOVEREIGNTY:
SPATIAL ANALYSIS FOR AN EMERGENT FOOD SYSTEM

Introduction

Indigenous peoples throughout the world experience the impacts of global, industrialized food systems on the health of their communities and their habitat (Kuhnlein, Erasmus, and Spigelski 2009). Increasing reliance on industrial food supplies are impacting human health, local economic opportunities, and cultural values. Although some communities may accept these changes as inevitable outcomes of globalization and the industrialization of food production, others are working to secure and expand systems that derive healthy foods from the landscape without the same impacts (LaDuke 2005). Most indigenous communities have developed sophisticated practices to obtain food from ecological relations with other beings in their landscapes (Kassam 2009a). The practical wisdom held by indigenous communities, as well as knowledge generated through partnerships with research institutions, can strengthen and develop local food systems (Robinson and Kassam 1998; Kassam and Soaring Eagle Friendship Centre 2001; Kassam and The Wainwright Traditional Council 2001).

The international *food sovereignty* movement is a coordinated response to trade agreements, state policies, and corporate practices that enforce the dominance of global, industrial food systems (Windfuhr and Jonsén 2005). Food sovereignty was first described by the global coalition of peasants, small farmers, agricultural laborers, and indigenous peoples known as *Via Campesina* before the 1996 World Food Summit in Rome (Menezes 2001). *Via Campesina* defined food sovereignty as the “right of each nation to maintain and develop their own capacity to produce foods that

are crucial to national and community food security, respecting cultural diversity and diversity of production methods” (Via Campesina 1996). In the context of protesting global trade structures, *Via Campesina* emphasized food sovereignty as a right, but also revealed its requirement for local capacities. In other words, a right to produce and distribute food is irrelevant if communities do not know how to do so. In fact, specific ecological knowledge enables food systems, particularly when those food systems are designed to withstand social and ecological changes. Losses of ecological knowledge resulting from the disintegration of local food systems reinforce dependencies on global supplies of industry-processed foods. Where these dependencies are already strong, efforts to restore food sovereignty will require concerted efforts to regenerate networks of social and ecological relations that enable local production and distribution of food.

As food sovereignty advocates respond to inequities resulting from existing global power relations, they challenge assumptions within the food security paradigm, which has guided development programs for at least the past 40 years (Shaw 2007). Although conceptualizations of food security are evolving (Maxwell 1996), they commonly emphasize the reliability of food supplies to meet the nutritional needs of people at various scales. Since food tends to be understood as an object or a volume, food security is achieved by actions that guarantee appropriate measures of nutrients to meet the caloric and biochemical requirements of households, communities, and nations (M. D Anderson and Cook 1999). Food sovereignty recognizes that food emerges from dynamic relations between people and their landscape, so demand within food systems is shaped by socio-cultural, as well as biophysical contexts. Whereas food as an object satisfies important metabolic needs, food as a manifestation of social and ecological process reinforces the structure of community life. In other

words, food systems integrate communities, and without autonomy to shape those systems, the long-term security of communities is doubtful.

Our objective for this study was to develop tools to analyze the spatial arrangement of human ecological relations within an emergent food system. In the narrative and analyses that follow, we evaluate whether innovative food assistance programs and strategic market placement can strengthen food sovereignty for indigenous communities, even if those communities currently rely on industrial food systems. These efforts can reactivate human ecological relations that are key sources of health, economic opportunity, and cultural values. Human ecological relations are multidimensional, but are also particular and concrete, and therefore occur across physical space (Kassam 2009a). Although we recognize food sovereignty as a complex of rights and capacities, research can contribute new knowledge for communities to improve the practice of food sovereignty. While local knowledge and democratic processes drive the creation and transformation of sovereign food systems, the use of spatial tools such as Geographic Information Systems (GIS), can contribute to those processes with practical information and important insights.

Context

The Standing Rock Nation extends west from the right bank of the Missouri River as it flows across the border of North and South Dakota (see Figure 1). The reservation boundaries encompass 2.3 million acres. The population of Standing Rock in 2009 was estimated at 8116 persons (U.S. Census Bureau 2010), of which 77.3% are Native American (U.S. Census Bureau 2008 Most Native Americans living in Standing Rock are enrolled in the Standing Rock Sioux Tribe, which includes descendents of the *Ihąŋkthūnwaŋna* (Upper Yanktonai, “Those dwelling at the end”) and *Húŋkpatina* (Lower Yanktonai, “Campers at the horn”) bands who speak the

Dakota language, as well as *Húŋkpaŋhá* (“Head of the camp circle”) and *Sihásapa* (“Blackfeet”) bands who speak the Lakota language (Barrett et al. 1995; Ullrich 2008). Fort Yates, North Dakota, is the seat of the tribal government, including the offices of the Tribal Chairman and the Tribal Council. The reservation is divided into eight administrative districts, each of which elects a representative to the Tribal Council and a district chairperson who oversees district business. Standing Rock districts own and manage community centers, social programs, range and agricultural lands, cattle operations, and bison herds. Whereas identities have always been linked to *oyáte* (tribe or people) and *thiódšpaye* (extended families), Standing Rock residents now often also identify with their district of origin.

Before the middle of the 19th century, the food sovereignty of Dakota and Lakota people was assumed, although their right to hunt in certain areas was sometimes challenged by other Native groups (Standing Bear 1975). As settlers moved into the Great Plains, Native leaders negotiated a series of treaties with the U.S. government that guaranteed hunting and gathering rights within newly delimited territories (Smith 1981). As conflicts between plains tribes and the U. S. military escalated in the 1870s, the frontier Army led a systematic (albeit uncoordinated) campaign to eliminate the bison herds on which tribes throughout the region relied. Military leaders recognized that the political sovereignty of Native groups was strengthened by their ability to feed themselves, and bison were targeted as their primary food supply (Smits 1994). After their forced removal to reservations, Indian agents required that Standing Rock families adopt European-American farming systems. Although these agents claimed to promote the self-sufficiency of Native peoples, they sought to replace traditional modes of food production with farming technologies that would prove unreliable in the drought-prone northern Great Plains (Pfaller 1992). As farming systems failed to support Standing Rock families, a

growing reliance on military rations led to widespread dependencies on food assistance programs throughout the 20th century (Jackson 1994). Although many Native families continued to grow, gather, and hunt their own food, national food distribution continued to displace local food production.

In 1959, despite the protestations and legal actions of the Standing Rock tribal government, the U. S. Army Corps of Engineers completed the Oahe Dam on the main stem of the Missouri and permanently inundated 55,993 acres of Standing Rock land (Lawson 1994). These losses included approximately one half of all deciduous forests and woody wetlands in Standing Rock (see Chapter 1). Before the dam, floodplain forests had been primary sources of food, medicine, and fibers, and the destruction of these forests drastically reduced the possibilities for families to gather and hunt the plants and animals needed for traditional foods. As it reduced and eliminated key food system components, the Oahe Dam threatened the possibility for Standing Rock families to regenerate the food systems they had known.

The loss of food sovereignty has had alarming consequences for the health of Standing Rock communities. A needs assessment conducted by Standing Rock Nutrition for the Elderly (NFE) and the Standing Rock Elder Advisory Council confirmed that Standing Rock elders (aged 60 and older) are suffering from high rates of diet-related diseases (2007). For example, the incidence of Type II diabetes among Standing Rock elders is twice the national average (46% as compared to 23%, Center for Disease Control and Prevention 2007). Despite the prevalence of diet-related diseases, interviews revealed that most elders choose not to follow diets recommended by their doctors. Elders were not asked why they do not follow these diets, but several stated that recommended foods are unfamiliar or that suggested dietary restrictions are culturally inappropriate. Many elders told interviewers that they know that traditional foods can improve their health, but that their consumption of these foods has declined.

Interestingly, lack of ecological knowledge among elders was not cited as a reason for this change; 71% of elders say they know how to gather plants needed to prepare certain traditional foods (NFE 2007).

The physical health of Standing Rock elders is therefore linked to food sovereignty in multiple ways. First, elders and health care providers agree that eating habits need to change in order to reduce the incidences of diet-related diseases, but programs to bring about these changes need to recognize food as culture. Dietary standards that are not in keeping with local practice or values are unlikely to be effective because they are unfamiliar and inappropriate, and their imposition could erode the diversity of traditional foodways that are key sources of health (Menezes 2001). Second, elders have a right to decide which foods will bring them health, but this right is irrelevant if communities cannot provide the foods that elders need. It is likely that participation of elders in shaping the food system would lead to increased availability of the ingredients needed to prepare healthy traditional foods. Even if elders cannot hunt or gather food plants, their practical wisdom can enable others to engage these practices and provide for their communities.

The ecological relations that are a source of food sovereignty are dynamic, including those among human communities and between humans and plants in the Standing Rock landscape. Standing Rock is dominated by grasslands, generally wheatgrass-needlegrass plains (Johnson and Larson 2007). According to GIS analysis of land tenure, cover, and use, 79% of the Standing Rock is uncultivated grasslands, 13% is cultivated cropland, and 4% is dedicated pasture and hay fields. Uncultivated grasslands are grazed by cattle and bison and are habitat for a number of non-cultivated food plants, including *thinpsiyła*, (prairie turnip, or *Pediomelum esculentum*), a protein-rich root crop that has been a staple food for Native people in the region for millennia (Kindscher 1987). It is important to note that more than 50%

of Standing Rock's grasslands and 90% of pastures and hayfields are in private ownership¹¹, so *thinpsinla* gatherers must obtain formal or informal permissions to gather plants from most of these lands.

In 2010, a small percent of the Standing Rock landscape is deciduous forest (0.9%) and woody wetlands (1.1%) and is habitat for a number of important food plants described by Standing Rock elders, including a diversity of berries, herbs, and legumes (see Chapter 1). These habitats make up a smaller portion of the landscape than before the construction of the Oahe Dam. Although a number of important food and medicinal plants are less accessible due to these changes (Kraft 1990; Jones 1998), healthy populations of many of these plants remain in tributary floodplains and ravines. In addition, the majority of forests and woody wetlands (56.3%) are located on tribal or allotted trust lands, which facilitates access to food plants in those habitats by tribal enrollees. Preliminary GIS analysis of aerial photography also indicates that National Land Cover Databases underestimate forest cover along wooded ravines because these habitats are often too narrow to be detected at that resolution, so the total forest cover in Standing Rock is likely higher than previously estimated.

Although the Standing Rock landscape produces a considerable volume and diversity of plant and animal foods for humans, only a small percent is distributed to local markets. Instead, crops and livestock raised in Standing Rock are delivered to local storage facilities from which they are sold into regional and national distribution networks; Standing Rock residents rely on grocery and convenience stores that market food from the same networks. In 2009, small grocery stores were located in Fort Yates, McLaughlin, and McIntosh; convenience stores were located in Fort Yates, McLaughlin, Cannon Ball, Selfridge, and Bullhead. Some of these stores sell a small

¹¹ More than half Standing Rock land (1.28 million acres) was conveyed into private (fee) ownership following allotment in the 1880s (Barrett et al. 1995).

volume of locally-grown vegetables during gardening seasons, but the majority of fresh fruits and vegetables sold in Standing Rock is grown in other regions of the United States, Canada, and Mexico.

With the principal objective of expanding the availability of fresh, locally-grown and gathered foods to elders, NFE applied to the USDA Food and Nutrition Services to initiate a Senior Farmers Market Nutrition Program (SFMNP) in Standing Rock. SFMNP is a national program administered by state and tribal agencies that provides low-income elders and their spouses with vouchers that can be exchanged for fresh, unprocessed, locally-grown fruits, vegetables, and herbs at authorized farmers markets, roadside stands, and community-supported agriculture operations. In 2008, NFE became the fifth tribal agency in the United States to receive federal funding for an SFMNP. The program administered by NFE is unique in that it allows elders to exchange vouchers for many non-cultivated plants that are used to prepare traditional foods (for a list, see Appendix B). The inclusion of these non-cultivated plants as eligible foods expands economic opportunities for local gatherers as well as small-scale farmers and gardeners. The SFMNP framework also allows some degree of local control over the eligibility of foods, and this means the tribal agency administering the program can promote traditional foodways that rely on particular plants.

In addition to issuing SFMNP vouchers to elders, NFE authorizes and monitors markets, market vendors, and roadside stands that agree to exchange SFMNP vouchers for produce. In 2009, NFE authorized two existing farmers markets in Mandan and Bismarck, ND. NFE also joined the Native Gardens Project (NGP) of the Standing Rock Diabetes Program and Sioux County Cooperative Extension (SCCE) in an effort to expand the Standing Rock Farmers Market in Fort Yates. This market opened and operated successfully in 2007, but vendor participation waned in 2008. Market

organizers and vendors later attributed this decline to a change in organizational leadership and low market attendance because families could not afford fresh produce.

Organizers anticipated that SFMNP vouchers would infuse money into the Standing Rock Farmers Market and increase vendor attendance and profitability. NFE also supported the development of new markets and roadside stands in other districts of the reservation. By August 2009, NFE determined that SFMNP voucher redemption in the southern districts of Standing Rock had been significantly lower than in districts closer to Fort Yates. NFE predicted that an opportunity to exchange vouchers closer to these districts would increase redemption rates. NFE established a “temporary market” in McLaughlin City Park and provided travel funds for the vendor with the largest variety and volume of produce to sell vegetables there for two days in August and October.

In 2010, NFE, NGP, and SCCE were looking for ways to strengthen and expand the Standing Rock food system through the SFMNP and other programs. These collaborations represent a continued effort to promote practices that enhance food sovereignty in Standing Rock by expanding economic opportunities for gatherers and gardeners and increasing the availability of fresh, healthy, and traditional foods to community members. Adding markets will increase participation by both elders and vendors. Towards that end, this paper examines spatial factors that may help NFE and organizational partners anticipate the success of new markets based on their locations in the landscape.

Methods

The author served as an Americorps*VISTA volunteer in Standing Rock from February 2007 to February 2008. Working closely with the NFE director and staff, he helped conduct the needs assessment of elders as well as develop the original proposal

for the Standing Rock SFMNP. The author returned to Standing Rock in 2009 to conduct a research project focusing on indigenous plant knowledge and knowledge transmission processes (see Chapters 1 and 2). He also assisted with voucher program implementation and market development, and received feedback about the program from participating elders and vendors.

SFMNP procedures allowed each voucher to be traced from its issuance in a specific district to its redemption at a particular market or roadside stand. NFE printed SFMNP vouchers on standard check stock with a unique 6-digit identifier. NFE also provided each vendor with a stamp including a unique vendor number. Whenever a program participant exchanged a voucher, the vendor signed, dated, and stamped the voucher before submitting it to NFE for payment. Vendor codes printed on each voucher were associated with markets at specific locations because no vendor operated at more than one market or roadside stand. Therefore, voucher redemptions at each market by recipients from each district could be analyzed in a GIS database¹². Vouchers exchanged by the same household at the same market on the same day were consolidated as independent trips to markets.

Cost-distance analysis is a method of measuring the costs associated with movement in a landscape, in this case driving on paved and improved gravel roads. For the purposes of this study, one cost-distance unit is equal to the cost associated with traveling one mile on a paved road. The minimum cost-distance for each trip was calculated from the district (a polygon) to a market (a point). Trips made within a district were assigned a minimum cost-distance of 0.

To investigate the relationship between cost-distance and voucher redemption rates, the lowest minimum cost-distance to any market was calculated for each district.

¹² This database was coded for anonymity and used for analysis based on a data-sharing agreement between the author and NFE.

Redemption rates per district were calculated from the number of vouchers redeemed by recipients from each district divided by the total number of vouchers issued in that district.

New cost maps were created to analyze the effects of new markets on the minimum cost-distance values from communities. Cost-distance maps were generated for eight communities that could host a market. Cost-distances from each Standing Rock community to potential market locations were calculated and compared to cost-distances from each community to the existing markets (the Standing Rock and McLaughlin markets). Maps were created to assess spatial overlap of cost-distance radii from proximate markets and to provide a visual reference for decision-makers.

Finally, it was important to consider the number of vendors that are able to attend markets based on their location. The locations of authorized and potential vendors were obtained through a data-sharing agreement with NGP¹³. Authorized vendors had participated in the SFMNP in 2009, whereas potential vendors received technical assistance from NGP in 2009 and are likely to operate at local markets in the future. The number of vendors located less than 20 cost-distance units from each existing and potential market were tabulated for analysis.

Results

Change in the Standing Rock food system

By the end of the 2009 harvest season, 347 individuals from 194 households had received \$50 of SFMNP vouchers issued in \$5 increments. Based on counts of individuals who receive services through other NFE programs, 71% of the estimated number of eligible persons participated in the SFMNP (Table 7). Although the

¹³ All GPS locations provided by NGP were coded for anonymity according to the data-sharing agreement.

percent of estimated eligible persons that participated was consistent between districts, (average 73% \pm 6.7% st. dev.), the percent of vouchers issued that were redeemed by participants was more variable (average 50% \pm 12% st. dev.). Before the vouchers expired on 31 October 2009, 53% of all vouchers issued were redeemed.

Table 7. SFMNP participation and voucher redemption rates per district.

District	Estimated eligible population	SFMNP Participants (2009)	Participation rate (2009)	Redemption rate (2009)
Bear Soldier	74	48	65%	51%
Cannon Ball	61	41	67%	48%
Kenel	26	20	77%	54%
Long Soldier	172	121	70%	60%
Porcupine	26	19	73%	29%
Rock Creek	37	32	86%	52%
Running Antelope	41	29	71%	70%
Wakpala	52	37	71%	39%
All districts	489	347	71%	53%
		District mean	73%	50%
		Standard deviation	6.7%	12%

Table 8. Summary of markets authorized to participate in SFMNP during the 2009 season.

Name	Location	Number of authorized vendors	Frequency of market days	Percent of all issued vouchers redeemed
Standing Rock Farmers Market	Fort Yates, ND	14	weekly	18%
McLaughlin City Park Market	McLaughlin, SD	1	twice annually	14%
Capital Farmers Market	Bismarck, ND	12	daily	14%
Mandan Farmers Market	Mandan, ND	6	three times weekly	1%
All roadside stands	Solen, ND; Fort Yates, ND; Mobridge, SD	4	daily	5%

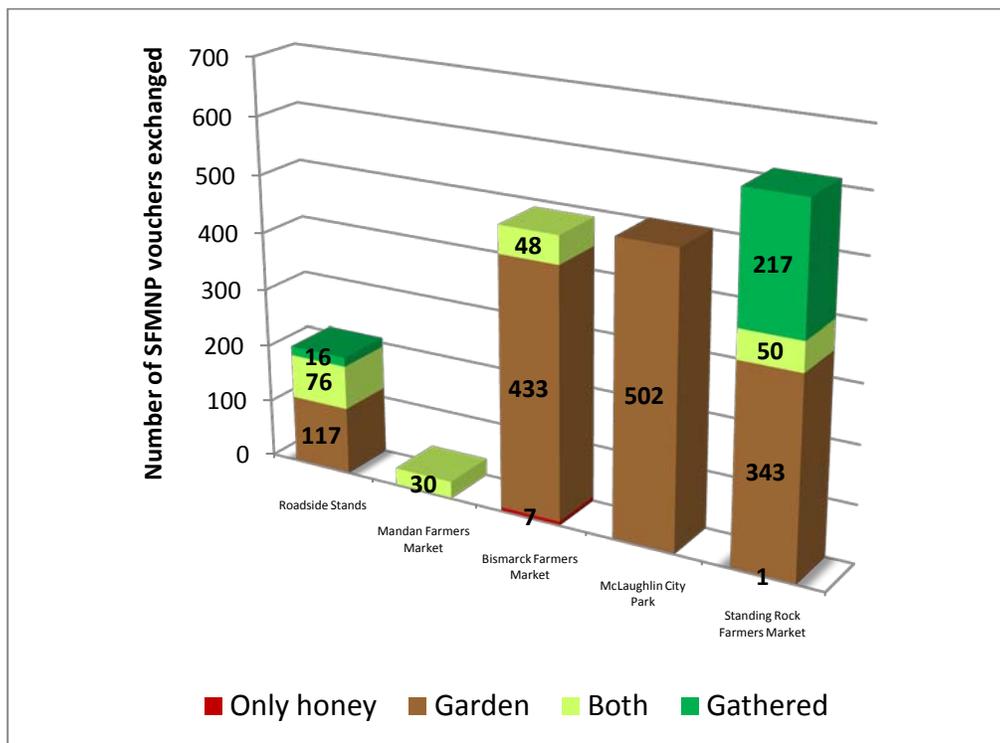


Figure 5. Number of vouchers redeemed at markets and roadside stands with reference to the category of produce (gathered, garden, or both) offered by vendors.

In 2009, 36 vendors operating at 4 markets and 4 roadside stands were authorized to exchange SFMNP vouchers for fresh fruits, vegetables, herbs, and honey. Authorized markets varied in the number of vendors as well as frequency of market days, or the number of days that the market sold goods (Table 8). The Standing Rock Farmers Market was the site of the highest number of voucher redemptions. The markets in McLaughlin and Bismarck were responsible for approximately the same number of redemptions, even though the frequency of market days in Bismarck was much higher. Markets also differed in the variety of fresh fruits, vegetables, and herbs they offered in exchange for SFMNP vouchers. Although quantitative data on diversity of produce at the Bismarck market were collected only for program monitoring purposes and are therefore inconsistent, the variety and volume of produce available was considerably higher there than at any other market. The diversity of produce available at the Standing Rock Market varied throughout the season (see Appendix C). Whereas other markets offered primarily cultivated products, 43% of voucher redemptions at the Standing Rock Farmers Market were for non-cultivated products sold by local gatherers (Figure 5), including *thiŋpsinŋla* (prairie turnip, *Pedimelum esculentum*), buffalo berries (*Shepherdia argentea*), wild plums (*Prunus americana*), chokecherries (*Prunus virginiana*), and sand cherries (*Prunus pumila*). These five plants are culturally significant because they are used in a number of Dakota and Lakota foodways (see Appendix B). One important variety of herbs, *čheyáka* (wild mint, *Mentha* sp.), is normally sun-dried before it is sold, and is therefore considered processed by the USDA Food and Nutrition Service and not authorized as an eligible food for the SFMNP (Harrison, personal communication).

Cost-distance as a predictor of voucher redemption

Analysis of trips to redeem vouchers within Standing Rock revealed that residents traveled only the minimum cost-distance for the majority of trips (Figure 6). In all but one district the median cost-distance of trips is equal to the minimum cost-distance, indicating that more than 50% of trips were made to the market located at the minimum cost-distance. For four districts, the interquartile range of cost-distances per trip is located at the minimum cost-distance, indicating that 75% of trips were made to the market with minimum cost-distance. Figure 6 also illustrates the differences in minimum cost-distance between districts, ranging from 0 (Bear Soldier and Long Soldier) to 14.2 (Porcupine).

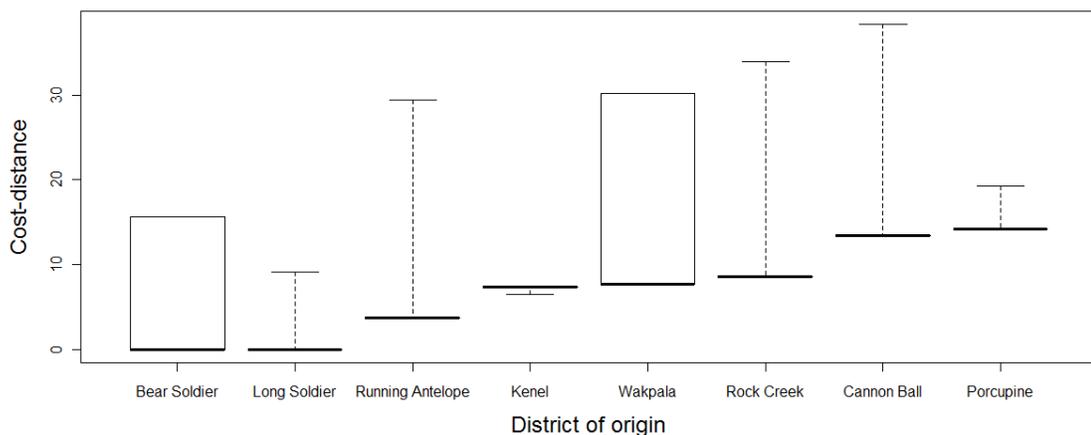


Figure 6. Cost-distance per trip to markets within Standing Rock (n =277). Whiskers represent minimum and maximum values, including potential outliers.

From all districts, the Standing Rock Farmers Market and the temporary market in McLaughlin City Park were located at the minimum cost-distance. Cost-distances to these markets explained some of the variance in SFMNP voucher redemption rates ($r^2 = 0.3348$, $p = 0.07757$, see Figure 7). Notably, three of the four

districts with the highest minimum cost-distance values experienced the lowest redemption rates.

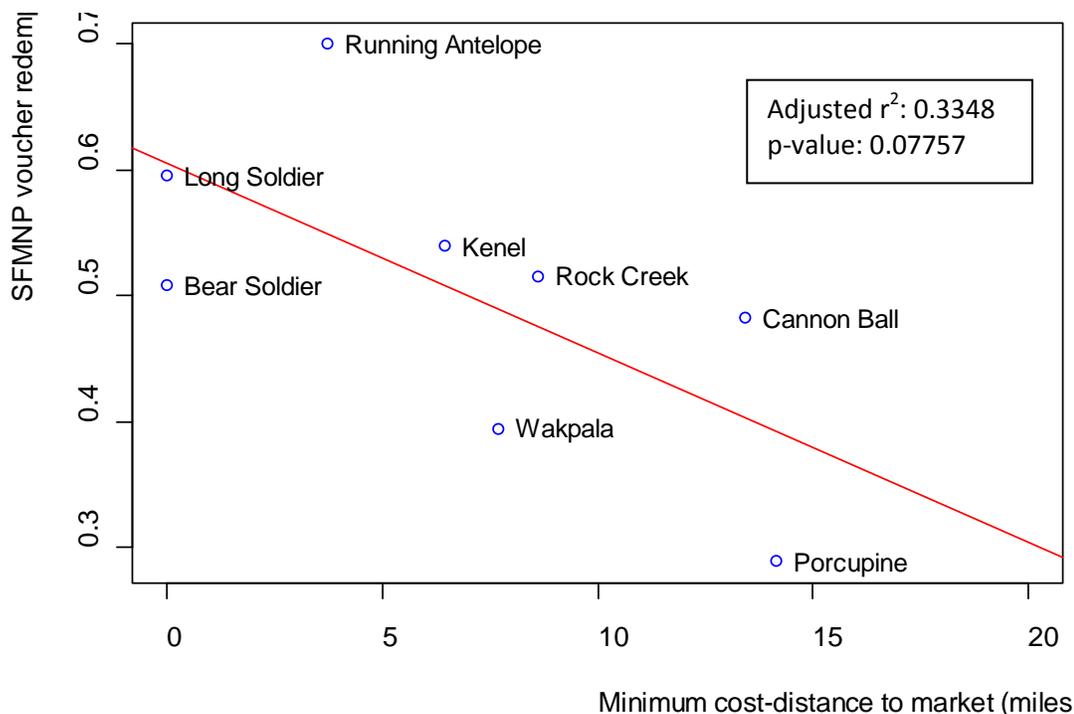


Figure 7. Effect of minimum cost-distance to market on voucher redemption rates per district.

Analysis of potential market locations

As a means to analyze potential market locations, cost-distance calculations using GIS confirm that a new farmers market located in McLaughlin City Park would reduce the minimum cost-distance for the greatest number of elders receiving SFMNP vouchers (Table 9). A McLaughlin market would substantially reduce the minimum cost-distance to a market for residents of Bullhead, Little Eagle, McIntosh, Mobridge, and Wakpala, as well as McLaughlin itself, which is currently the second largest population of potential participants. In addition, the 20-mile cost-distance radius illustrated for a McLaughlin market shows relatively little spatial overlap with the same cost-distance radius for the Standing Rock Farmers Market (Figure 8), indicating complementarities rather than redundancy. This is further supported by empirical

evidence: the temporary market in McLaughlin resulted in more voucher exchanges during two market days than the much larger market in Bismarck achieved during 106 market days (Figure 5).

Without considering the population sizes of communities, spatial analysis indicates that Porcupine and Wakpala would experience the greatest reduction in minimum cost-distance to market (a reduction of 28 miles) if a new market were located in one of those communities (Table 9). Wakpala has a much larger population of potential SFMNP participants than Porcupine, so the greatest change in minimum cost-distance to market for the greatest number of people would result from a new market in Wakpala (Table 9). The second-greatest reduction in cost-distance for the greatest number of people would result from a new market in Cannon Ball.

For vendors, analysis of cost-distances showed that individuals who were authorized to accept SFMNP vouchers at the Standing Rock Farmers Market live at cost-distance radius values between 0 and 42 from that market (mean = 18 ± 14.9 st. dev.). Six authorized vendors and 31 potential vendors (NGP participants) live within a cost-distance radius of 20 miles from the Standing Rock Farmers Market (Table 10). The number of authorized vendors living within that radius increases by only 1 with the addition of the McLaughlin market, but the number of potential vendors would increase by 68%. From the same standpoint, a third new market in Cannon Ball would have the highest number of authorized and potential vendors within a cost-distance radius of 20 miles (see Table 10).

Table 9. Changes in cost-distance per community with the addition of new markets.

Community	Potential SFMNP participants (2009)	Cost-distance to market in Fort Yates, ND	Change in cost-distance with 2nd market in McLaughlin, SD	Change in cost-distance with new <i>third</i> market in...						
				Wakpala	Cannon Ball	Kenel	Bullhead	Porcupine	Little Eagle	Selfridge
Breien	2	33	0	0	-11	0	0	-11	0	-6
Bullhead	30	43	-26	0	0	0	-17	0	0	0
Cannon Ball	48	26	0	0	-26	0	0	0	0	0
Fort Yates	172	0	0	0	0	0	0	0	0	0
Kenel	26	23	0	-6	0	-23	0	0	0	0
Little Eagle	41	36	-26	0	0	0	0	0	-10	0
McIntosh	9	56	-26	0	0	0	-6	0	0	0
McLaughlin	72	26	-26	0	0	0	0	0	0	0
Mobridge	4	50	-18	-19	0	-5	0	0	0	0
Porcupine	16	28	0	0	0	0	0	-28	0	-7
Selfridge	8	17	0	0	0	0	0	0	0	-17
Solen	10	30	0	0	-17	0	0	-2	0	0
Wakpala	48	41	-13	-28	0	-10	0	0	0	0
Sum of [the change in cost-distance x number of potential participants] for all communities			-4648	-1576	-1440	-1098	-564	-490	-410	-260

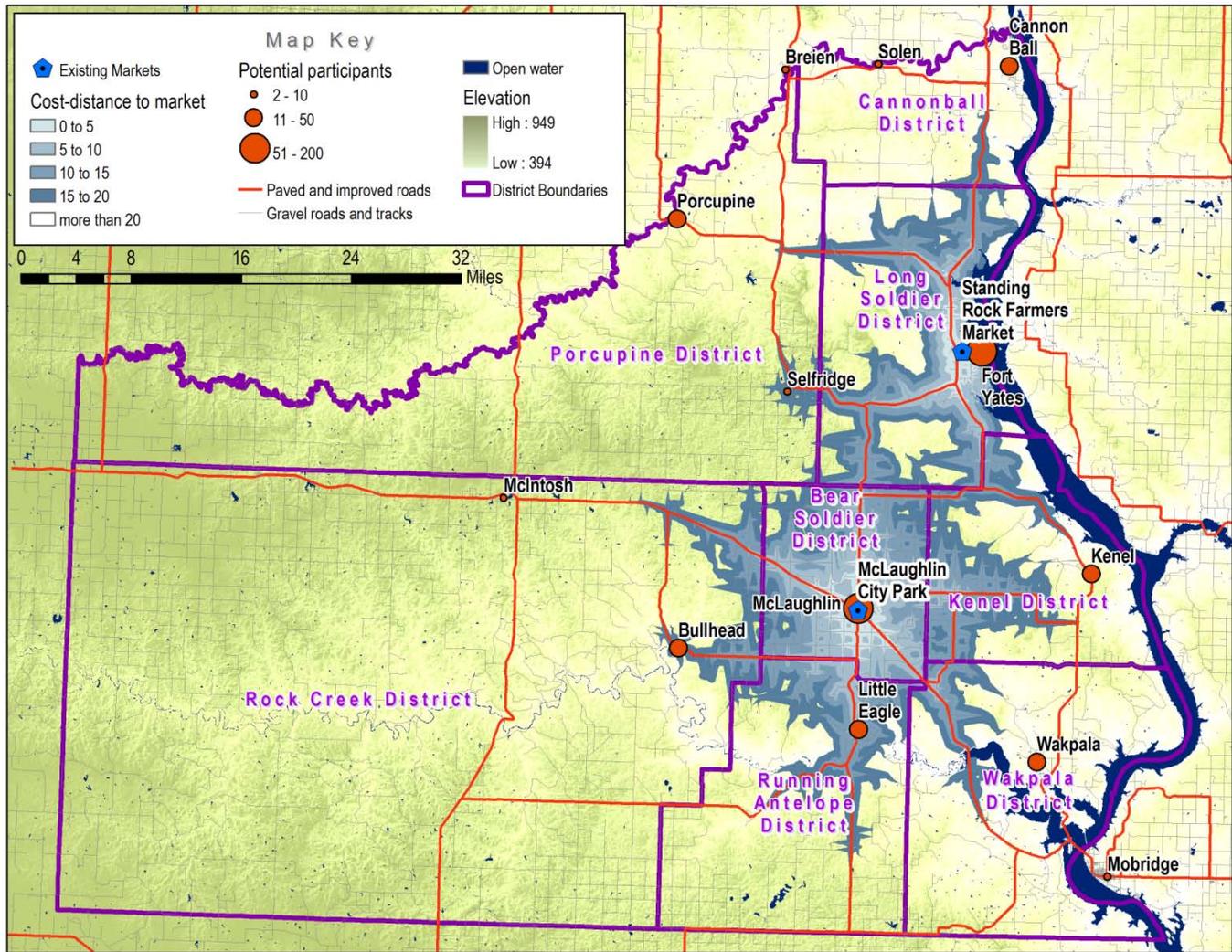


Figure 8. Cost-distances to existing markets in Standing Rock in 2009.

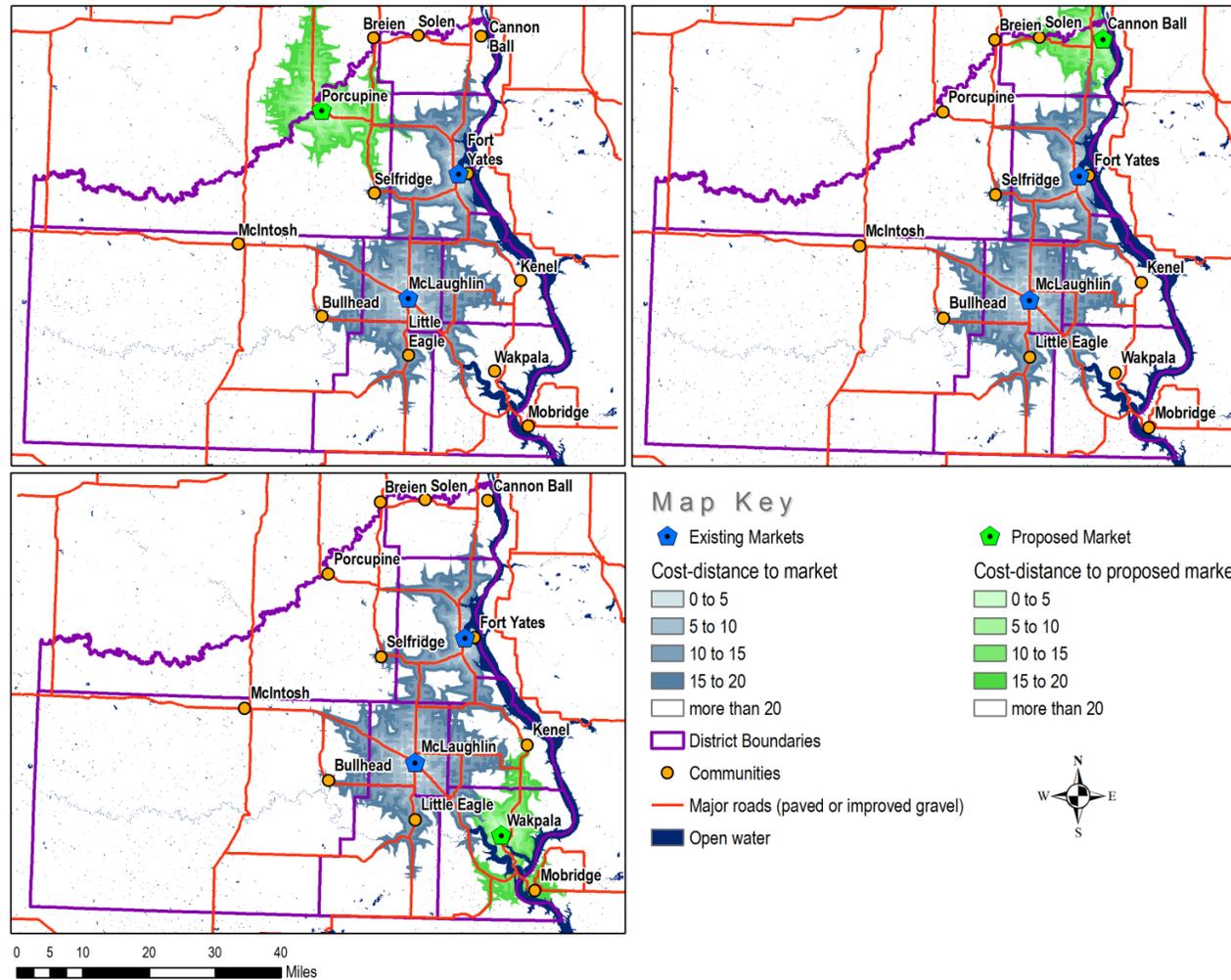


Figure 9. Comparison of changes in cost-distances to market with the addition of markets in Porcupine, Cannon Ball, and Wakpala communities.

Table 10. Summary of effects of new markets on cost-distances for previously authorized and potential market vendors.

	Number of vendors living within a cost-distance radius less than 20 miles from a market				
	With <i>first</i> market in Fort Yates	With <i>second</i> market in McLaughlin	With <i>third</i> market in Cannon Ball	With <i>third</i> market in Porcupine	With <i>third</i> market in Wakpala
Authorized vendors (2009)	6	7	10	8	8
Potential vendors (NGP participants)	31	55	80	60	67
Total	37	62	90	68	75

Discussion

Local definitions of sovereignty

The term food sovereignty may not be frequently used within Standing Rock communities, but “tribal sovereignty” is often discussed, and its use can provide some important insights into local interpretations of the sovereignty concept. Conversations with elders show that some individuals relate sovereignty to self-sufficiency or self-reliance, i.e. an ability to generate what is necessary for one’s own health and happiness. Sovereignty is also described as an inherent right to self-determination, which is recognized (but not granted) by treaties between the U.S. Government and tribal representatives (Pevar 2002). The spatial and social scale of sovereignty changes with context; in some cases sovereignty is described as personal (e.g. the right and ability to hunt deer in accordance with cultural values), while in others sovereignty is asserted on a national scale (e.g. the right of the Tribe to create and enforce its own legal frameworks pertaining to hunting and gathering within tribal territory). Some elders claim that sovereignty is indivisible and therefore lost when “limited” by federal policy. Elders also say that sovereignty must be asserted, and is

therefore contingent upon practices that exercise capabilities or demonstrate specific rights. These complex local understandings have shaped the conceptualization of food sovereignty used here; one that includes the rights and abilities of a person, community, or nation to make choices about their food system. The success of the Standing Rock SFMNP to promote food sovereignty can be evaluated in terms of observable changes to the food system that reflect local decision-making processes, as well as increases in opportunities for communities to engage and expand their food systems in specific ways.

Markets as knowledge-sharing space

During its first season of operation, the voucher program provided Standing Rock elders with locally grown and gathered products that have not been available to many participants in recent years. These include a variety of non-cultivated food plants that are used in preparations of traditional foods. Although the total volume of products exchanged for vouchers is small compared to sales at local grocery stores, the social impacts of these exchanges were remarkable; the voucher program and subsequent market development resulted in strengthened and expanded relations between elders, gatherers, and gardeners. Even after all of their SFMNP vouchers had been exchanged, some elders continued to attend the Standing Rock Farmers Market to observe market activity and socialize, indicating that the market had become an important place for elders to connect to their social and ecological landscapes. Subsequently, these relations are sources of knowledge about traditional foodways. Farmers markets are important nodes not only within economic networks of supplies and demand, but also in the social-ecological networks through which knowledge is transmitted and transformed.

Food sovereignty increases as ecological knowledge moves within social relations, and markets afford an opportunity for vendors to share their knowledge with each other. Gatherers and gardeners who had been practicing these activities for up to 15 years offered advice to those who were gathering or gardening for the first time. Both groups conversed about the seasonal availability of cultivated and non-cultivated plants and predicted harvests and key gathering times given unusual weather patterns. Gatherers were hesitant to share the locations of food plant populations. This caution may represent both competition among gatherers and a general concern about inappropriate or unsustainable harvesting of plants by others. Although they spoke about the abundance of food plants in their landscape, vendors emphasized the importance of specific practices to honor and conserve plants. For example, many gatherers spoke about the importance of harvesting *thinpsinla* in such a way that the ground is not disturbed and the inflorescence is left upright so that seeds will disperse normally. One vendor also said that he doesn't return to the same population (field) of *thinpsinla* for several years after harvesting so that populations can recover in the interim. Experienced gatherers expressed concern that more novice gatherers were not yet invested in the survival of plant populations, but were able to communicate their concerns to those gatherers at the market. The market as a knowledge-sharing space facilitates contact between vendors and an opportunity to affirm and transform ecological relations between humans and plants. Moreover, the ethical codes and value systems that emerge from these interactions represent an increase in food sovereignty because they demonstrate that communities of gatherers can agree to maintain long-term relations with plant populations despite pressures to intensify harvest when short-term economic benefits to individuals are greatest.

Although the practice of food sovereignty may not result in economic self-sufficiency, new economic frameworks within innovative food assistance programs

can provide opportunities for increased participation in food systems. The Standing Rock SFMNP introduces a relatively small amount of money into the local food economy, but has provided 14 Standing Rock residents and their families with supplemental income from gardening and gathering. The SFMNP as a food assistance program relies on ecological knowledge and capacity existing within communities to develop food resources for those who cannot afford the same otherwise. As a result, vendors gain skills and confidence in their ability to earn money through gathering and gardening. During informal conversations, Standing Rock vendors say they are motivated by more than money to gather or grow foods. They describe their work as a service to communities because they provide healthy foods that are often otherwise unavailable. As they interact with their communities during voucher exchanges and cash sales, they share significant knowledge about traditional foodways and the cultural values they represent. In addition, direct, long-term relations with elders offer vendors insight into the multiple dimensions of demand for food, as well as the social and cultural impacts that give their work meaning. Although we should be careful not to downplay vendors' financial goals and concerns, to simplify vendors' motivations in economic terms would underestimate their intellectual, emotional, and spiritual commitments to community well-being.

Identifying factors of food-system participation

Disparities in program participation between districts are an important concern due to local perceptions that communities located farther from Fort Yates are less likely to receive services provided by tribal government agencies. Driven by a commitment to equity, NFE and partners envision a food system that increases the availability of fresh fruits, vegetables, and herbs to all districts of Standing Rock. Differences in program participation and redemption rates can be attributed to a

number of factors, some of which are difficult to measure. In the community of Little Eagle (Running Antelope District), for example, two elders promoted the SFMNP and ensured that other elders in the community were aware of market days and the benefits of the program. In such a relatively small community, the specific actions of motivated individuals certainly contributed to the highest participation and redemption rates in the SFMNP. In addition to community awareness and leadership, other differences between districts may impact participation and redemption rates, including: the percent of people commuting to market sites for other business, availability of district-owned vehicles that can transport groups of elders to markets, or the existing availability of garden produce from generous neighbors. Differences between markets may also affect program participation. Extremely high attendance at the temporary market in McLaughlin City Park is in part explained by the high quality and large variety of produce available. Similarly, the number of market days of the Bismarck market may explain why voucher exchanges at that market far surpassed those at the Mandan market (Figure 5), which is slightly closer to all Standing Rock districts but does not operate as often during the growing season (Table 8).

Analysis I: An “equity” approach

Redemption rates are variable between districts, and part of this variability can be explained by differences in minimum cost-distances and the effort required in traveling to a market (Figure 6). Observed differences in redemption rates indicate that existing market locations serve some districts better than others. New markets in districts with low redemption rates are expected to increase redemption and improve food system equity. Indeed, empirical evidence confirms this prediction: if we exclude vouchers redeemed at the temporary market in McLaughlin from analysis, the lowest redemption rates in 2009 (13%) were in Bear Soldier district where

McLaughlin is located. As a result of the temporary market in McLaughlin, redemption rates in Bear Soldier district increased by 38%. If equity within the food system is a priority and a McLaughlin market becomes permanent, the community of Porcupine is an appropriate location for a third market because Porcupine district now shows the lowest redemption rate (29%).

Analysis II: “Efficiency” for elders

Locating markets in the districts with the lowest redemption rates may not contribute to the efficiency of the local food system because the populations of communities are not taken into account. In addition, tribal agencies need to consider that new markets change minimum-cost distances to markets from other communities. Spatial analysis can be used to calculate such changes in minimum cost-distances to markets from all communities, and can use the number of eligible participants within each community to predict the greatest change in redemption rates throughout Standing Rock. For example, the temporary market in McLaughlin reduced the minimum cost-distance to market for six communities, including McLaughlin. These reductions account for greater changes in redemption rates in those communities than for the communities that did not see a reduction in minimum cost-distance.

Based on this spatial analytical approach, it is predicted that a third market in Wakpala would have the greatest impact on overall redemption rates because Wakpala has the third largest population of potential participants as well as one of the highest minimum cost-distances to market (Figure 6). As an added benefit, a market in Wakpala would also reduce the minimum cost-distance from Kenel and Mobridge. Similarly, market in Cannon Ball, which has the same estimated eligible population as Wakpala, but a slightly lower minimum-cost distance to market, is predicted to have almost as much of an effect on overall redemption rates. A market in Cannon Ball

would also reduce minimum cost-distances from Solen and Breien as well. It is important to note, however, that neither market location would impact minimum-cost distance to market for Porcupine district communities. Following this approach, such a disparity might be remedied by a well-placed roadside stand in or near Porcupine.

Analysis III: “Efficiency” for vendors

Finally, it may be important to consider the cost-distance of vendors to market. If one of NFE’s objectives is to increase economic opportunities for Standing Rock gardeners and gatherers, then new markets locations should also take the distribution of vendors into account. Cost-distance analysis of vendors shows that while the Standing Rock Farmers Market had a large number of authorized and potential vendors within a 20-mile cost-distance radius, the McLaughlin market would require the participation of many new vendors, since only one previously authorized vendor lives closer to McLaughlin than Fort Yates. As for a third market, Cannon Ball community shows the greatest number of authorized and potential vendors living within a 20-mile cost-distance radius. Since potential vendors were identified by NGP because they received technical assistance for gardening, this analysis does not account for gatherers who might choose to attend new markets in the future.

Implications for policy makers

We have focused on measureable factors rather than complex indicators to ensure that NFE, local organizational partners, and community members can interpret the implications of this research for themselves. Furthermore, factors we have considered can be monitored within an adaptive approach to food system development. For example, we have assumed that the success of the temporary market in McLaughlin in 2009 will result in its establishment as a permanent market

in 2010. Unforeseen circumstances may make this unfeasible, and changes in minimum cost-distance with the addition of other markets would need to be recalculated. To that end, we have provided the tools necessary to do so. In any case, the spatial arrangement of markets in Standing Rock will have some bearing on the growth of the SFMNP and food systems in general, and this analysis and approach may prove useful in planning efforts to enhance the equity and efficiency of food sovereignty in Standing Rock.

Conclusion

Food sovereignty is the inherent right and enduring capacity of individuals, communities, or nations to choose the food systems they generate and utilize. Food sovereignty as a right may not require localization of food systems, because communities may choose to continue to draw on global networks for their food. But food sovereignty as a capacity requires that people know how to produce and distribute food, and this implies continued practice through ecological relations within the landscape. Industrial food systems rely on economies of scale to distribute food to dispersed populations, but localized food systems must account for higher per-unit costs associated with the spatial arrangement of food system components. Hence, individuals and organizations participating in food systems must consider spatial relationships in determining the locations of food system enterprises. In rural areas the cost of travel to a market can easily exceed the benefits of vending or purchasing goods from that market. As fuel costs rise and the distances people are able or willing to travel decline, the spatial arrangement of food systems may become critical. GIS offers a set of tools to inform decisions about the distribution of food systems in time and space. In these efforts, cost-distances are one set of spatial measures that may

prove useful in anticipating the success of markets at specific locations in the landscape.

The findings shared here should not be interpreted as specific recommendations, but rather as a set of tools that can be applied now or in the future to make decisions on market locations. The analyses of redemption rates and minimum cost-distances are a few of multiple approaches that might anticipate the spatial concerns of organizations administering an SFMNP. We provide evidence that a permanent farmers market in McLaughlin would succeed in increasing SFMNP voucher redemption rates, both within Bear Soldier District and reservation-wide, by reducing minimum cost-distances to market for a significant number of people in several communities. An important caveat to this finding is the low number of previously authorized vendors living in close proximity to McLaughlin, so local organizations need to promote the McLaughlin market among potential vendors living in Bear Soldier and proximate districts. A third market in Porcupine would address the lowest SFMNP voucher redemption rates and the highest minimum cost-distances from a community to a market. If the goal is to reduce the minimum cost-distance for the most program participants (and therefore increase redemption rates reservation-wide) our analysis indicates the benefits of a third market in Wakpala. Alternatively, if markets are located based on the number of vendors available to participate in those markets, Cannon Ball has the greatest number of authorized and potential vendors within a specific cost-distance radius of the community.

We have not identified all of the options to address the issues revealed here; innovative solutions may involve rotating market sites, subsidizing transportation to existing markets, or increasing the number of roadside stands in certain communities. We also have not accounted for an increase in market participation by other community members (not voucher recipients) in response to new market placement.

Further research is necessary to investigate the ecological and economic sustainability of the food system components already established as well as possibilities indicated here. First, although elders and gatherers confirm that non-cultivated food plants are abundant in Standing Rock, the long-term impacts of intensified harvest of these plants are unclear. As the economic benefits of gathering and gardening increase, new participants may not know how to gather plants in accordance with local cultural values, which traditionally serve to promote the conservation of plant populations. Second, the federal funding that currently supports the voucher program could be reduced or withdrawn, in which case the current system might falter. Reliance on federal grants is not a reliable long-term strategy, but the influx of federal dollars has promoted rapid development of the technical skills and social-ecological infrastructures necessary for a food system that sustains itself.

Innovative food assistance programs can contribute to food sovereignty by investing in local capacities. Within the United States, the SFMNP represents an unusual opportunity for tribal governments to expand food sovereignty in partnership with a federal agency. Since this is not one of the explicit goals of the Act of Congress that created the SFMNP (107th United States Congress 2002), Food and Nutrition Services may not be aware of these outcomes. The monitoring mechanisms used to communicate the impacts of the SFMNP to federal agencies focus on compliance with federal regulations, rather than the impacts of programming on local health, economy, ecology, or culture. Within food assistance programs, power relations between program managers and recipients make it easy to ignore the cultural relevance of food, and food assistance program managers therefore tend to evaluate food as an object rather than a social and ecological process. In the case of Standing Rock, the intellectual orientation of NFE and partners allows these local organizations to recognize multiple dimensions of demand for food. To a limited extent, NFE is

able to assert food sovereignty within the SFMNP by proposing the inclusion of specific traditional foods, but the rejection of *čheyáka* as an eligible food reveals current limits to that sovereignty. NFE is able to contribute to food sovereignty by promoting local food systems, i.e. expanding opportunities for elders, gardeners, and gatherers to engage their knowledge and participate in those systems.

In providing new opportunities and incentives, tribal agencies and their partners can invest in the ecological relations that comprise food systems: relations between gatherers and non-cultivated plants, gardeners and soils, or elders and market vendors. As food moves within any of these relations, it connects people with each other and other beings in the landscape. Food sovereignty acknowledges and recommits communities to these relations and our dependence on them. The limitations of ecological relations across space are real, so the arrangement of food system components is critical to the workings of these systems. Spatial analysis is a powerful set of tools to examine the spatial dimensions and dynamics that link people to their landscape.

CONCLUSION

This thesis represents my first attempt at conducting an action research project, so I begin this conclusion with some reflections on the research process as a personal learning experience. I started this work as a VISTA volunteer without research objectives, and I spent a year developing relationships with individual elders and community members. My intentions were clear to NFE staff and elders because I worked closely with them in designing and implementing community projects. This experience helped me understand problems on Standing Rock so that I could begin developing applied research questions.

When I returned to Standing Rock as a graduate student, I hoped that elders would understand that I was still working for them, albeit through a different set of processes. My research process included continuing many of the projects I had started as a VISTA volunteer, only this time incorporating action research components. I wanted to include my former colleagues and supervisor, now research partners, in setting the research agenda. My approach was to discuss potential projects with staff at NFE, the NGP, BGC, and SCCE, the EAC members, as well as other elders, gardeners, and gatherers who expressed interest in our work. We did not create a forum to brainstorm possibilities, but my research objectives evolved as the result of many meetings with individuals and were refined throughout the research process. For example, my first interviews with elders included some attempts to map the locations of plants, but when they expressed more interest in creating seasonal rounds, the objectives shifted to focus on the temporal (rather than spatial) availability of plants.

I am aware the process I describe in Chapter 1 may not be considered sufficiently “participatory” by every reviewer. Although several action research

professionals have proposed categorizations for degrees of participation (e.g. Arnstein 1969; Pretty and Vodouhe 1997; Bacon, Mendez, and Brown 2005), I have not located a typology that accurately describes the forms of participation that I have experienced. I have found that people often want to contribute valuable information and insights to a research process but do not have the time or interest to participate in research design or analysis. If I were to require such a degree of participation, we (including elders who participated) would not have learned as much from each other because we would have it limited to a much smaller group of individuals with more free time. Therefore, having received feedback from the NFE director and many other project partners, I asked elders to join a research process that was already structured by a proposal and IRB approval, and I chose not to renegotiate the process together. I may have missed an opportunity to create a community controlled iterative research process. On the other hand, I am confident that elders felt our conversations were meaningful and they repeatedly expressed support for the research process and products. As an eager student relating to such wise teachers, I likewise expressed my gratitude for their contributions to our project, but emphasized their right to decide what should be included in my final product. I feel strongly that elders made many critical decisions about what was important to discuss and document.

My work with the Native Gardens Project and Sioux County Cooperative Extension conducting gathering trips and foodways workshops began without research goals; I decided later to incorporate a research component. I attempted to create iterative cycles of action and reflection by conducting interviews with key actors as they participated in knowledge transmission activities. Where many descriptions of action research treat action as one aspect of research, in this case research was one component of a much larger community change project (Stoecker 2005). This is not

to say that research (in this case analysis of reflections) did not contribute to project implementation (i.e. community action).

Again, some reviewers of my approach will point out that partners were not included in critical aspects of the research process, even if they were in control of the larger project. For example, I did not ask community partners to help me design interview questions or analyze interview data (although they did validate notes from their own interviews). At least initially, I did not take their interest in research for granted. As a researcher, I was asking community partners to take time away from seemingly more meaningful work, and they agreed because they appreciated my participation in their larger project. I believe their interest in the research grew as the reflective interviews proved useful; knowledge generated during interviews was valuable during planning meetings for subsequent activities. If I were to initiate another research project with the same group now, I would ask them to lead the research process, but that is because I have developed mutual understanding with these partners. More significantly, they have developed a relationship of trust with me because I have repeatedly returned to the community to discuss research results. Many action researchers have emphasized (e.g. Greenwood and Levin 1998) that action research requires significantly more time than most conventional social research. In this case time was necessary for a fundamental shift in perceptions of what it means to do research as part of community action projects.

Finally, the research I describe in Chapter 3 was not participatory because the analysis of voucher data was conducted after I returned to Cornell in January 2010. One could argue that my research includes an action component, because the organizations supporting farmers markets (a professional researcher among them) were learning from reflecting on their activities together, but this was not a systematic process and my knowledge claims in Chapter 3 were not cogenerated with my

partners. Nonetheless, I am convinced that the spatial analysis of new market locations will be useful for organizations attempting to expand their food system. I appreciate that there are a number of other factors that will undoubtedly guide this process, but our analysis should contribute insights to discussions between local decision-makers.

I remain interested in integrating indigenous knowledge with GIS tools, but a useful application for this process did not emerge during my time at Standing Rock. The gatherers with whom I spoke do not use maps to locate plants, and I was not able to propose a research product that would have been meaningful for them. At that time, I made an important decision not to design a GIS project simply because I wanted to test my own skills. Only after I was deeply involved in the Standing Rock SFMNP did I begin to see a need to analyze its spatial dimensions.

In October 2010, after I had successfully defended this thesis, I returned to Standing Rock to review my writings with key contributors and give them another opportunity to consider their contributions before I submitted this work as a complete thesis. Several elders and other partners took time to read through the thesis and comment on its contents, making a small number of adjustments to my interpretations of their own statements. My visit also confirmed that the gathering trips and workshops that began in 2009 have continued in 2010. The Boys and Girls Club and the Native Gardens Project continue to organize trips for elders and youths, and South Dakota Public Television recently aired a program about one of their trips to the Prairie Knights Marina. Sioux County Cooperative Extension acquired a new building in Fort Yates to host elder workshops and planted an impressive demonstration garden on the property. Elders gather every Monday to prepare foods together for their community, and plan to conduct traditional foodways workshops again in the winter. The Native Gardens Project has begun construction of a greenhouse at the same site.

The Standing Rock Farmers Market was active in 2010, although a cold spring seems to have resulted in fewer of the chokecherries that had been a major source of income for local gatherers in 2009. A vendor who had only attended the Bismarck Market in 2009 attended the Standing Rock Market at least nine times in 2010, and the volume, variety, and quality of his produce resulted in strong market attendance. Voucher redemption had already equaled 2009 by mid-October 2010, even though the temporary market in McLaughlin had not been reestablished in 2010. The cost of travel to markets remains too high for some of the elders I met, and NFE and NGP staff expressed commitment to making the food system more equitable.

The sustainability of the work I have described is increased by community ownership of them, but also interactions between project components. Figure 10 is a conceptual diagram of linkages between knowledge sets (brown), community actions (blue), and supply and demand of fresh foods (green). Elders' knowledge was the primary source for seasonal rounds, the knowledge base, and both intergenerational and intragenerational knowledge transmission activities. Elders also receive knowledge through relations with youth and other elders developed during knowledge transmission activities. The compiled seasonal round as well as the knowledge base was used to plan gathering trips for youth, and the knowledge base was used to select traditional foodways for the workshops with elders. All workshops relied on fresh foods supplied by local gardeners and gatherers, and therefore contributed to local demand for those products. Demand was also increased as elders, youth, and anyone who read from the plant knowledge base learned *how* to prepare traditional foods. The supply of fresh foods needed to rise to meet demand, and this was facilitated by work to develop the Standing Rock Community Farmers Market. Gatherer and gardener knowledge (necessary to increase that supply), was augmented by seasonal rounds, the plant knowledge base, and by discussions with elders and other vendors at the market.

This model may be applicable in other contexts where a coalition of organizations is ready to promote ecological knowledge, traditional foodways, and the local food system simultaneously. Where some might be tempted to initiate these projects in phases, on Standing Rock these projects were interdependent from the beginning. In this case, all of the organizations involved in these efforts contributed to most of the community actions, but in other contexts, organizations might consider dividing up these tasks based on their respective missions and priorities.

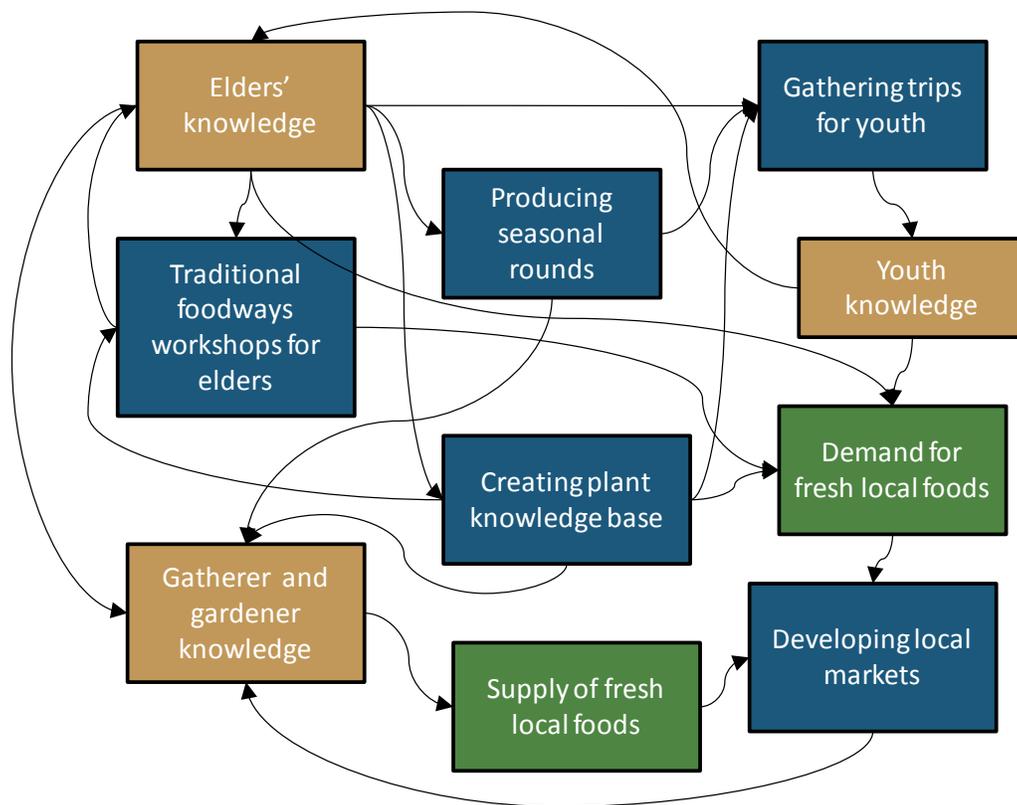


Figure 10. Conceptual diagram of interactions between knowledge sets, community actions, and supply and demand for fresh food.

Finally, I must address the impacts of gathering on food plants. There is a risk that long-term implementation of the community actions we have initiated could lead to overharvest of local plants. In working to increase demand for gathered foods and

providing financial incentives for gatherers through the voucher program, these projects might inadvertently contribute to declines in populations of some food plants. Further research to document the abundance of the food plants on Standing Rock would provide a baseline from which to monitor and manage their populations, particularly in the context of climate change. Another promising research opportunity is to work with local gatherers to understand the diverse practices they use to conserve plants, as well as the values that underlie those practices.

Our research shows that ecological knowledge is embedded in life experience. Seemingly forgotten knowledge can be rediscovered through active engagement within one's habitat. On Standing Rock, children are finding ravines full of plums, chokecherries, and grapes, and venturing out onto the hillsides to gather *thinpsinla* and *poiipi*. Young people are sharing their harvests with elders, whose memories are coming back into life. There are busy kitchens full of mothers and aunts preparing *kabúbu* bread and *wóžapi*, the crackling of kidney fat in skilletts, and the almond-scent of chokecherries as they are ground or pounded for patties. These patterns of existence are not a "thing of the past"; they remain deeply meaningful for people in the present.

APPENDIX A: DESCRIPTIONS OF KNOWLEDGE DOMAINS

1. **D/Lakota name:** Elders use or mention the Dakota or Lakota name of the plant.
2. **Varieties:** Elders distinguish between different types of a plant, e.g. “man’s sage” and “woman’s sage”. NOTE: These types may or may not correspond to Western-botanical species.
3. **Regional distribution:** Elders describe the geographical range in which a plant can be found, e.g. buffalo berries are not found in the southern part of Standing Rock.
4. **Habitat requirements:** Elders describe the features of places in the landscape where a plant can be found, e.g. rocky hay fields or ravines.
5. **Specific locations:** Elders mention particular sites where a plant can be found.
6. **Ecological relations:** Elders describe connections between a plant and other plants or animals, e.g. burr oak acorns are eaten by squirrels. NOTE: ecological relations with humans are a pretext of conversation and are not included here.
7. **Life history:** Elders refer to the stages of development of a plant, e.g. *čheyáka* is taller by August.
8. **Calendar availability:** Elders refer to the Gregorian solar calendar or Dakota/Lakota lunar calendars in describing the times of year when a plant is typically ready to gather.
9. **Seasonal cues:** Elders refer to variable seasonal events that signal that a plant is ready to gather, e.g. wild grapes are sweet after the first frost. Alternatively, elders describe the use of plants as seasonal cues themselves, e.g. it is safe to swim when goldenrod blooms.

10. **How to locate:** Elders describe methods for finding a plant in the landscape, e.g. walk into the sun so that *thiŋpsiŋla* blossoms will be lit up from behind.
11. **How to identify:** Elders mention characteristics that can be used to distinguish a plant from other plants, e.g. *thiŋpsiŋla* has fuzzy leaves, whereas *wanáǵi thiŋpsiŋla* does not.
12. **How to evaluate readiness:** Elders describe methods to determine if a plant is ready to gather for a given purpose, e.g. jelly should be made from chokecherries when some are still red.
13. **How to gather:** Elders describe methods for gathering a plant, e.g. buffalo berries are gathered by placing a blanket under the bush and hitting it with a stick
14. **How to conserve:** Elders describe practices intended to sustain populations of a plant, e.g. *thiŋpsiŋla* are gathered in such a way that the flower stalks remain in place to disperse seeds.
15. **How to honor:** Elders describe practices intended to express gratitude for a plant.
16. **How to prepare:** Elders describe methods for using a plant to prepare a food for consumption.
17. **How to store/preserve:** Elders describe methods to prepare a plant so that it can be saved for use at a later time.
18. **Medicinal uses:** Elders describe the use of a plant to treat or prevent disease.
NOTE: Although all food is medicine, the medicinal uses in this category are only those that are distinct from the uses of plants as food.
19. **Fiber uses:** Elders describe the use of a plant as fiber, e.g. cattails were used as “diapers” for babies.

20. **Ceremonial uses:** Elders mention the use of a plant in activities that the elder identifies as spiritual or religious.
21. **Other uses:** Elders describe the use of a plant for purposes other than food, medicine, fiber, or ceremony.
22. **Precautions:** Elders describe the impacts of using a plant improperly.
23. **Trade/Exchange:** Elders mention the trade opportunities for a plant or note the market value of a plant.
24. **Changes in population:** Elders describe an increase or decline in the size of a population of a plant, often within Standing Rock.
25. **Associated technology:** Elders describe technologies that are in foodways associated with a plant.
26. **Historical practices:** Elders describe any practice related to a plant occurring in the past.
27. **Changes in practice:** Elders describe changes in the ways their communities use a plant.

APPENDIX B: PLANT KNOWLEDGE BASE

NOTE: This knowledge base is a “snapshot” of knowledge at particular point and time (June-December 2009). Much of the knowledge documented here is inherited from past generations but continues to adapt to new social and ecological contexts. The information that follows should not be interpreted as representative of Lakota or Dakota knowledge of plants or plant use. The elders who shared this knowledge agreed to let me use their names in association with their contributions to this document. This knowledge base was previously published as a community report entitled, “Elders Know Plants!” and distributed to the Standing Rock Elder Advisory Council in December 2009.

Acorns – úta – from burr oak – *Quercus macrocarpa*

The elders who mentioned these called them “acorns” and did not tell me the Lakota name. The New Lakota Dictionary lists “úta” as the acorns from black oak, which does not grow in this area. Burr oak is the only oak that grows in the Dakotas, according to the Kershner et al. (2008).

Helmina Makes Him First and Blanche Lawrence remembered that there used to be a lot of acorns on Standing Rock, but said they don’t see them anymore. They remembered that they had to compete with the squirrels to get them. They said that if you roasted them on a woodstove with salt and a little grease they tasted good.

Bitterroot – siŋkphéthawote (“muskrat food”) – Sweet flag – *Acorus calumnus*

All of the elders called this plant bitterroot. Sidney Eagleshield, Iyonne Bear Ribs, Helmina Makes Him First, also used its Lakota name (siŋkphéthawote). Helmina also called it “sweet flag”, which is what it is called in many field guides.

Most of the elders said that bitterroot does not grow on Standing Rock. Leonard Village Center and Sidney Eagleshield said that bitterroot comes mostly from Sisseton, where they have many lakes. Iyonne Bear Ribs said that it grows in Minnesota where there are muskrats (since it’s called “muskrat food”). Helmina Makes Him First said she travels to Sisseton and gathers it herself.

Shirley Marvin described a ditch near the “Eagle Unit” (where the Tribe plants sweet corn) where bitterroot can be found. Helmina said that you might find the same plant on Standing Rock, but it doesn’t have the “cables” to harvest. When you pull on them here, they come up, whereas when you pull on them in Sisseton, they won’t move. She said that’s how you know they have “cables”.

Mary Jane Tiokasin said that you could harvest bitterroot anytime the lakes aren’t frozen, usually from April through September. Helmina said it’s best to dig it in July or August, when it’s warm enough to be in the water.

Helmina said you get all wet and muddy when you gather it. She said that she’s scared of water snakes when she’s gathering it. Sidney said that you have to pull it out and break off the bottom. Helmina said you have to find the “cables” in the mud, decide how much you want, and break it off at both ends. She said it’s important to offer tobacco when you take it (or any other plant) to say “thanks, wopila”.

Leonard said that people on Standing Rock buy it at powwows. Florence McLaughlin said that the only place she knows to get it is at the United Tribes Powwow in Bismarck. She said it costs about \$10 for a piece. Sidney Eagleshield said that people sell it at church meetings to other Indians. Iyonne Bear Ribs remembers her mother buying it from Minnesota Indians at annual church meetings.

Sidney Eagleshield said that it can be used for sore throat. Stella Guggolz remembers her grandfather grinding it and drinking it. Stella uses it whenever she has

a cold. Florence said you take a little bit and chew on it, and no matter what's wrong with you it helps. She said that her mother-in-law kept most Indian medicines to herself, but shared her knowledge about bitterroot.

Buffaloberry – maštíŋčaphuté (“rabbit nose”) - *Shepherdia argentea*

The elders who mentioned this plant called it simply “buffaloberry” when they spoke to me. The Lakota name and the translation are from the New Lakota Dictionary.

Sidney Eagleshield said that these are scattered all over (like all the berries) but that they grow wherever there is some water. Iyonne Bear Ribs said that she doesn't know much about them because they don't grow around Bullhead. She said they grow in North Dakota, near Mandan, starting north of Cannonball, starting around Fort Rice. Stella Guggolz said that they grow west of Highway 63 north of Little Eagle and around the small lake on her property.

Sidney said that if you see a nice red color, then that's buffaloberries. Iyonne said they have grey leaves.

Sidney Eagleshield said that these are ready after July 5th. Theo Iron Cloud, Pearl Day, Florence McLaughlin, Mary Jane Tiokasin said that the best time to gather these is after the first frost. Pearl and Florence said the frost makes them much sweeter. Theo said the frost must make them ripe and juicy. Florence said the timing of the frost changes every year. Helmina Makes Him First and Blanche Lawrence said that they are usually ready sometime in September. Theo said they are usually ready near the end of September.

Stella said that they are hard to pick because they have a lot of sharp thorns. Mary Jane said that you gather buffalo berries by placing a blanket under the bush and knock it with a stick. Iyonne said that she had heard the same thing.

Theo said that you can water pack buffaloberries, dry them like chokecherries, and make them into wóžapi or jam. Iyonne said that she doesn't think the Lakotas made anything out of buffaloberries, but maybe the Dakotas or people in Crow Creek used them. She said she thought maybe they had been flooded out when the Oahe dam was built.

Stella said she kind of guards the buffaloberries that grow along the road because people come and break off the branches, and that's no good.

Cattails – čhelí or hiŋtkáŋhu – *Typha* species

The elders who mentioned this plant called it “cattail”. Florence McLaughlin named a plant “pussy willows”, but seemed to describe a cattail. The Lakota names are from the New Lakota Dictionary.

Shirley Marvin said that women used to put the fluffy parts of the cattail in their carriers. She and Mary Jane Tiokasin said that they are even more absorbent than modern diapers, so they that moisture doesn't stay near the skin. Florence McLaughlin said that women used them in diapers and “for Kotex”.

Shirley said they gathered the tufts April through August. Florence said they gathered them in the fall.

Cedar and juniper – haŋté – *Juniperus* species

Elders mentioned “cedar”, “flat cedar”, and “juniper”. The common names of these plants are confusing. Eastern redcedar (*Juniperus virginiana*), which grows in southern parts of Standing Rock, is truly a juniper. Rocky mountain juniper (*Juniperus scapulorum*) can hybridize with redcedar in parts of its range. Creeping juniper (*Juniperus horizontalis*) is a creeping shrub that is also common throughout the Great Plains. (Johnson and Larson, 2007)

According to the New Lakota Dictionary, the Lakota name for cedar and juniper is the same, “hanǵé”, and yet the elders who mentioned these plants seemed to distinguish between different types of cedars and junipers.

Mary Jane Tiokasin said that you can gather flat cedar anytime. She said you can boil it with sage for tea or medicine.

Mary Jane said that kids put some juniper in their shoes when they’re playing sports (track and field) to keep them from spraining their ankles or getting hurt.

Pearl Day remembered that the community used a cedar tree for a Christmas tree in Porcupine.

Stella Guggolz remembered that her mother used to take a little bit of cedar – the one with the blue berries – and throw it on the stove. She said she used just a little pinch with some of the berries, not a whole bunch. She said it was a kind of air freshener.

Čheyáka – wild mint tea – *Mentha arvensis* and other Mint family species

The elders referred to this plant as either wild mint or čheyáka. Both terms are used comfortably and the Lakota name is well-known. The spelling comes from the New Lakota Dictionary (2009).

Theo Iron Cloud said that there are two kinds of čheyáka: woman's and man's čheyáka. She said they call the man's čheyáka “bloka” (male). She said the man's čheyáka is square stemmed, while the woman's is round stemmed. Theo said the woman's is the main type that people use. Helmina Makes Him First and Blanche Lawrence said that there are three kinds of čheyáka, including a tall type with thin stems and another that travels along the ground like a grape vine.

Vernon Iron Cloud said that čheyáka has purple flowers. Iyonne Bear Ribs said it smells like peppermint. Helmina and Blanche said you can rub the leaves with your fingers and taste them to see if it's mint.

Pearl Day said that čheyáka grows along creeks and in other damp places. Helmina and Blanche said that it grows along dams or near water. They said you can follow your nose to find it. Theo said that there is some čheyáka growing by the gravel pit near Wakpala. Iyonne said that it grows way out in the country on the prairies.

Mary Jane Tiokasin said that you can harvest čheyáka from June until August. Theo said that she usually harvests čheyáka around the time of our interview (mid-August). Vernon said that that you can harvest it earlier than August but people usually wait until it is tall. Helmina and Blanche said that you can harvest čheyáka from late June through August, depending on the type of čheyáka.

Helmina and Blanche said that you can either pull it up by the root or cut the stems to gather it. If you pull it up, they say it will move somewhere else. If you cut it, it will grow back.

Mary Jane said that you dry čheyáka for the winter in September and October. Helmina and Blanche said they remember their grandmother dunking her frybread in čheyáka tea.

Chokecherries – chanpha – *Prunus virginiana*

The elders who mentioned this plant called it “chokecherry” when they spoke to me. The Lakota name is from the New Lakota Dictionary (although I have heard it used).

Mary Jane Tiokasin said that chokecherries bloom in May. Helmina Makes Him First and Blanche Lawrence said that they have white-pinkish blossoms that you can see from a distance. Therese Martin said that someone she knows who gathers chokecherries goes into all the ravines to find them. She said that there are a lot of

chokecherries around the community of Promise (in the Cheyenne River Nation to the south).

Shirley Marvin said that she had heard from someone that they were ripening at the time of our interview (mid-June). Sidney Eaglesfield said that they are ready after July 5th. Helmina and Blanche said that they are ready in July.

Stella Guggolz remembered that her mother used to gather chokecherries when they were just turning glossy to make them into syrup and jelly. Theo Iron Cloud said that you can start to gather them in July, and some people do this because this helps for making jelly.

Florence McLaughlin and Stella said that they ripen in the last part of July. Mary Jane said they are ready “when the bulls get mean”, usually in late July or early August. Pearl Day also said that they are ready in late July or early August. Iyonne Bear Ribs said that they are ready in August. Stella said chokecherries are good the whole month of August. Theo said that they are good when they get really black in August. Theo and Therese Martin each said they were getting ripe at the time of our interviews in mid-August.

Leonard Village Center said that you harvest chokecherries in the summer until the birds take the rest. Stella said that where she used to gather chokecherries, now there are too many different kinds of birds, including many she has never seen before. She said those birds are competition for the chokecherries and berries.

Sidney said that he used to eat so many chokecherries while he was gathering them that he barely had to eat when he got home. Pearl said that kids used to brush their teeth with sand after eating chokecherries, so when they came home they had sand on their elbows and ankles.

Iyonne said that chokecherries from around houses aren't as good as the ones from further out. Stella said that now she gathers cherries from her sister's place in Kenel. She said her sister keeps the bushes clean underneath, so Stella doesn't get bit up while she's gathering, and she can visit with her sister.

Leonard said you can dry chokecherries to save them for winter. Stella said that when they were really ripe and mushy, her mother had a rock and mallet that she would use to pound the cherries into patties like hamburger patties. Iyonne said that her mother had a stone that wouldn't chip (it had lots of tiny colors in it) and had a dent in the middle. Her mother had another stone to pound the cherries. Pearl said her mother would wash the cherries in a bucket and then pound and pound them with two rocks to make the patties. Theo said she uses a meat grinder to make her patties, while her husband Vernon Iron Cloud pounds his with a stone. Therese Martin said that now most people use chokecherries to make jelly, but people used to pound them and make patties. She said you can use a meat grinder and make the patties with your hands. She said you don't add anything to chokecherry patties.

Iyonne said her mother set her chokecherry patties on the roof to dry (along with wild plums). Therese Martin said you can dry them on plastic or a cloth, but you should cover them with netting to keep bugs off. Stella said her mother used a canvas and cheese cloth to put them up to dry. Iyonne remembered she had to guard the patties from magpies. She said that a full day in the hot sun should dry them. Stella said that once they are dry enough you can put them in a cheesecloth sack. She said some of the kids ate them right away like candy. Pearl said that kids used to pretend they were hamburger patties.

Therese Martin said you can keep chokecherry patties for more than 15 years and they will still taste fresh. She said they will turn black with time. Stella said the purpose of drying the patties is that you can make wóžapi from them in the winter. Theo said that when make the patties into wóžapi you can use a strainer to take out the

small pieces of pits. Leonard and Mary Jane said that chokecherries make good wóžapi.

Mary Jane said that pemmican is made out of chokecherries and usually kidney grease. She said the chokecherry pits go right in; you need to pound the cherries and then make into balls, and you don't need to add sugar. She said that white people can learn to make this.

Mary Jane said that you can also make a tea from chokecherries. Pearl said that chokecherry bark is peeled and boiled to make tea.

Stella said she plans on having a naming ceremony for all her children at her house. She said she plans to do everything natural, without using imitation ingredients, including real chokecherries and chokecherry juice as part of the ceremony.

Corn – wagníza – *Zea mays*

Although most of the elders I spoke with assumed we were focusing on non-cultivated plants, some of them discussed corn and its use in local foodways. These elders called the plant “corn”. The Lakota name is from the New Lakota Dictionary (2009). Corn has many names in Dakota and Lakota, depending on the variety and how it has been prepared.

Mary Jane Tiokasin said that you plant corn in May or June. She said you harvest it in September. Florence McLaughlin said you harvest corn in the end of the fall. Mary Jane said that in October you dry (or parch) corn. She said that you can use parched corn through the winter and spring. She said that after the corn is parched, you can roast it in a coffee can over an open flame.

Crabapples – thaspáŋ (apple) – *Malus species*

According to the Field Guide to Trees of North America (2009), there are four species of crabapples native to North America, but none of them occur in the Dakotas. The crabapples mentioned by elders are most likely Eurasian crabapple species. The Lakota name for apple (thaspáŋ) is included because the New Lakota Dictionary (2009) does not have an entry for “crabapple”.

Mary Jane Tiokasin said that crabapples bloom in May. She said the blossoms are pink. She said the apples fall off of the trees in September. She said that these can be used to make jelly.

Dandelion – yapížapi iyečheča – *Taraxacum or Agoseris species*

Mary Jane Tiokasin called this plant “dandelion” when she spoke to me. The Lakota name is from the New Lakota Dictionary (2009). Mary Jane said that you can eat dandelion greens.

Elm trees – p'ěchaŋ – *Ulmus species*

The elders who mentioned these trees called them “elm trees” when they spoke to me. The Lakota name is from the New Lakota Dictionary (2009).

Mary Jane Tiokasin said that you can make a tea from the red bark underneath the top bark if you peel that back. She said you can harvest the red bark any time of year.

Goldenrod – many names in Lakota – *Solidago species*

Pearl Day called this plant “goldenrod” when she spoke to me. The New Lakota Dictionary (2009) lists many Lakota names for the many goldenrod species.

Pearl said that goldenrod blooms in May. She said that her mother told her that it was alright to swim in the Cannonball River from the time the goldenrod

bloomed until the bloom was gone. Otherwise, her mother said she would get polio. She said she didn't know what polio was, but she was still scared of getting it.

Gooseberries or currants – wičháǵnaška – *Ribes* species

The elders who mentioned these trees called them “gooseberries” or “currants” when they spoke to me. When I asked them, they said these are the same plant. The Lakota name is from the New Lakota Dictionary (2009).

Stella Guggolz, Helmina Makes Him First, and Blanche Lawrence said that they have yellow flowers.

Mary Jane Tiokasin said that they are ripe in June and July. Iyonne Bear Ribs said that they ripen right after the Juneberries in July. Helmina and Blanche also said that they ripen in July.

Blanche and Helmina said that they used to grow around the school in Little Eagle, and that everybody had a spot and watched them turn from green to red to black. They said that when they were black they were all gone in one day.

Pearl Day remembered that one bush grew in the Porcupine cemetery, and that she used to fill her pockets and some pails and sit in the shade to eat them.

Iyonne said that you don't eat them as you pick them. She said that her grandmother made wóžapi, jam, and jelly out of them.

Stella said that she used to see more of them than she does now.

Horsetail – wanyéča swúla – *Equisetum laevigatum*

As Pearl Day described this plant we identified it from a field guide as “smooth scouring rush”, a horsetail family member. The Lakota name is from the New Lakota Dictionary (2009). Pearl said that she used to take a bunch of the stems of these plants and take them apart, then try to put back together again, like a puzzle (which Pearl still loves). She said that she and her friends used to sit for hours doing that as kids.

Juneberries – wípazukha – *Amelanchier alnifolia*

The elders who mentioned these called them “Juneberries”. The Lakota name is from the New Lakota Dictionary (2009).

Florence McLaughlin said that Juneberries blossom in early June and are ready to harvest in the second half of June. Vernon Iron Cloud also said they are ready in June. Helmina Makes Him First and Blanche Lawrence said that you gather them in late June until the 1st of July. Iyonne Bear Ribs said that they are ready in June, and that no other fruit ripens before them. Leonard Village Center said that Juneberries were probably ripe at the time of our interview (mid-June). Therese Martin said that you can find Juneberries around the same time as thínpsinǵla, mainly in June. She said that after that, the birds eat them up.

Pearl Day said that Juneberries grew behind the Iron Boulders' house, close to her childhood home. Iyonne said that Juneberries can be hard to find because the berries are deep in the bushes, and they seem to be hiding. She remembered that her husband would go into the bushes on horseback to reach them. She said they taste so good when you pick them. Theo Iron Cloud said you don't need sugar for Juneberries. Iyonne remembered that her grandmother had to use them right away or the children would eat them all up.

Florence said that this year the birds got all the Juneberries. She said there had been a lot, but now the bushes were all bare in Little Eagle, Cannonball, and Rock Creek.

Leonard said that you can dry Juneberries in the summer to keep them for winter. Iyonne said that they can be used in pies and wóžapi.

Medicinal plants – unidentified

Helmina Makes Him First and Blanche Lawrence described medicinal plants as a distinct category. They said that after a good spring, you gather these plants in late June to the first of July. They said that each plant has its own flower that shows the identity of the plant. They said you have to look out for the flower because they change locations every year. They compared this to “moving camp”.

Medicine for sores – unidentified

Helmina Makes Him First and Blanche Lawrence described a medicinal plant that can be found around prairie dog towns. They said that this can be made into a salve and used to treat sores.

Milkweed – many Lakota names – *Asclepius* species

Florence McLaughlin called this plant “milkweed” when she described it to me. The New Lakota Dictionary (2009) lists many Lakota names for the various species of milkweed found in the region. Florence said that her grandmother gathered the pods and used the fluffy seeds like down to make pillows.

Mouse beans, earth beans, or dirt beans – makhátomniča – *Amphicarpaea bracteata*

Most of the elders who mentioned these trees called them “mouse beans” when they spoke to me, except for Therese Martin, who also called them “ground beans”. I have heard other elders refer to them as “earth beans” or “dirt beans”. I assume these are all the same plant. The Lakota name is from the New Lakota Dictionary (2009), but Sidney Eagleshield recognized it when I asked him.

Mary Jane said that the plants blossom in June and July. She said you look for the beans in August through October. Therese Martin said that you look for mouse beans close to winter (October and November), because the mice are getting ready for winter.

Mary Jane Tiokasin said that the plants grow in the forest. Shirley Marvin said that they grow in heavily wooded areas. Therese Martin remembered her mother gathering them from mounds close to the river. She said that those all are under water now, but they might still be found around Little Eagle, along the Grand River. Sidney Eagleshield said that you have to go to certain areas north of Mobridge to find them now.

Shirley said that the mice leave a trail that will lead you to their stash of these beans. She remembered her mother telling her that you never take the whole stash, but just the top, so that the mice have something to eat over the winter and keep gathering the beans the following year. Therese Martin said you always leave some mouse beans for the mice. Sidney said that people used to give the mice yellow corn and take the wild beans in place of it.

Mary Jane said that you can put a canvas underneath the plant and knock it with a stick so that they fall off.

Sidney said that his wife’s brother makes a big sack of them, at least a couple of cups, which he said is quite a lot. He said that maybe some elders in Wakpala have some now.

Mushrooms – čhaṅnákpa (“ear of the tree”) – Fungus kingdom

The elders who described these called them “wild mushrooms”. Therese Martin also called them “čhaṅnákpa” and explained that this means “ear of the tree”

The spelling in Lakota is from the New Lakota Dictionary (2009), and Helmina Makes Him First and Blanche Lawrence said it was correct.

Mary Jane Tiokasin said that mushrooms grow on ash trees. Iyonne Bear Ribs said that they only grow on čhaŋšúška (box elder trees). Stella Guggolz said that there are mushrooms growing up the creek behind her house and in the big draws on either side of the lake on her property. Theo Iron Cloud said that mushrooms grow mainly on elms and čhaŋšúška along the creeks. Therese Martin said that they grow on tall trees that are along the river, mainly oaks. She said that you can probably find a lot of them around the community of Promise (Cheyenne River Nation) because of all the trees there. Mary Jane and Theo said there was a nice elm tree in front of the old Tribal Office that had mushrooms on it. Vernon Iron Cloud said that mushrooms can grow on elm, oak, or ash, and sometimes on cottonwoods by the river. He said that they grow mostly in on oak and elm along creeks and in ravines. He said they were all the same kind.

Therese Martin said that they look like cabbage, but also like white pancakes “hanging” in the trees. She said that sometimes you have to climb up in the trees to get them.

Vernon said you can gather mushrooms in the spring. Mary Jane said that mushrooms are good for food from mid-June to mid-August. She said that after that they slow down and become powdery in the middle. She said they are good for medicine during the rest of the year. Iyonne said that mushrooms should be gathered at the same time as grapes (in the fall). Stella said that mushrooms are gathered in the fall, mainly in September and October. Therese Martin said that mushrooms are gathered mainly in the fall. Theo said that you gather mushrooms in the fall, and if you wait one or two days after a rain they will get larger. Helmina and Blanche said that they were ready at the time of our interview (late October) but that after the first frost they get wormy.

Mary Jane said the mushrooms that grow on trees are safe, but the ones on the ground are poisonous. Iyonne said that the only good, non-poisonous ones grow on čhaŋšúška. She said she didn't let her children pick them because some are poisonous.

Theo said that the Hutterites from across the river like to trade their canned goods for mushrooms that that people around here gather because they say that Indians have the best mushrooms.

Mary Jane said that people boil or fry wild mushrooms. Shirley Marvin said they are good in soup. Iyonne said they taste so good. Stella said that if you take a nice big mushroom, boil it, take it out of the water, slice it up, and fry it in butter, it makes a really good side dish. Therese Martin said that you can mix mushrooms with dry meat, cook them like potatoes, or use them in soup. She said they taste like cabbage. She said she wasn't sure if you can preserve them. Shirley said that you can dry mushrooms to store them, and gave me some that had been dried.

Mary Jane said you can open up the mushroom and take out the brown powder to use as medicine to treat babies' umbilical cords.

Iyonne said that only a few people gather them now, and she hadn't seen any yet this year, but said they should grow every year. Helmina and Blanche said that no one seems to be picking them this year.

Poison ivy – wikhóška thapežúta – *Toxicodendron rydbergii*

The elders who described this plant called it “poison ivy”. The Lakota name (wikhóška thapežúta) is from the New Lakota Dictionary (2009).

Pearl Day said that kids who swam in the Cannonball River knew how to identify poison ivy and made sure that their paths didn't lead to it. Mary Jane Tiokasin said that you can pack your skin with mud to treat poison ivy.

Prickly pear cactus – uñhčéla tháŋka – *Opuntia* species

Mary Jane Tiokasin called this “prickly pear cactus” in our conversation. The Lakota name (uñhčéla tháŋka) is from the New Lakota Dictionary (2009). Mary Jane said that the plums ripen in May and June. She said they fall off cactus in July and they don’t have any thorns. She said they are tasty and some people make jam out of them.

Sage – phežíhota and other Lakota names – *Artemisia* species

The elders who described sage usually mentioned that there are several types. The Lakota name (phežíhota) is the generic term from the New Lakota Dictionary (2009). It usually refers to “white sage” (*Artemisia ludoviciana*), which is often called “man’s sage” on Standing Rock.

Sidney Eagleshield said that sage has a grey leaf. Stella Guggolz said that there is one kind of sage that is wide and flat and grows by the river. Pearl Day said she always gathered the short kind, because she wasn’t sure what the tall kind was for. Theo Iron Cloud said that there are man’s and woman’s sages, and you need to use the right one. She said that that the man’s sage has leaves that are big and flat, while woman’s sage has leaves that are skinny and narrow. Vernon Iron Cloud said you can tell it is woman’s sage because it has round parts on the top. Helmina Makes Him First and Blanche Lawrence said that there are many different kinds of sage, including “prairie sage”, which grows in clumps and you can break it off because it’s woody. They also said that “female” sage and “male” sage are different types.

Theo said you can gather sage anytime. Leonard Village Center said that it is better to harvest sage in the spring before it dries up. Mary Jane Tiokasin said that you can harvest sage from April until November or December. Helmina and Blanche said that wind carries the sage seeds, and when they start seeding you shouldn’t gather it anymore. Helmina and Blanche said they gather sage from the end of July until first week of August, because then the plants go to seed and by September the leaves go to sleep (curl up).

Leonard said that sage is growing around the dumpster in front of the Long Soldier Nutrition Site. Sidney said you can find it along the highway.

Mary Jane said that you have to dry sage yourself.

Sidney said you can hang a bunch of it in your house and it will smell good. He called it “Indian deodorant”. Pearl said her mother burned it in a large tub to repel bugs.

Mary Jane said that you can use sage for a tea or burn it to smudge. Stella said that when you use it to smudge it calls the good spirits. Blanche takes a little bit of sage and rubs it into a ball before she places it in a shell and burns for smudge. Helmina and Blanche said they use “prairie sage” to smudge and keep away mosquitoes.

Stella said the wide flat type of sage is good for treating psoriasis if you boil it and wash with it. She said it feels like soap so you can scrub with it. She heard there is another type of sage that is fuzzier and is good for stomach ailments, but she has never found it.

Sandcherries – aúŋyeyapi – *Prunus pumila*

The elders who described these plants called them “sandcherries”. The Lakota name (aúŋyeyapi) is from the New Lakota Dictionary (2009).

Mary Jane Tiokasin said that sandcherries grow along the river. Pearl Day said they are small bushes that grow north of Porcupine in the hills. Blanche Lawrence and Helmina Makes Him First said that the sandcherry bushes grow along the hills. They

said that sandcherries are bigger than chokecherries, but the bushes are shorter (1 to 2 feet tall).

Mary Jane said that sandcherries start growing in April and May, and ripen in mid-June to early July. Blanche and Helmina said they are ready in July with the chokecherries. Theo Iron Cloud said they ripen at the same time as chokecherries (in August).

Iyonne Bear Ribs remembered that her grandfather used to pick sandcherries and bring them back in his cap. She said she never picked them herself, but she said they taste really good and are bigger than chokecherries. She said that they always ate them right away so they never lasted long enough to cook them.

Mary Jane said not to pick sandcherries if the wind is blowing from the South, because they will be bitter. Iyonne remembered that her grandfather had to come from a certain direction when he was picking them or they would taste bitter. Pearl said to stand against the wind to eat them and they taste sweeter. Theo said that if you gather them where the wind is hitting them they will taste bitter, so you have to go around to where the wind isn't hitting them so they will taste sweet. Helmina and Blanche also said that when you're picking them you have to check the wind and approach them going into the wind; otherwise they will be bitter.

Iyonne said that snakeberries look like sandcherries and grow right on the ground the same way, so her grandparents never let the children pick them.

Theo said she hasn't seen sandcherries in years and thought they were gone.

Soapweed – huphéstola – *Yucca glauca*

The elders who described these plants called them “soapweed”. The Lakota name (huphéstola) is from the New Lakota Dictionary (2009).

Shirley Marvin said that people used this plant to wash. Pearl Day remembered a grandmother who gathered the soapweed root. She said she placed tobacco in the hole after gathering it.

Sweetgrass – wačhánǵa – *Hierochloe odorata*

The elders who described this plants called it “sweetgrass”. The Lakota name (wačhánǵa) is from the New Lakota Dictionary (2009).

Sidney Eagleshield mentioned sweetgrass as an important plant. Mary Jane Tiokasin said you harvest it from June through August, then braid and dry it in September and October. Stella Guggolz said it calls bad spirits so she doesn't use it.

Thínpsinǵa – prairie turnip or wild turnip – *Pediomelum esculenta*

The elders who described these plants called them “thínpsinǵa”, “prairie turnips”, or “wild turnips”. The Lakota name is well known, and this spelling is from the New Lakota Dictionary (2009).

Iyonne Bear Ribs said that thínpsinǵa grow on the sides of hills, but not on hilltops or in ravines. Stella Guggolz said that her family gathers them on the flats up above her house.

Shirley Marvin said that she and other community members have learned that the thínpsinǵa are ready to harvest when the cottonwoods are letting go of their seeds. She said this is usually in mid to late June. Therese Martin said they are available at the same time as Juneberries, mainly in June. Iyonne and Stella said that thínpsinǵa are good in June. Florence McLaughlin also said that you start digging in mid-June. Leonard Village Center said that thínpsinǵa are usually ready at the time of our interview (mid-June). Sidney Eagleshield said they are ready after July 5th. Theo Iron Cloud said you know they're ready after they've bloomed, about the third week in July.

Iyonne said that this year (2009) she saw a thínpsinla around Chief's Day (May 25th). She said this was because there was so much rain, and the thínpsinla was large but not good to eat.

Sidney said that you can see thínpsinla way out in the prairie, and the easiest way to find them is to go against the sun so you can see the bluish color of the flowers.

Shirley and Sidney said that thínpsinla grow in hayfields, but you have to get to them before they hay because you can't find them afterwards.

Iyonne, Shirley, and Mary Jane Tiokasin said that if there is too much rain, thínpsinla get phophópa (spongy). Theo said you have to watch them and test them and if they're soft you don't start getting them. Vernon said that his grandmother told him that if you eat them when they're soft you'll get a stomach ache. He said that when they get harder they get sweeter too.

Therese Martin said that after June, the thínpsinla "hide" or are gone. Florence said that they dry up by the end of July. Leonard said that they disappear by August. Sidney also said they dry up in August. Stella said you need to get them before the high winds come and knock the plants over so you can't find them. Theo also said that they turn brown and the wind blows off the tops in August.

Sidney said that thínpsinla can get about as big as a whole thumb. Iyonne said the small ones are the best.

Leonard said that when you go out to dig thínpsinla, be careful of snakes, because there are plenty out there but you have to look.

Shirley said there is a similar plant that has orange blossoms. Theo said she has taught all of her children to identify them by breaking off a stem to show them the blossom. Helmina Makes Him first said another plant looks similar, and she taught her kids to identify thínpsinla as the one with hairy stems. Iyonne Bear Ribs said that one similar plant is called "wanáǵi thínpsinla" or "spirit turnip", and the real one is hairy with "white fur".

Shirley said that if you replant the stems after you take the thínpsinla, the seeds will fall back and grow. Iyonne said that her grandmother would cut off the tops and throw them back in the hole.

Shirley said that "this is one of the things we still have as a tradition", and she bought a braid from a local vendor the night before our interview (in June). Iyonne said she hadn't seen braids for sale for three years.

Iyonne said that her son-in-law used to dig thínpsinla and make beautiful braids. She said his braids were big at the top to small at the bottom. Stella said she doesn't like braids; she prefers cutting the thínpsinla when they are fresh and then stringing them so that they don't have to be cut after they are soaked.

Leonard said thínpsinla are getting expensive: about \$50 for a braid. Helmina and Blanche Lawrence said that some people just display them and don't use them.

Iyonne said that thínpsinla can be eaten raw or dried and then used in soups. She said it is eaten at special occasions, like funerals and feeds, and is not an everyday food. Theo also said you can eat them raw.

Helmina said the thínpsinla broth is a medicine as well as a food. She said not to throw out the broth when you soak turnips. Blanche said she used the broth to help her daughter gain weight.

Pearl Day said her mother never gathered thínpsinla, so she never did, but other people would bring them into Porcupine.

Theo said there seem to be less thínpsinla because so many people are gathering them. She said it seems like now the kids have to go out further to gather them. Vernon said that there seem to be more thínpsinla in North Dakota where you can sometimes gather a pail-full in a few feet, while in South Dakota you can walk ¼

mile before you find another one. He said too many cows might be causing this difference.

Toothache medicine – unidentified

Several elders mentioned a root that can be used to treat a toothache. Each described it differently. I believe that at least some of these descriptions refer to the same plant, and I suspect that it is “purple cone flower” (*Echinacea purpurea*). After reading the first version of this report, Blanche Lawrence said she agreed that the elders were probably referring to this plant.

Iyonne Bear Ribs described a long root that was used to treat toothaches. She said that her grandmother kept this root in little bags made of cloth or leather. She said that if you chew on it, your mouth will go numb like when you go to the dentist. She said her grandmother found it when they were digging for *thínpsinla*.

Helmina Makes Him First and Blanche Lawrence also described a medicine for toothaches that makes your mouth go numb.

Vernon and Theo Iron Cloud described a plant they call *poipi*. They said it has a green stem has pink petals and is daisy-like. They said you use the root, but you have to dig down far for it. They said it grows everywhere. They said it usually appears in July, but some years it grows and some years it doesn't. This year (2009) it didn't. They said you can use it for toothache but it can help wherever you have pain.

Trees (various species) – čhaŋ

Several elders mentioned the local uses of trees that may not depend on the type of tree. We have already listed the importance of trees as hosts for mushrooms (see “mushrooms”). According to the New Lakota Dictionary (2009) the Lakota word “čhaŋ” can be used for “tree”.

Shirley Marvin said that when she was at boarding school kids were hungry all the time, so they would strip the buds off the trees that were near the schools to eat. Mary Jane Tiokasin also said that kids ate the green buds off cottonwood trees May through October.

Mary Jane said that people used ashes from elm, ash, and cottonwood trees to whiten their clothes when they were doing laundry. She also said they used ashes in making soap.

Shirley said that ashes from the same trees can be used when people have that grey covering on their eyes. She said they put ashes in their eyes and that “sliced” that off of their eyes.

Wagmú — Crooked necks, Hubbards, and other squashes — *Cucurbita* species

Although most of the elders I spoke with assumed we were focusing on non-cultivated plants, some of them discussed squashes and their use in local foodways. Florence McLaughlin talked about “crooked necks”, a yellow summer squash with a curved top. Vernon Iron Cloud talked about Hubbard squash, the large, dark green winter squash. Mary Jane Tiokasin used the Lakota name (*wagmu*) in reference to all squash.

Florence McLaughlin said that crooked necks are harvested from the end of July until the end of August. Vernon Iron Cloud said that you dry Hubbard squash in September or whenever it is ready.

Mary Jane said that *wagmu* are an important food, and can be dried for the winter. Stella Guggolz remembered that her mother would put squash under the bed. She said her mother would leave a long stem on the squash, probably to prevent it from rotting quickly. She said it didn't last very long anyway because the family ate a lot of squash. She said her family would rather eat than potatoes. She said that when

you want to dry a big squash, you peel them and sliced them, clean out the seeds, and then hang the rings up to dry. She said her mother didn't choose the really big ones, because they needed to have soft meat. She said that they shrunk down a lot, but once you started cooking them they swelled up again, the same as mushrooms.

Vernon said that when you're cutting a Hubbard to dry it, you can cut it into rings or in a spiral so that it's a long, connected, piece that you hang to dry.

Wild grapes – čhuŋwiyapehe – *Vitis vulpine*

The elders who described these plants called them “grapes” or “wild grapes”. The Lakota name (čhuŋwiyapehe) is from the New Lakota Dictionary (2009).

Mary Jane Tiokasin said that the wild grapes hang just like “real grapes”.

Iyonne Bear Ribs said that they grow along the Grand River. She said she had some relatives who lived down there and they grew around their place. She said her uncle picked them.

Mary Jane said that grapes are harvested in August and September. Florence McLaughlin said that grapes are harvested just before the buffaloberries, so just before the first frost. Iyonne said they are ripe in fall, so people bring them in with the mushrooms. Vernon Iron Cloud and Pearl Day said that if you eat them after the first frost they are juicier and sweeter. Helmina Makes Him First and Blanche Lawrence said that they are ready in September.

Helmina and Blanche said that they seem to hide under the vines. They said you don't see them at first until you walk under the tree. They said they use a long stick with a hook on it to pull down vines, but later they put the vines back up at least halfway so that they can grow back.

Iyonne said that the grapes taste really bitter, but you can make something out of them.

Helmina and Blanche said that nobody seemed to gather grapes this year even though there were a lot of them according to some people. They said the Hutterites didn't come to buy them this year either. They said that one time someone was selling them for \$10 a bushel and that ruined it for everyone else (it was too little money for the work involved).

Wild onions – pšij šičamna – *Allium* species

The elders who described these plants called them “wild onions”. The Lakota name (pšij šičamna) is from the New Lakota Dictionary (2009).

Iyonne Bear Ribs said they grow all over the hills. Mary Jane Tiokasin said she saw some with Iyonne when they were in the Bullhead cemetery recently.

Mary Jane said that you can harvest them from May until October. Theo Iron Cloud said that they come out in May and you start pulling them in June. She said they last all summer. Iyonne and Florence McLaughlin said to harvest them in July and August, whenever they get high enough. Pearl said that you start eating them in late July or early August until the 1st of September.

Mary Jane said that every kid used to eat them lying in the ditches. Iyonne remembers playing and eating them after school got out. She said the kids ate a lot of them.

Vernon Iron Cloud said that when cows eat onions their milk starts to smell like onions so people who have cows go out and get them. Theo said the cows eat the tops off but not the onions.

Iyonne said she always ate onions raw. Florence said she dried them to use later.

Wild plums – kháŋta – *Prunus americana*

The elders who described these plants called them “plums” or “wild plums” as opposed to “tame plums”. The Lakota name (kháŋta) is from the New Lakota Dictionary (2009).

Vernon Iron Cloud said that wild plums grow along the rivers.

Mary Jane Tiokasin said that they blossom in May. Helmina Makes Him First and Blanche Lawrence said that they have white flowers that smell good when they’re in bloom.

Sidney Eaglesfield said they are ready after July 5th. Mary Jane said that plums are ready in late July or early August, but they are best after the first frost (in September). She said before that time, they are sour. Florence McLaughlin said to harvest them before the first frost. Iyonne Bear Ribs said they are ready the first part of September. She said some people pick them earlier for jams and jellies. Stella Guggolz said that plums started 3 weeks to a month later than chokecherries, and are available into September. Pearl Day said that you can eat plums from late July or early August until the first of September. Vernon said that plums are best in September when they are ripe and juicy. Helmina and Blanche said that they are ready in September.

Vernon said that plums aren’t out for long after they are ripe because the wind knocks them down or the deer get them.

Iyonne remembered picking plums before school started in the fall. She remembered popping sour ones in her mouth and making funny faces.

Leonard Village Center said that you harvest plums in the summer and dry them to keep them for winter. Mary Jane said you can use wild plums to make jelly, jam, and wóžapi. Iyonne remembered that to dry plums you boil them until they pop open, then her family put them on the roof on a clean cloth or dish towel. She said they used them later in wóžapi. Stella said that if you get ripe plums you can make jelly or you can parboil them, spread them out, and let them sun-dry. She said to use the big jars for plum jelly. She remembered that if her mother had extra, she used those for juice. Theo Iron Cloud said that you can make good wóžapi out of plums, and she gave me some that her relative had water packed.

Pearl said that the regular wild plums are small and red, but she remembered a tree with plums that were large and yellow across the river from Porcupine. Iyonne said that the plums that grow in town don’t taste as good as the wild ones. Stella has a plum tree behind her house that was covered with ripening plums at the time of our interview.

Wild rose – uŋžiŋžitka hu – *Rosa species*

The elders who described this plant called it “wild rose” or “prairie rose”. The Lakota name (uŋžiŋžitka hu) is from the New Lakota Dictionary (2009).

Iyonne Bear Ribs said that wild roses grow near creeks.

Stella Guggolz said that when the rose bushes blossom, you should plant your garden. She said that this is a sign that all the frost is out of the ground and seeds will now germinate faster.

Iyonne said that she has never used wild roses, although she has heard that they can be used for medicine, not food.

Iyonne Bear Ribs and Pearl Day described a “small, tomato-like plant” during their interviews, but couldn’t remember its Lakota name. Later, they asked Blanche Lawrence for the name and she told them it was uŋžižitka, which they repeated to me as wažižitka. In my first version of this report, I included these as two different plants (uŋžižitka and wažižitka). When Blanche reviewed that version, she assured me that these are the same, and that uŋžižitka is the correct name.

Iyonne said that the fruits of this “small tomato-like” plant are red. She said they grow along roads and usually appear in the fall. She said her grandmother used to boil the little fruits for stomach sickness (flu), put them in jars with a tight lid after she dried them. She said that the meaning of the name is "when you eat them it makes your butt itch". She said that when you see a lot of these it's going to be a cold winter.

Pearl said she ate the outside of the fruits very carefully because she heard that swallowing the seeds would give you an itchy butt.

Wild strawberries – wažúšteča – *Fragaria virginiana*

The elders who described these plants called them “wild strawberries”. The Lakota name (wažúšteča) is from the New Lakota Dictionary (2009), and Sidney Eaglesfield said it was correct. Sidney said that the wild strawberries are ready after July 5th. Helmina Makes Him First and Blanche Lawrence said that they can be surprisingly large (almost golf-ball sized!) and grow in shady places, not in full sun.

Willow – many Lakota names – *Salix* species

When Shirley Marvin described this plant she called it “willow”. The New Lakota Dictionary (2009) lists several Lakota names for the various species of willows that grow on Standing Rock. Shirley Marvin said that you can use willow bark to make a medicinal tea.

APPENDIX C: SEASONAL AVAILABILITY OF FRESH PRODUCE AT THE
STANDING ROCK FARMERS MARKET IN 2009.

Product	Market Day (2009)											
	7/25	8/1	8/8	8/14	8/21	8/28	9/4	9/10	9/18	9/24	10/2	10/9
beans (green)				Green	Green							
bear medicine*	Dark Green											
beets		Dark Red		Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red	Dark Red
buffalo berries						Red	Red	Red	Red	Red		
carrots					Orange	Orange	Orange	Orange	Orange	Orange	Orange	Orange
chard				Dark Purple								
čheyáka (wild mint)*	Light Green			Light Green							Light Green	
chokecherries			Dark Red	Dark Red	Dark Red		Dark Red	Dark Red	Dark Red	Dark Red		
corn						Yellow	Yellow		Yellow			
cucumber				Green		Green	Green		Green		Green	
grapes (domestic)*										Dark Purple		
herbs, cilantro	Green	Green										
herbs, dill	Light Green	Light Green		Light Green		Light Green						
herbs, parsley										Green		
herbs, thyme										Light Green		
honey				Orange						Orange		
lettuce	Light Green	Light Green	Light Green	Light Green	Light Green							
onions						Light Orange			Light Orange	Light Orange		
peppers (Annaheim)											Red	
peppers (Bell)				Green	Green	Green	Green	Green	Green		Green	
peppers (jalapeno)				Dark Green	Dark Green	Dark Green	Dark Green	Dark Green	Dark Green		Dark Green	
peppers (lantern)									Yellow			
peppers (purple)						Dark Purple						
peppers (Serranos)											Red	
peppers (mild variety)				Light Green	Light Green			Light Green	Light Green	Light Green		
potatoes				Brown		Brown	Brown		Brown	Brown		
pumpkins											Orange	Orange
rhubarb				Red								
sand cherries				Dark Red								
squash, summer				Yellow	Yellow		Yellow		Yellow		Yellow	Yellow
squash (crooked neck)				Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
squash (zucchini)				Dark Green	Dark Green		Dark Green		Dark Green	Dark Green	Dark Green	

Product (continued)	7/25	8/1	8/8	8/14	8/21	8/28	9/4	9/10	9/18	9/24	10/2	10/9
squash (acorn)												
squash (buttercup)												
squash (butternut)												
squash (gourds)												
squash (Hubbard)												
squash (orange buttercup)												
Squash (spaghetti)												
thiɣpsɪŋla (prairie turnips)												
tomatoes												
turnips (domestic)												
wild plums												
<i>Number of vendors</i>	4	2	2	6	3	7	7	3	8	6	6	7
<i>Number of products for sale</i>	6	5	3	20	11	17	16	10	20	18	18	8

Products in bold are non-cultivated and sold by local gatherers.

* These items were sold at market but were not approved by USDA as an eligible food for SFMNP voucher exchange.

Eligible foods available at other markets: apples, cabbage, eggplant, garlic, **Juneberries**, kale, kohlrabi, melons, plums (domestic), radishes, strawberries
 Other eligible foods (not observed at markets): asparagus, bokchoy, broccoli, Brussels sprouts, cauliflower, celeriac, celery, leeks, mesclun, **mushrooms (wild and domestic)**, nectarines, okra, parsnips, peaches, pears, peas, radicchio, scallions, spinach

REFERENCES

- 107th United States Congress. 2002. *Farm Security and Rural Investment Act of 2002*. H.R. 2646. May 13.
- Agrawal, A. 1995. Dismantling the Divide Between Indigenous and Scientific Knowledge. *Development and Change* 26, no. 3: 413-439.
- Anderson, K. 2005. *Tending the wild : Native American knowledge and the management of California's natural resources*. Berkeley, CA: University of California Press.
- Anderson, M. D, and J. T Cook. 1999. Community food security: Practice in need of theory? *Agriculture and Human Values* 16, no. 2: 141–150.
- Aristotle. 1976. *The ethics of Aristotle : the Nicomachean ethics*. Trans. J. A. K. Thomson. Revised ed. Harmondsworth, NY: Penguin Classics.
- Arnstein, S. R. 1969. A Ladder of Citizen Participation. *Journal of American Institute of Planners* 35: 216.
- Bacon, C., E. Mendez, and M. Brown. 2005. Participatory action research and support for community development and conservation: examples from shade coffee landscapes in Nicaragua and El Salvador. *Center for Agroecology and Sustainable Food Systems*, no. 6. Research Briefs.
- Barrett, C., C. Red Eagle, J. Taken Alive, and K. Billingsley. 1995. *The History and Culture of the Standing Rock Oyate*. The North Dakota Tribal Curriculum. Bismarck, ND: North Dakota Department of Public Instruction.
- Benz, B. F., J. Cevallos E, F. Santana M, J. Rosales A, and S. Graf M. 2000. Losing knowledge about plant use in the Sierra de Manantlan Biosphere Reserve, Mexico. *Economic Botany* 54, no. 2: 183–191.
- Berger, R.J., and R. Quinney. 2005. The Narrative Turn in Social Inquiry. In *Storytelling Sociology: Narrative as Social Inquiry*, ed. R. J. Berger and R. Quinny. Boulder, CO: Lynne Rienner Publishers.

- Berkes, F. 2008. *Sacred ecology*. 2nd ed. New York: Routledge.
- Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological applications* 10, no. 5: 1251–1262.
- Berkes, F., C. Folke, and M. Gadgil. 1995. *Traditional ecological knowledge, biodiversity, resilience and sustainability*. Beijer International Institute.
- Berkes, F., and N. Turner. 2006. Knowledge, Learning and the Evolution of Conservation Practice for Social-Ecological System Resilience. *Human Ecology* 34, no. 4: 479-494. doi:10.1007/s10745-006-9008-2.
- Bruhn, J. 1974. Human Ecology: A Unifying Science? *Human Ecology* 2, no. 2: 105-125.
- Bucko, R. 1998. *The Lakota ritual of the sweat lodge : history and contemporary practice*. Lincoln, NE: University of Nebraska Press.
- Cavalli-Sforza, L., and M. W. Feldman. 1981. *Cultural Transmission and Evolution*. Princeton University Press, May 1.
- CDC [Center for Disease Control and Prevention]. 2007. National Diabetes Surveillance System. *County Level Estimates of Diagnosed Diabetes*. <http://www.cdc.gov/diabetes/statistics/index.htm>.
- Chase, S. 1995. *Ambiguous empowerment: The Work Narratives of Women School Superintendents*. Amherst, MA: University of Massachusetts Press.
- Cox, P. A. 2000. Will Tribal Knowledge Survive the Millennium? *Science* 287, no. 5450: 44-45.
- Davis, A., and J. Wagner. 2003. Who Knows? On the Importance of Identifying “Experts” When Researching Local Ecological Knowledge. *Human Ecology* 31, no. 3: 463-489. doi:10.1023/A:1025075923297.
- Dreyfus, H. L., and S. E. Dreyfus. 1986. *Mind Over Machine: The Power of Human*

Intuition and Expertise in the Era of the Computer. New York: The Free Press.

Flyvberg, B. 2001. *Making Social Science Matter: Why Social Inquiry Fails and How We It Can Succeed Again*. Cambridge: Cambridge University Press.

Fritz, S. C., D. R. Engstrom, and B. J. Haskell. 1994. 'Little Ice Age' aridity in the North American Great Plains: a high-resolution reconstruction of salinity fluctuations from Devils Lake, North Dakota, USA. *The Holocene* 4, no. 1: 69-73.

Garcia, G. S. C. 2006. The mother - child nexus. Knowledge and valuation of wild food plants in Wayanad, Western Ghats, India. *Journal of Ethnobiology and Ethnomedicine* 2, no. 1: 39. doi:10.1186/1746-4269-2-39.

Gilmore, M. 1991. *Uses of plants by the Indians of the Missouri River region*. Lincoln, NE: University of Nebraska Press.

Grant, B. R., and P. R. Grant. 1993. Evolution of Darwin's Finches Caused by a Rare Climatic Event. *Proceedings: Biological Sciences* 251, no. 1331 (February 22): 111-117.

Greenwood, D., and M. Levin. 1998. *Introduction to action research : social research for social change*. Thousand Oaks: Sage Publications.

Hämäläinen, P. 2003. The Rise and Fall of Plains Indian Horse Cultures. *The Journal of American History* 90, no. 3: 833-862.

Harmon, D. 2002. *In light of our differences : how diversity in nature and culture makes us human*. Washington D.C.: Smithsonian Institution Press.

Harnack, L., M. Story, and B. Rock. 1999. Diet and Physical Activity Patterns of Lakota Indian Adults. *Journal of the American Dietetic Association* 99, no. 7: 829-835. doi:10.1016/S0002-8223(99)00197-2.

Ingold, T. 2000. *The perception of the environment: essays on livelihood, dwelling and skill* Routledge. London.

- IPCC. 2007. *Climate Change 2007: Impacts, adaptation and vulnerability : contribution of Working Group II to the fourth assessment report of the Intergovernmental Panel on Climate Change*. Ed. M Parry. Cambridge: Cambridge University Press.
- Jackson, M. Y. 1994. Diet, culture, and diabetes. In *Diabetes as a disease of civilization: the impact of culture change on indigenous peoples*, ed. J. R. Joe and R. S. Young. Studies in the Social Sciences 50. New York: de Gruyter Mouton.
- Johnson, J. R., and G. E. Larson. 2007. *Grassland Plants of South Dakota and the northern Great Plains*. Brookings, SD: South Dakota State University, College of Agriculture & Biological Sciences.
- Jones, L. 1998. *Culturally Important Plants of the Lakota along the Missouri River, Pre-Oahe Dam*. Fort Yates, ND: Standing Rock Tribal Historic Preservation Office.
- Joyce, L. A., D. Ojima, G. A. Seielstad, R. Harris, and J. Lockett. 2000. Potential Consequences of Climate Variability and Change for the Great Plains. In *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change*. Washington, DC: US Global Change Research Program.
<http://www.usgcrp.gov/usgcrp/Library/nationalassessment/overviewgreatplains.htm>.
- Kantor, L. 1998. *A Dietary Assessment of the U.S. Food Supply: Comparing Per Capita Food Consumption with Food Guide Pyramid Serving Recommendations*. Agricultural Economic Report. Washington, D.C.: Food and Rural Economics Division, Economic Research Service, U. S. Department of Agriculture.
- Kassam, K-A. 2009a. *Biocultural Diversity and Indigenous Ways of Knowing: Human Ecology in the Arctic*. Calgary: University of Calgary Press.
- . 2009b. Viewing Change Through the Prism of Indigenous Human Ecology: Findings from the Afghan and Tajik Pamirs. *Human Ecology* 37, no. 6: 677-690.
- . 2010. Pluralism, Resilience, and the Ecology of Survival: Case Studies from

the Pamir Mountains of Afghanistan. *Ecology and Society* 15, no. 2: 8.

Kassam, K-A., and Soaring Eagle Friendship Centre. 2001. *So that our voices are heard : forest use and changing gender roles of Dene women in Hay River, Northwest Territories*. Calgary: CIDA-Shastri Partnership Programme.

Kassam, K-A., and The Wainwright Traditional Council. 2001. *Passing on the Knowledge: Mapping Human Ecology in Wainwright, Alaska*. Calgary: Arctic Institute of North America.

Kershner, B. 2008. *National Wildlife Federation field guide to trees of North America*. New York: Sterling Pub. Co.

Kimmerer, R. 2000. Native Knowledge for Native Ecosystems. *Journal of Forestry* 98 (August 1): 4-9.

Kindscher, K. 1987. *Edible wild plants of the prairie : an ethnobotanical guide*. Lawrence, KS: University Press of Kansas.

Kraft, S. 1990. Recent Changes in the Ethnobotany of Standing Rock Indian Reservation. Master's thesis, University of North Dakota.

Kuhnlein, H. V., B. Erasmus, and D. Spigelski. 2009. *Indigenous Peoples' Food Systems: The many dimensions of culture, diversity, and environment for nutrition and health*. Rome: Food and Agriculture Organization of the United Nations.

LaDuke, W. 2005. *Recovering the sacred: the power of naming and claiming*. Cambridge, MA: South End Press.

Lawson, M. L. 1994. *Dammed Indians: The Pick-Sloan Plan and the Missouri River Sioux, 1944-1980*. Norman, OK: University of Oklahoma Press.

Loh, J., and D. Harmon. 2005. A global index of biocultural diversity. *Ecological Indicators* 5, no. 3 (August): 231-241. doi:10.1016/j.ecolind.2005.02.005.

Lozada, M., A. Ladio, and M. Weigandt. 2006. Cultural Transmission of

Ethnobotanical Knowledge in a Rural Community of Northwestern Patagonia, Argentina. *Economic Botany* 60, no. 4: 374-385. doi:10.1663/0013-0001(2006)60[374:CTOEKI]2.0.CO;2.

Maffi, L. 2005. Linguistic, Cultural, and Biological Diversity. *Annual Review of Anthropology* 34: 599.

Maxwell, S. 1996. Food security: a post-modern perspective. *Food Policy* 21, no. 2 (May): 155-170.

McGregor, D. 2004. Coming Full Circle: Indigenous Knowledge, Environment, and Our Future. *American Indian Quarterly* 28, no. 3/4: 385-410.

McNaughton, S. J. 1983. Compensatory plant growth as a response to herbivory. *Oikos* 40: 329-336.

Menezes, F. 2001. Food Sovereignty: A vital requirement for food security in the context of globalization. *Development* 44, no. 4: 29-33.

Moller, H., F. Berkes, P. O. B Lyver, and M. Kislalioglu. 2004. Combining science and traditional ecological knowledge: monitoring populations for co-management. *Ecology and Society* 9, no. 3: 2.

Nabhan, G. P., P. Pynes, and T. Joe. 2002. Safeguarding species, languages, and cultures in the time of diversity loss: from the Colorado Plateau to global hotspots. *Annals of the Missouri Botanical Garden*: 164-175.

NFE [Standing Rock Nutrition for the Elderly and Caregiver Support]. 2007. *Needs Assessment 2007*. Fort Yates, ND: Standing Rock Tribal Health Department.

Noss, R. F. 1990. Indicators for Monitoring Biodiversity: A Hierarchical Approach. *Conservation Biology* 4, no. 4 (December): 355-364.

Nyong, A., F. Adesina, and B. Osman Elasha. 2007. The value of indigenous knowledge in climate change mitigation and adaptation strategies in the African Sahel. *Mitigation and Adaptation Strategies for Global Change* 12, no. 5 (June 1): 787-797.

- Ohmagari, K., and F. Berkes. 1997. Transmission of Indigenous Knowledge and Bush Skills Among the Western James Bay Cree Women of Subarctic Canada. *Human Ecology* 25, no. 2: 197-222.
- Park, R. 1952. *Human communities the city and human ecology*. Glencoe Ill.: Free Press.
- Pelto, P. J., and G. H. Pelto. 1975. Intra-Cultural Diversity: Some Theoretical Issues. *American Ethnologist* 2, no. 1 (February): 1-18.
- Pevar, S. 2002. *The rights of Indians and tribes: the authoritative ACLU guide to Indian and tribal rights*. 3rd ed. Carbondale: Southern Illinois University Press.
- Pfaller, L. L. 1992. *James McLaughlin: The man with an Indian heart*. Richardton, ND: Assumption Abbey.
- Phillips, W. 2003. *Plants of the Lewis and Clark Expedition*. Missoula, MO: Mountain Press Publishing Co.
- Pickering, K. 2004. Decolonizing Time Regimes: Lakota Conceptions of Work, Economy, and Society. *American Anthropologist* 106, no. 1: 85-97.
- Pilgrim, S., C. Samson, and J. Pretty. 2009. Rebuilding lost connections: How revitalisation projects contribute to cultural continuity and improve the environment. iCES Occasional Paper 2009-01. <https://www.essex.ac.uk/ces/esu/occasionalpapers>.
- Pollan, M. 2008. *In defense of food: an eater's manifesto*. New York: Penguin Press.
- Powers, W. K., and M. N. Powers. 1990. *Sacred foods of the Lakota*. Kendall Park, NJ: Lakota Books.
- Pretty, J., and S. D. Vodouhe. 1997. Using rapid or participatory rural appraisal. In *Improving agricultural extension: A reference manual*, ed. B. E. Swanson, R. P. Bentz, and A. J. Sofranko. Rome: Food and Agriculture Organization of the United Nations. www.fao.org/docrep/w5830e/w5830e00.htm#Contents.

- Reyes-Garcia, V., J. Broesch, L. Calvet-Mir, N. Fuentes-Peláez, T. W McDade, S. Parsa, S. Tanner, et al. 2009. Cultural transmission of ethnobotanical knowledge and skills: an empirical analysis from an Amerindian society. *Evolution and Human Behavior* 30, no. 4: 274–285.
- Robinson, M. P., and K-A. Kassam. 1998. *Sami potatoes: living with reindeer and perestroika*. Bayeux Arts Inc.
- Ruddle, K., and R. Chesterfield. 1977. *Education for traditional food procurement in the Orinoco delta*. Berkley, CA: University of California Press.
- Ryle, G. 1984. *The Concept of Mind*. Chicago: University of Chicago Press.
- Salmón, E. 2000. Kincentric ecology: indigenous perceptions of the human-nature relationship. *Ecological Applications* 10, no. 5: 1327-1332.
- Shaw, D. J. 2007. *World food security: a history since 1945*. New York: Palgrave Macmillan.
- Silliman, S. 2009. Change and continuity, practice and memory: Native American persistence in colonial New England. *American Antiquity* 74, no. 2: 211–30.
- Smith, R. A. 1981. *Moon of Popping Trees*. First Edition. Bison Books.
- Smits, D. D. 1994. The Frontier Army and the Destruction of the Buffalo: 1865-1883. *The Western Historical Quarterly* 25, no. 3: 313-338.
- Standing Bear, L. 1975. *My people, the Sioux*. Lincoln, NE: University of Nebraska Press.
- Stoecker, R. 2005. *Research Methods for Community Change: A Project-Based Approach*. Thousand Oaks: Sage Publications.
- Turner, N., and H. Clifton. 2009. "It's so different today": Climate change and indigenous lifeways in British Columbia, Canada. *Global Environmental Change* 19, no. 2 (May): 180-190. doi:10.1016/j.gloenvcha.2009.01.005.

- U.S. Census Bureau, Population Estimates Program. 2008. 2008 Population Estimates for Sioux County, North Dakota, and Corson County, South Dakota: Race (Alone or in combination with one or more other races). *American Fact Finder*. <http://factfinder.census.gov>.
- Ullrich, J., ed. 2008. *New Lakota Dictionary: Lakǰótiyapi-English, English-Lakǰótiyapi & incorporating the Dakota dialects of Yankton-Yanktonai & Santee-Sisseton*. Bloomington, IN: Lakota Language Consortium.
- Via Campesina. 1996. Food Sovereignty: A Future without Hunger. In . Rome, November 11.
www.voiceoftheturtle.org/.../1996%20Declaration%20of%20Food%20Sovereignty.pdf.
- Walker, J. 1980. *Lakota belief and ritual*. Ed. R. J. DeMallie and E. Jahner. Lincoln, NE: University of Nebraska Press.
- Wells, H. F., and J. C. Buzby. 2008. *Dietary Assessment of Major Trends in U.S. Food Consumption, 1970-2005*. Economic Information Bulletin. Washington, D.C.: U.S. Department of Agriculture, Economic Research Service.
- Windfuhr, M., and J. Jonsén. 2005. *Food Sovereignty: towards democracy in localized food systems*. Rugby, Warwickshire, UK: Intermediate Technology Development Group Ltd.