# CONCEPTS AND MECHANISMS OF CULTURAL ECOSYSTEM SERVICES IN THE MONO-KOUFFO, REPUBLIC OF BENIN AND MICHIGAN, USA: TOWARD AN INTEGRATED MODEL.

By

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ABSTRACT

CONCEPTS AND MECHANISMS OF CULTURAL ECOSYSTEM SERVICES IN THE MONO-KOUFFO, REPUBLIC OF BENIN AND MICHIGAN, USA: TOWARD AN INTEGRATED MODEL.

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Ecosystem services science theory highlights the interdependency of people and nature. Ecosystem services (ES) science theory posits that the biophysical ecosystem generates ecosystem services, which are benefits that improve human well-being, identified by beneficiaries. Human action, influenced by human well-being, in turn affects the biophysical system. Social-ecological systems research describes the complex and dynamic feedbacks between the social and ecological components of a given system. ES science is one way to explore social-ecological systems. Placing ES science within a social-ecological system allows for questions about the social and ecological drivers that affect ecosystem services provision.

This dissertation research explores the relative contribution of social and ecological drivers on the provision of cultural ecosystem services (CES) of spirituality, cultural heritage, and cultural identity, in the Mono-Kouffo, Republic of Benin and in Michigan, USA, by characterizing CES and developing conceptual causal loop diagrams (CLDs). Results demonstrate that CES, especially spirituality, heritage, and identity, are strongly overlapping and rely upon social institutions for people to develop the capacity to identify these benefits from nature. Further, results show these particular CES contribute toward a eudaimonic sense of well-being, or of living a good life, as well as feeling well, like being happy and relaxed. A third major finding is that while CES are strongly associated with pro-environmental and pro-social

behaviors, the size and ecological quality of the space where CES are identified may likely be relatively small.

The results of this research contribute to conceptual development of what cultural ecosystem services are, especially spirituality, cultural heritage, and cultural identity, as well as their mechanisms of provision. Results from both the Republic of Benin and the USA illuminate the social-ecological dynamics of systems where people identify ecosystem services by articulating their actions in and about the woods and how those actions facilitate benefits to their well-being via the woods. The two case studies are used to build causal loop diagrams that are compared and contrasted to contribute knowledge of CES mechanisms and to identify relevant areas of further research.

This dissertation research demonstrates the utility of the connectedness to nature scale in incorporating CES in ES assessments and evaluations, and considers the important time-dependent relationship between people's knowledge and skills, the capacity to identify benefits from nature, and the size and quality of the wooded space. The time-dependent relationship emphasizes ways in which people affect nature in a positive way. These points should be further pursued in research and incorporated into policies and practices that affect natural resources and human well-being based on decisions made through ES science.

This dissertation is dedicated to all those who seek peace and healthy connections.
To my family: Jimmy, Leif, and Dean, and whoever else is to come.
To those who told me to write, especially Uncle Jim Stewart and Uncle Jim Stuart;
and Grandpa Lawrence B. Kraus

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# 1. Introduction

Ecosystem services science is about assessing human impact on global resources, and accounting for the myriad ways ecosystem structures and functions provide benefits to human well-being. Ecosystem services (ES) are benefits people identify from the ecosystem that improve their well-being; ecosystem functions process energy and matter through the ecosystem and exist regardless of how people relate to them (Costanza et al., 2017). Species richness and structure affect processing of energy and matter (Cadotte et al. 2011; Gao et al. 2014).

The framework utilized in ES science views ecosystems through the lens of the services they provide to society, how these ecosystem services affect human well-being, and how human actions affect the ecosystems (see Figure 1; Carpenter et al., 2009; Liu et al., 2007).

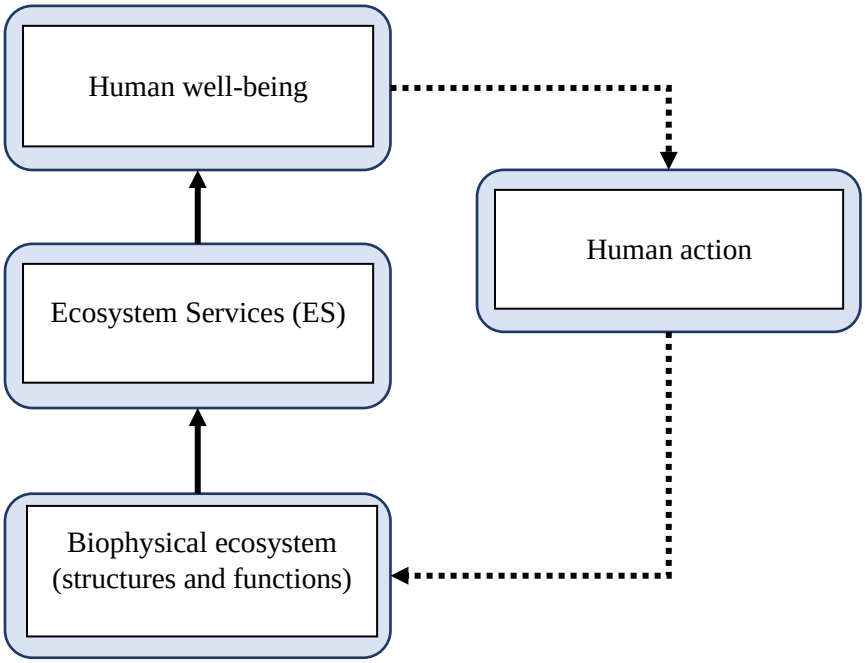


*Figure 1. Conceptual diagram of the ES science paradigm with a feedback loop. People's perceptions of their well-being influence the actions people take that affect the biophysical system from which people benefit, improving their well-being.*

This unidirectional flow insufficiently frames human-nature interactions (Bennett, 2017) with a reconceptualization of human dependency on nature, that receives strong critiques (Costanza et al., 2017; Schröter et al., 2014). ES science is charged with proffering an anthropocentric frame for human-nature relationships, effectively de-valuing the traditional conservation approach that every species has intrinsic value (Fisher & Brown, 2014; Schröter et al., 2014). The focus of ES science on how nature benefits human well-being enables opportunities to ascribe only monetary values to nature, potentially increasing human consumption with nature as a 'green box' to buy from (Fisher & Brown, 2014; Schröter et al., 2014). Finally, ES science is also perceived as skipping over the role of biological diversity in the biophysical structures and functions from which the theory claims services are derived (Bennett, 2017; Fisher & Brown, 2014; Schröter et al., 2014). ES science conceptual foundations have potential to compromise non-utilitarian arguments for nature conservation, and are generally used to broaden the constituency of conservation agendas (Fisher & Brown, 2014).

The above critiques show weaknesses in the framework that can be improved with research. Although ES science emphasizes the human dependency on nature, this idea does not preclude intrinsic values; disciplines such as anthropology and religious studies demonstrate that people value the basic existence of nature, relevant to ES science as cultural ES (CES) (Fisher & Brown, 2014; Schröter et al., 2014). Specific species and plants serve as totems and taboos in many religions worldwide (Kokou & Sokpon, 2006; Pungetti, Oviedo, & Hooke, 2012). In addition, non-monetary metrics for valuing nature are essential to ES science, especially within the CES category (Costanza et al., 2017; Daniel et al., 2012; Satz et al., 2013). Furthermore, the specific role of species in ES science is most promising in CES, such as recreational birdwatching or fishing (Harrison et al., 2014). Individual species are integral in sustaining

ecosystem function over time and through disturbances, concepts under study in functional ecology and expressed in theories like the insurance hypothesis (Lefcheck et al., 2015; Loreau, 2000, 2004; Naeem & Wright, 2003; Pillar et al., 2013; Turnbull, Isbell, Purves, Loreau, & Hector, 2016).

Concepts of ES science inherently link social and ecological systems (Costanza et al., 2017; Darvill & Lindo, 2016). Because ecosystem services benefits must be identified by their beneficiaries (Costanza et al., 2017; Mouchet et al., 2014), they do not exist without people; furthermore, people modify ecosystems to affect the production of some ecosystem services (Bennett, 2017; Bennett, Peterson, & Gordon, 2009; Comberti, Thornton, Wyllie de Echeverria, & Patterson, 2015). Pursuing ES science theory as a social-ecological system improves the capacity to understand mechanisms between people and nature and human well-being. With this understanding, ES science may be improved with application of social-ecological systems thinking (Figure 2, below; Bennett et al. 2009).

There is a reinforcing loop among the components in Figure 2, such that an increase in learning of benefits increases ES and therefore well-being; simultaneously, increases in species, structure and function increase ES and consequently human well-being. Conversely, decreases in learning of benefits and species, structure and function cause a decrease in ES and human well-being.

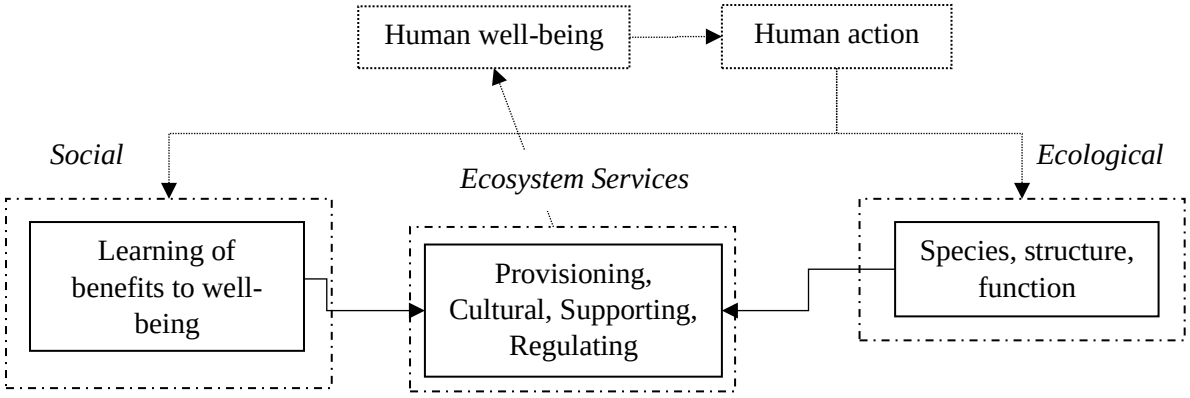


*Figure 2. Causal loop conceptual diagram of ES science within a social-ecological system, wherein the social dynamics are hypothesized to form ES along with ecological.*

Social-ecological systems are a set of ecological and social subsystems linked through feedback mechanisms (Liu et al., 2007; Ostrom, 2009). The dynamics and complexities in social-ecological systems are driven by feedbacks between resources, actors, and institutions at and across multiple scales (Liu et al., 2007; Ostrom, 2009; Schlüter et al., 2012). These complex adaptive systems are characterized by non-linear dynamics, potential for regime shifts, self-organization, cross-scale interactions, and surprise (Bennett, 2017; Liu et al., 2007; Ostrom, 2009; Schlüter et al., 2012).

To improve predictability and accounting of ecosystem services, ES science needs more understanding about the relative roles of and interplay between the social and ecological components in the social-ecological systems producing ES (Bennett, 2017; Bennett et al., 2015; Costanza et al., 2017; Reyers et al., 2013). These two system components need to be better integrated to suggest more effective and relevant policies about natural resource management (Reyers et al., 2013; Rissman & Gillon, 2017). There are simultaneous calls for more and improved empirical data for both the social (Bennett et al. 2009; Bennett 2017) and ecological (Rissman & Gillon, 2017) domains in S-E systems.

Frameworks of ES science build on principles of sustainable development and goals of enhancing ecosystem function and human well-being. There is a need for understanding the ecological foundation of ES, how those ES impact human well-being, and how to govern those benefits (Bennett et al. 2015, Farhad et al. 2015). There are differences in the roles and balances of ecological and sociological components in the supply of services. This leads to contrasting emergent properties or unexpected effects on long-term sustainability of service supply (Bennett et al., 2015). ES science research would benefit with more information on preferences and access of ES across stakeholders, how ES affect well-being (Bennett et al., 2015), and more dynamic, integrated modeling (Costanza et al., 2017).

CES are most commonly understood as non-material benefits of an ecosystem (Chan et al. 2012; Daniel et al. 2012; Satz et al. 2013; Gould et al. 2014). Recent clarification of CES concepts and definitions more accurately account for the complexity of 'culture' and incorporate different world views (Chan et al., 2016; Fish, Church, & Winter, 2016). Cultural ES are important because the value people place on them cannot likely be replaced with technological advances (Hernández-Morcillo et al. 2013; Daniel et al. 2012; Tengberg et al. 2012), such as water filtration systems may replace wetlands (Brauman, Daily, Duarte, & Mooney, 2007), and are argued to be essential to human well-being (Satz et al., 2013). Because ES benefits must be identified by the beneficiaries (Costanza et al., 2017; Mouchet et al., 2014), understanding social constructs, like how people perceive their relationship with nature, is inherent to this research, especially for the case of CES (Daniel et al., 2012). CES as identified by beneficiaries depend upon the cultural context, and these services must be connected to the biophysical system in some way (Daniel et al., 2012).

Studies exploring the characteristics of CES are increasing, expanding knowledge of the non-material benefits people identify from biophysical spaces (Bieling, 2014; Gould et al., 2014), especially from 2012-2016 (Cheng, Van Damme, Li, & Uyttenhove, 2019). In addition to the categories of CES presented in the Millennium Ecosystem Assessment (MA), more categories are being developed to explore benefits people identify (Gould & Lincoln, 2017). CES have been connected to the biophysical system in previous research via methods like participatory mapping (Plieninger, Dijks, Oteros-Rozas, & Bieling, 2013), analysis of cultural heritage values (Tengberg et al., 2012), and identifying discernible marks on the landscape such as benches (Bieling & Plieninger, 2013). However, more research characterizing CES, especially beyond recreation and tourism, and their connections to the ecosystem is needed to effectively incorporate non-material benefits from nature into ES science-based decision making (Blicharska et al., 2017; Fish et al., 2016; Milcu, Hanspach, Abson, & Fischer, 2013; Satz et al., 2013) and to improve the classification system of CES, decreasing ambiguity of the CES categories (Cheng et al., 2019).

Research presented here explores concepts and provision of CES from two very different case studies through the ES science framework. The first case is from the Republic of Benin where stakeholders' perceptions of the importance of wooded shrines are understood as cultural ecosystem services. The second case is from the United States, using qualitative methods to develop CES concepts and mechanisms of provision from the point of view of forest stakeholders. Ultimately, results from these two case studies are developed into causal loop diagrams to engage system thinking for advancing science of CES.

For this research, 'ecosystem services' are defined as ecosystem functions from which humans can derive benefits, often through additional inputs of other forms of capital (Bennett,

2017; Costanza et al., 2017). Ecosystem functions provide many ecosystem services, but beneficiaries identify which services are contributing to their well-being (Costanza et al., 2017; Mouchet et al., 2014). In contrast, ecosystem functions transfer energy and matter through biotic and abiotic relationships in an ecosystem. These interactions among organisms and their ecosystems underpin the ability of an ecosystem to provide ecosystem services (Bennett, 2017; Costanza et al., 2017). Dissertation research presented here is designed to explore how knowledge of cultural ES can re-shape the idea of ecosystem services in general from the ES theoretical assumption as function-and-structure based, to social-ecological based. If these ideas are supported through research, the definition of ecosystem services should begin to include benefits derived from nature as determined through social norms, values, and institutions.

## 1.1 Research Questions

The overarching interest motivating this research is how people affect nature in a positive way; this question is approached through the ES science framework and the provision of cultural ES through social-ecological systems. Dissertation research addresses these broad questions:

1. How are the cultural ecosystem services of cultural heritage, cultural identity, and spirituality expressed by those benefitting in such ways?
2. How do social and ecological components contribute to CES provision?
3. How can mechanisms of CES provision be understood through social-ecological systems thinking?

Qualitative methods of interviews were chosen because research on CES must include social constructs that enable people to identify how their well-being is benefitted (Daniel et al., 2012); modeling is a means to explicitly represent people's perceptions of the world (van den Belt, 2004). Modeling system thinking will be used to analyze causal loop diagrams for CES

provision and natural resource conservation. ES science is intended to be user-focused, and appropriate applications of ES come from co-production of knowledge with stakeholders, sharing and making explicit mental models of benefits from natural systems (Bennett, 2017).

# 2. Exploring contributions of wooded shrines in the Republic of Benin to Ecosystem Service Science and Cultural Ecosystem Services.

## 2.1 Abstract

Wooded shrines in the Republic of Benin provide unique cases to study human-nature interactions, especially within an Ecosystem Services (ES) Science framework. ES Science generally posits that nature provides benefits to human well-being. Cultural ecosystem services are non-material benefits from nature including themes like spirituality, cultural heritage, and cultural identity. This qualitative, exploratory study about ES benefits from wooded shrines uses semi-structured interviews from 2014 and 2015 with people in Benin. Through thematic coding, we found that people expressed benefits of wooded shrines via Vodoun as a religion, as heritage, and as identity. Wooded shrines in Benin are sites where both material and non-material ES intersect and interact, including spirituality, medicines, cultural heritage, cultural identity, and micro-climate regulation. We also found aspects of governance integral to people's capacity to identify and receive benefits from wooded shrines. Applying the ES Science framework to wooded shrines in the Republic of Benin emphasizes the importance of understanding the dynamics of 'culture' in how people identify and benefit from nature.

Keywords: Vodoun, spirituality, cultural heritage, cultural identity, healing, governance

## 2.2 Introduction

Ecosystem service (ES) science theory emphasizes the interdependency of people and nature, positing that biophysical ecosystems generate services, which are benefits that improve human well-being as identified by beneficiaries (Costanza et al., 2017). Ecosystem service science is used to assess human impact on global resources, and account for the myriad ways ecosystem structures and functions provide benefits to human well-being (Bennett, 2017). Using

an ES framework may lead to improved decision making and contribute to planning for, and forecasting changes in, ecosystems and management to sustain benefits for human well-being (Bennett, 2017; Fisher & Brown, 2014).

Cultural ecosystem services (CES) are understood as non-material benefits of an ecosystem (Chan et al. 2012; Daniel et al. 2012; Satz et al. 2013; Gould et al. 2014). Cultural ES are argued to be essential to human well-being (Satz et al., 2013), and are important because the value people place on them cannot likely be replaced with technological advances (Hernández-Morcillo et al. 2013; Daniel et al. 2012; Tengberg et al. 2012); whereas clean drinking water services supplied from natural wetlands might be replaced by water from treatment plants (Brauman et al., 2007). More research characterizing CES, especially beyond recreation and tourism, and their connections to the ecosystem is needed to effectively incorporate non-material benefits from nature into ES science-based decision making (Blicharska et al., 2017; Fish et al., 2016; Milcu et al., 2013; Satz et al., 2013), to improve the classification system of CES, and decrease ambiguity of CES categories (Cheng et al., 2019).

Wooded shrines are sites for worship in Vodoun religious practice. Vodoun is a faith system that includes a creator God, many divinities, and ancestors. These beings are believed to reside in natural objects such as rocks, water, and trees and so are explicitly connected to ecosystem structures. A Vodoun wooded shrine thus serves as a residence for spiritual beings (Fournier, 2011; Juhé-Beaulaton, 2010), and is where people perform rites, rituals, and/or ceremonies to give thanks, ask for blessings, and make requests of the divinities. Wooded shrines are also known as sacred groves or forests; ‘wooded shrine’ is more accurate when considering the variability in area and species composition of these sites (Fournier, 2011).

Wooded shrines are typically small wooded sites found across the land. They harbor floral and faunal species not frequently found outside of these small woods, and are rich in biological diversity when compared to other forested, non-sacred sites (Nagel et al 2004; Kokou and Sokpon 2006; Kokou and Kokutse 2007; Ceperley et al 2010; Alohou et al 2017). Some specific vegetation is important at these sites for rituals, such as *Newbouldia laevis* leaves that are used for ritual purification, although much of the floristic composition varies from site to site (Juhé-Beaulaton & Roussel, 2002; Sanou, Devineau, & Fournier, 2013). Some tree species found throughout Benin and neighboring Togo are frequently venerated because they are admired for qualities people aspire to, such as the "strength and grandeur of the baobab (*Adansonia digitata*), … and the splendor of the iroko (*Milicia excelsa*) (Kokou and Sokpon 2006, p. 18)."

Wooded shrines are tightly connected to communities (Agbo and Sokpon 1998) as well as natural features. Typically, there is one of three types of connections between the community and the shrine: the founder of the village leaves the forest to the community; the forest was a refuge from conflict at some point; or the forest was a hunting reserve for the community founders (Agbo and Sokpon 1998). Wooded shrines may be classified as isolated sacred trees, hunting reserves, forest burial grounds, forests inhabited by ancestors, gods, or genies, or forests used by 'secret societies' for initiation rites (Kokou and Sokpon 2006).

People customarily responsible for the sacred site include the Vodoun religious leader and land distributors, as well as other customary leaders and council members (Agbo and Sokpon 1998). *Vodoun* religious leaders have been trained in the rites, rituals, languages, and practices specific to that site and the divinities perceived as residing therein. Transferring such power and responsibility happens generationally, and to those selected by the leaders and accepted ritually by the divinities within the site (Agbo and Sokpon 1998). Previous authors of

research at wooded shrines state that the greatest threat to wooded shrines is a decrease in faith and belief in traditional religion and respect for traditional authority (Alohou, Gbemavo, Mensah, & Ouinsavi, 2017; Kokou & Sokpon, 2006).

Previous research on wooded shrines in Benin studied the differences between sacred and non-sacred sites with forest stand structure and biological diversity (Ceperley, Montagnini, & Natta, 2010). They found trees with higher basal area and higher species diversity in places nearer to sacred sites. These same authors reported people identifying cultural and spiritual importance at sacred sites, and overall recommended sacred sites to be part of a larger conservation effort in the Republic of Benin. Results from additional research from the southeast of Benin found similar benefits from wooded shrines: spiritual, cultural, medicinal, regulating, and supporting services (Alohou, Gbemavo, Ouinsavi, & Sokpon, 2016).

Religion and spirituality (R/S) are overlapping constructs found to have strong mental and psychological benefits (McClintock, Lau, & Miller, 2016). R/S are about how people relate to the "transcendent, sacred, and ultimate dimensions of existence (McClintock et al., 2016, p. 2)." R/S are categorized as sub-themes about wonder and awe within the cultural ES category in Ecosystem Service science (Millennium Ecosystem Assessment, 2005). 'Culture' is a complex concept in and of itself (Fish et al., 2016; Pröpper & Haupts, 2014; Ryfield, Cabana, Brannigan, & Crowe, 2019; Winthrop, 2014). Research on spirituality, cultural heritage, and cultural identity has lagged because of the perceived difficulty in treating such non-material benefits (Cheng et al., 2019; Satz et al., 2013). However, previous research in these areas successfully articulated non-material benefits and contributed to understanding of CES with qualitative empirical research such as in Hawai'i, USA (Gould et al., 2014; Gould, Krymkowski, & Ardoin, 2018; Gould & Lincoln, 2017) and the Swabian Alb, Germany (Bieling, 2014).

This case study of wooded shrines in the south west of the Republic of Benin seeks to deepen the understanding of cultural ES. Unlike previous studies in wooded shrines in Benin, we use qualitative data that brings more description of these benefits from the voices of the beneficiaries. This study contributes to the conceptual development of ecosystem services by building upon previous wooded-shrine-specific research with two research objectives: 1) to understand which ecosystem services, and especially cultural ES, were relevant to people connected and/or knowledgeable about wooded shrines; and 2) to identify social and biophysical factors contributing to these services.

## 2.3 Methods

### 2.3.1 Study Site

The Republic of Benin is located on the sub-Saharan west coast of Africa about ten degrees north of the equator. Benin's land borders are Togo to the west, Burkina Faso in the north-west, Niger in the north-east, and Nigeria to the east; the Atlantic Ocean is the southernmost border. The southwest trade winds are nearly parallel with the coast at this point in the Bight of Benin (Booth 1958, p. 60); the confluence of wind and water currents creates a unique climatic condition called the Dahomey Gap, present for about 4000 years (Salzmann & Hoelzmann, 2005).

In a national inventory, Agbo and Sokpon (1998) documented 2,940 wooded shrines throughout the country of Benin, covering a collective total of 183.6 $km^2$, less than 2% of the total land area. Nearly 70% of the sites in this inventory were less than one hectare in area. The nation overall has about 70,000 $km^2$ of some form of forest cover, or about 60% of the total land area. Forest cover types include tree plantations, small woodlands, forest patches, parklands, and savannah bush (UNDP PIFSAP-B Project).

### 2.3.2 Data collection

We chose a qualitative research approach to increase conceptualization of CES. Semi-structured interviews were conducted mainly from the Athiémé *commune* in the Mono region of Benin (see Figure 3, below). Questions were open-ended to allow for oral history-type narratives when possible. Interviewees included religious and non-religious leadership of communities and relevant organizations, as well as stakeholders of wooded shrines who did not hold leadership positions connected to the shrines, such as regional foresters and university professors. Responses were recorded in a field notebook, then digitized and summarized with field observations at the end of each day. All French-English translations were completed by the corresponding author; all local language (*Gengbé, Fongbé, Kotafongbé, Adjagbé,* and others)-French translations were completed in the field by Beninese research colleagues.

For non-religious leadership stakeholders, the local elected official at the village or neighborhood level was requested to summon men's and women's groups of any type, such as farming cooperatives or tailors and seamstresses. These groups were comprised of people who had self-organized previous to the research to achieve a common goal or share knowledge and/or labor. This type of organizing is common in Beninese communities. Groups of men and women were either interviewed separately or together, but in either case women and men were directly asked the same set of questions, specifically addressing both genders to best include all perspectives. The Vodoun religious leaders of the sites were interviewed separately, thus these non-religious leadership stakeholder groups provided new responses to the research.

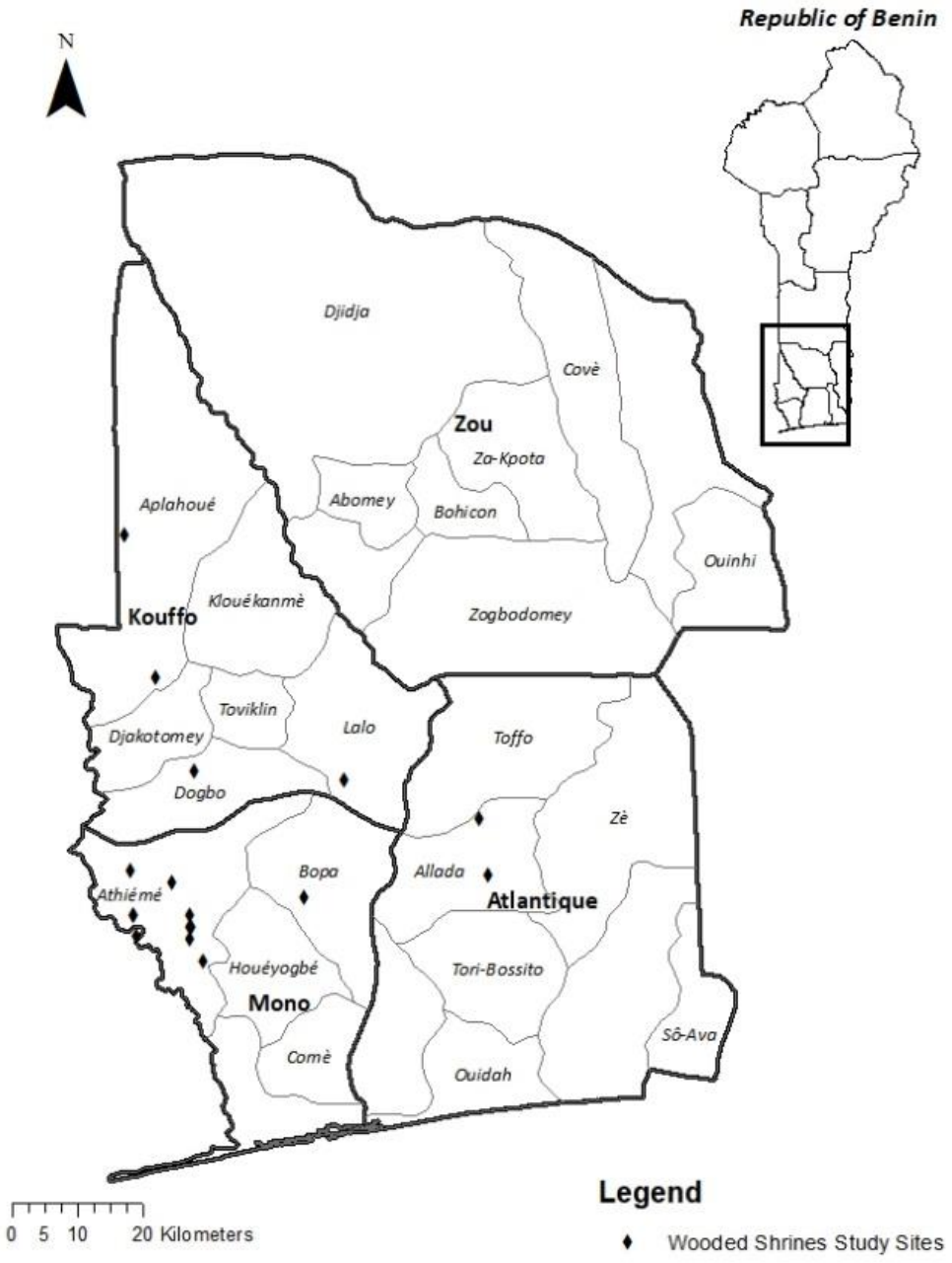


*Figure 3. Map of study area in the Republic of Benin. Created by author.*

### 2.3.3 Data description

A total of 33 people participated in interviews about the importance of wooded shrines from 2014-2015. These interviews occurred in groups ranging in number from 2-10 people and included some individuals. Table 1 summarizes interviewees in this study.

*Table 1. Interviewee category descriptions. *DGFRN: Direction Générale des Forêts et des Ressources Naturelles, or the National Office for Forests and Natural Resources.*

| Title | Description/example | Total of interviewees |
|---|---|---|
| *Bokono* | Vodoun religious leader, specially trained and caretaker of wooded shrine | 52% |
| Key informant | Non-religious leadership; DGFRN*, university professor, or project leader; knowledgeable of wooded shrines | 27% |
| Community group member | Non-religious leadership; resident of a community with a wooded shrine | 21% |

Vodoun religious leadership, or *bokono* in Fongbé, have been trained on the esoteric languages and practices of rites and rituals; that is, languages used exclusively for Vodoun-related activities. *Bokono* interviewed are responsible for at least one wooded shrine included in this study. Key informants and community members may engage with the Vodoun religion, but do not actively claim *bokono* status. Male and female community members reside in the same community as *bokono* interviewed, and were interviewed separately from the *bokono*. A key informant was interviewed because of their knowledge and familiarity with wooded shrines at a regional or national level. Key informants include representatives of the National Division of Forests and Natural Resources (DGFRN), university professors, and United Nations

representatives who worked with a United Nations Development Program (UNDP) project concerning wooded shrines in Benin.

Responses were coded using NVivo 12 Pro. A sample of transcripts was coded by a team of social science researchers to check consistency of themes and interpretation. This inter-rater reliability test produced an average agreement of 78%, demonstrating strong agreement and consistency amongst thematic codes (LeBreton & Senter, 2008). Any discrepancies were resolved and codes were further clarified.

## 2.4 Results

Wooded shrine stakeholder perspectives were grouped into four broad themes: wooded shrine common knowledge, ecosystem service benefits, governance, and changes in the biophysical system (Table 2). To maintain anonymity, we identify respondents by their association with a shrine as in Table 1, using the first letter(s) of the site name; key informants are identified as such, followed by first letters of part of their name.

*Table 2. Themed coding categories of importance and benefits from wooded shrines according to stakeholders.*

| Themes | Subthemes |
|---|---|
| 2.4.1 Wooded shrine common knowledge | 1. Definition |
| | 2. Strength and capabilities |
| 2.4.2 Ecosystem Service benefits | 1. Spirituality |
| | 2. Provisioning |
| | 3. Cultural identity |
| | 4. Cultural heritage |
| | 5. Physio-spiritual healing |
| | 6. Women-specific healing |
| | 7. Spiritual-provisioning |
| | 8. Climate regulation |
| 2.4.3 Governance | 1. Ownership and Origins |
| | 2. Rules |
| 2.4.4 Changes in biophysical system | 1. Decrease natural resources |
| | 2. Maintain or increase natural resources |
| | 3. Tree species preferences |

### 2.4.1 Wooded shrine common knowledge

1. Definition of a wooded shrine

A wooded shrine is a place where people perceive Vodoun divinities reside. People rely on Vodoun divinities for help in their lives. Any given wooded shrine is a resource for a certain group of people, which could be a community, a family, or other distinct groups within or across groups of people, such as by gender or by which type of Vodoun is practiced (key informant P). These definitions were connected to an appreciation for why wooded shrines are important. *Bokono* emphasized the non-material importance of the shrines, while community groups spoke of material and non-material components.

> *[The importance of the wooded shrine is] protection: it provides treatments for illnesses; people can ask for water for agriculture; protects both the environment and the spirits; improves lives of people who come and ask the spirit for help* (*bokono,* wooded shrine Z).

*[Wooded shrines are important for] fagots of wood, healing remedies…* (community group, wooded shrine Z).

2. Strength and capabilities

Initial responses illuminated a type of respect toward these sites. For example, *bokono* of wooded shrine G stated, "This forest... has a strong reputation." Another *bokono* related that:

*We know one grove's fetish is very strong because of how quickly it has resolved problems for people requesting help* (*bokono,* wooded shrine A).

This respect for the wooded shrine was formed based on positive feedback from the divinity perceived to be residing within the shrine meeting people's needs:

*The strength of the vodoun is in the grove. There are many stories of the people the* fétiche *has healed, and the requests the* fétiche *has answered* (*bokono,* wooded shrine A).

Furthermore, respondents clarified that respect for the grove comes from the satisfaction of people's prayers, rather than the size or composition of the wooded shrine:

*No matter the size, the forest must be respected… All the restrictions must be obeyed regardless of the size of the forest* (community group, wooded shrine Ad.)

Common knowledge of wooded shrines on the part of stakeholders in Benin included how both material and non-material needs may be met, and how this capacity to meet people's needs encourages respect toward a wooded shrine.

### 2.4.2 Ecosystem services

In terms of ecosystem services, or benefits to people's well-being from nature as identified by beneficiaries, wooded shrines contributed materially and non-materially.

1. Spirituality

Wooded shrines are spaces where people can "…do rituals for sick people… [and]

ceremonies for the village, especially for spiritual protection (community group, wooded shrine De)." This spiritual protection benefits many people:

> *…the entire community against illnesses… As people are satisfied, prayers continue after the request has been made, [people] must return and give thanks"* (*bokono,* wooded shrine D).

One *bokono* shared a story of how important the wooded shrine is spiritually: as he labored in the shrine, questioning why he put such effort into protecting the space, he saw a panther walk through the woods. A panther is a very thrilling animal to see; in addition, the origin story of people in this area tells of a mystical coupling between a princess and a divinity disguised as a panther. The moment was very rewarding and encouraging for him in his work to protect the shrine (*bokono,* wooded shrine Ka).

People referred to the sites as places for "rituals, benedictions, and thanksgiving" (community group, wooded shrine Ka). For Vodoun in this region of Benin, wooded shrines contributed in non-material ways to people's lives as space for certain religious practices.

> *The importance of this forest is community protection, and that if a person were to ask for something they needed or desired, they would receive it if they had a ceremony, and would need to return to give to the vodoun whatever they had promised* (*bokono,* wooded shrine G).

Vodoun believers benefited from a wooded shrine because it is a place to ask for spiritual help.

2. Provisioning

Wooded shrines provided material benefits to people, notably in the form of medicinal plants commonly found there. Some treatments are said to need a ritual; other treatments require just the medicine:

> *As for treating illness that don't require a ritual, using materials from this grove is like going to a pharmacy, where some medicines cost different amounts. You also have to pay*

> *a bit for the prayer that goes with the leaves and roots and other materials that treat the person… Some leaves are in some groves, some leaves are in others, just like a pharmacy*. (*bokono,* wooded shrine S).

People benefitted in a real way from wooded shrines by having better medicines to improve their health. Pragmatic reasons for using materials from a wooded shrine reflected typical sanitation conditions in Benin.

> *The plants perform better as treatments because of the restrictions of entry… Outside the forest, people pee and spit wherever, so inside the forest the sanitary conditions are much improved, and the materials are cleaner, because people can't just spit and pee wherever like outside the forest* (community group, wooded shrine Ad).

Trees from a wooded shrine may be used for construction, canoes, and wood fuel, and fruits may be harvested.

> *Any downed wood in the forest is used for rituals and ceremonies. If any wood is sold, or anything is sold, the money goes to something for the grove* (*bokono,* wooded shrine S).
>
> *Anyone can benefit from the fruits of the grove, but you have to eat it or enjoy it there as you pick it. No profit from it.* (community group, wooded shrine Ka).

The rules and restrictions referred to in these quotes are presented in more detail in the Governance section, part 2.4.3.

3. Cultural identity

People spoke of cultural identity in terms of a sense of belonging, self-knowledge, and inter-relationships. Ideas of belonging and knowing who one is applies on individual and collective levels. People in Benin understand their relationships amongst themselves in the context of wooded shrines because they recognize names of wooded shrines and what certain titles imply. *Bokono* have a title associated with wooded shrines that indicates a social responsibility, social status, and respect. These titles are officially recognized by the government of Benin (see photo in Figure 4).


*Figure 4. An interviewee, on the right, displays certificates of recognition of his bokono title and status. Photo by author, used with permission granted by photo subjects.*

People of a certain community connected to a wooded shrine understand their collective relationship to the shrine. A key informant said that "everyone comes from a wooded shrine (R)," meaning that people are connected through the groups and communities associated with the sites. Furthermore, a different key informant stated that:

> *Recognition of environmental and cultural importance of sacred groves is by those outside of the immediate use/management of the sites. Those folks who recognize the importance are all in town* [not in a village] (key informant Ko).

For example, a son of a community who had moved away "recognized the importance of the sacred forest and encouraged the external support (*bokono,* wooded shrine T)*."* This external support came in the form of finances and tree planting resources. A *bokono* from a separate site reported similar events, where a son of the village who had moved away returned to encourage the community to participate in a tree planting project specific to wooded shrines (wooded shrine Ka).

4. Cultural heritage

The *bokono* title also indicates cultural heritage as memories from the past in that these titles may be passed along generationally. Multiple *bokono* reported their grandfathers had also claimed that title for the same site. This is an individual level of heritage.

Other respondents spoke of community-level heritage, as in this statement from a key informant:

> *[Wooded shrines are important sites of] cultural heritage, there are secrets, mysteries within them to protect… It's an ancestral heritage* (key informant, M).

*Bokono* related that the importance of the wooded shrines was the "maintenance of tradition (wooded shrine T)," and

*We have kept the forest because of respect for the ancestors, because it is a way of life* (wooded shrine S).

These responses demonstrate that wooded shrines are recognized as sites where people remember those who have come before them.

Inter-generational activity is a part of heritage of wooded shrines. *Bokono* of one wooded shrine stated:

*[The wooded shrine is important] … to show to younger generations what we were able to preserve, and thus in turn encouraging those younger generations to also conserve the space* (wooded shrine G).

This quote demonstrates conscious effort to conserve wooded shrines for the benefit of future generations. People hope their current efforts and successes serve as motivation for people of future generations to also conserve the space.

5. Physio-spiritual healing

The benefit of these materials as medicine is cited above in 'Provisioning;' however, the physio-spiritual healing benefit identified here refers to the use of these materials for illnesses requiring a ritual, as well as for illness that need both spiritual and physiological treatment to be healed. This type of healing is based on the perception that Vodoun divinities reside in these sites.

*Species found in a grove are better because you have to respect the rules of entry to the forest. Leaves are 'natural' in the form God made them; not touched by impure hands. Leaves are different from non-sacred places: spirits reside in the leaves, mystical forces reside in the forest…* (community group, wooded shrine At).

*Bokono*'s specialized knowledge enhances the healing capacity:

*Leaves and other healing materials found in the forest are better for two reasons: there is a spiritual strength along with the parts of the plant collected; the healers know how the plants are treated and cared for, increasing the quality of the plant overall and the needed parts for treatments* (*bokono*, wooded shrine Z).

For many, belief in the wooded shrine's materials' effects on healing motivates them to use additional materials for treating an illness when necessary. For example, if a material required for treating the physiological element of an illness is found outside of the wooded shrine, a person might mix that out-of-shrine material with a material found within the shrine to gain the healing benefit of a material grown in the presence of the divine:

> *Also, using géomancie* [ritual communication with divinities and spirits], *the vodoun can heal. Sometimes the trees from the forest are used to heal, other times the trees required by the vodoun for the treatment are not in the forest, but elsewhere, and those are used* (*bokono*, wooded shrine G).
>
> *[Treatments from the forest are better because there is a] stronger force. Outside-found species are associated with those found inside the grove to increase their efficacy* (community group, wooded shrine D).

Physio-spiritual healing is a means to meet real needs for many people in Benin, simultaneously satisfying physiological and spiritual components of illness.

6. Female-specific healing

Female interviewees referenced wooded shrine resources used in specific ways. For example, one respondent stated:

> *We find many benefits, especially materials for treatments after giving birth for washing the baby, bathe the baby with certain plants. Sometimes enough outside the forest… Can ask the bokono for what's in the forest* (community group, wooded shrine Ad).
>
> *Sacred forests especially provide healing teas for new mothers and babies* (community group, wooded shrine D).

These responses reveal a gender-specific use of certain resources. Further, female respondents indicated these resources could be found inside or outside the grove; however, sanitation concerns as cited above motivate women to prefer shrine-located resources.

7. Spiritual-provisioning

While stakeholders in Benin perceive wooded shrines as improving their lives through religious worship, people also perceive the sites as benefitting the Vodoun divinities. Vodoun

divinities reside in the woods, so woods contribute to the perceived spiritual world by providing a home for them; in addition, the woods provide tangible materials like leaves, roots, and certain plants required for certain ritual communication:

> *Vodoun live in the forest, require the forest, the leaves for their rituals require the forest… The power of Vodoun is in the forest* (*bokono*, wooded shrine S).

*Bokono* of wooded shrine T stated that the namesake of the wooded shrine "didn't like to be with lots of people around, so he's happier with a good cushion of trees to keep people away." Especially for *bokono* and Vodoun practitioners, satisfying the perceived needs of the Vodoun divinities and working toward the Vodoun divinities' perceived comfort is a initial step in achieving spiritual protection for the community.

8. Climate regulation

People appreciated the woods themselves for micro-climate regulation, soil health, and habitat:

> *Ecosystem protection, rain, cultivation, and health* (community group, wooded shrine D).
> *Protects the environment: If this forest was larger, it would attract rain clouds, big trees especially attract rain. The wooded shrine protects animals such as snakes, snails, small animals who hide there during the day, and come out at night.* (community group, wooded shrine At).

### 2.4.3 Governance

1. Ownership and Origins

Every wooded shrine has a story of its inception. These stories may be interpreted to improve understanding of the ideas of ownership surrounding these sites. Notably, there is a cultural practice of saying people perceived to be great leaders, or who led exemplary lives, have 'disappeared' instead of died.

> *T[…, namesake of the wooded shrine] didn't die, he was ill and taken by the earth* (*bokono*, wooded shrine T).

This is important for understanding how the legends of origin of the wooded shrines contribute to ideas about ownership of the sites.

Wooded shrine B is an example of how a wooded shrine came to be, for whom it was intended, and included an exemplary leader of the community's history. This shrine and community is located on a high plateau distant from other sources of water, so water is a constant need. Wooded shrine B shelters a water source for people in the community who use the spring daily for all water needs. The wooded shrine and water source are part of the legend of origin of this wooded shrine:

> *The regional king promised his people he would sacrifice himself for the sake of providing water. The king told the people that when they saw a spring start running water, to know that the spring was where he had sacrificed himself.* (*bokono*, wooded shrine B).

As mentioned above in the cultural identity section, this response highlights how people of a certain community recognize their collective relationship with the site. In this case, people of the wooded shrine B community understand that site as a community point of access for water, in addition, and potentially apart from, spiritual benefits.

Wooded shrine Z is another example that sheds light on some aspects of ownership:

> *A* bokono *manages, but is not necessarily the owner [of the wooded shrine]. The ancestors owned the land, and donated it to be a forest for the population. Once given, the bokono acts as a go-between for the ancestors' spirits and the community* (community group, wooded shrine Z).
>
> *Descendants of the founder* [of the village] *own the forest, currently me, but I am not allowed to sell the forest; I wrote and signed that this land will not be sold* (*bokono*, wooded shrine Z).

As cited in the section on cultural heritage, the title of 'bokono' and the shrine are passed along generationally, which is how the *bokono* is the current owner; however, the community member of wooded shrine Z articulated the type of responsibility the *bokono* has. In this case, the

*bokono* of wooded shrine Z acknowledged his responsibility as intermediary for the good of the community by binding himself legally to never sell the land the wooded shrine is located on. On one hand, the Vodoun divinities believed to reside in the wooded shrines can be interpreted as the 'owners' of the site; on the other hand, community members and *bokono* recognize human ownership of the same space, too, including the relationship of the national government system with the land.

> *Some groves are for a family, on family land for the family's ancestors, or for a village, and these are more commonly preserved still today* (key informant H).
>
> *Law 93 states that anything standing (trees, vegetation) is under the control of the National Direction of Forests and Resources* (key informant P).

2. Rules

Everyone has access to wooded shrines; however, there are distinct rules about when and in what condition. Across wooded shrines, there are rules connected to the status of sexual activity on the part of the individual seeking help from the divinity within the grove: menstruating women, and men and women who have been sexually active within a certain amount of time are forbidden from interacting with the Vodoun divinities and participating in Vodoun rituals within the wooded shrine. There are rules limiting the days of rituals to certain market days, and generally requiring the practitioners of Vodoun and the *bokono* to maintain regular contact with the divinities they believe to be residing within the shrine about the use of resources in the shrine and the community members the divinity is interacting with.

> *[Rules and restrictions are:] days for sacrifice and ritual: Chtifizan -Dantokpa market day, also market days of Lokossa, Dogbo, and Ouédémé. No women in period, no men or women after sex to participate in ceremonies. If a follower passes away, must inform the deity on the specified market day. Collecting and harvesting must be done with authorization from the Vodoun; to collect without permission would perturb the spirits* (*bokono*, wooded shrine D).

Responses from wooded shrine G demonstrate how ownership rights and rules interact with benefits from wooded shrines. As told by *bokono,* wooded shrine G is located on land that was sold about 40 years ago by the Beninese government for a demonstration farm operated by non-Beninese farmers. The farm encompassed much of their grandparents' land, which included the wooded shrine. Many people at the time of the sale were too upset to accept monetary compensation for the land. The new owners built walls encircling the property, altering access to the shrine. Community members consequently had to ask permission of the demonstration farmers to enter the forest of their ancestors. At the time of this work, wooded shrine G was in transition back to the community, with support from the local mayor's office and a UNDP project. This meant people of the community would have access to wooded shrine G as before the sale, once again able to practice Vodoun as needed.

Regardless of religion, breaking the rules or disrespecting the divinities within the shrine would disrupt one's life.

> *Regardless of how the national justice system would deal with [unsanctioned tree cutting within a wooded shrine], everyone, everyone, knows that the person who cut the tree down would get his comeuppance one day. It could be death, but it could be something else that would render his life very difficult, in compensation for killing a tree that housed an important spirit* (key informant R).

> *Cutting a tree without consultation results in the Vodoun deity following the person until they correct their action* (*bokono,* wooded shrine Ka).

Responses presented here show how ownership and rules about wooded shrines are connected to the religion of Vodoun, in addition to and interacting with national law.

### 2.4.4 Changes in biophysical aspects

Components of the biophysical structures and functions were associated with CES benefits. These components include changes in the area, density, and composition of wooded shrines. Above all, though, stakeholders emphasized that:

*…when a person is cured, the forest earns more respect; finding cures and blessings supports the forest. It's not the size of the forest that matters, just the size and power of the spirit residing there* (*bokono,* wooded shrine D).

*Not necessarily the density, forest can be big or small. [The importance of the shrine is] simply the force of the supernatural* (community group, wooded shrine D).

1. Decrease in natural resources of wooded shrines

Respondents made clear that wooded shrines were greatly affected by colonialization and the Marxist-Leninist government that followed independence of the nation.

> *Much of the change was during the revolution that brought in communism during the 70s and 80s. The government discouraged all religion and religious sites, many groves were cut down and the land was provided for social use, such as schools, health centers, collective's fields… Some of the groves were sold for the public cemetery because the communist government didn't allow burying people in their homes anymore* (community group, wooded shrine At).

Beyond socio-political legacies, respondents reported current threats to wooded shrines:

*Population pressure, needs for agriculture and home-building space; a diminishing belief in Vodoun and its myths. Increased book learning makes for less fear of Vodoun* (key informant H).

*Population pressure erodes the forest, the school construction, home constructions* (community group, wooded shrine Z).

Mono River flooding was cited as causing erosion in many wooded shrines in this study.

The school at wooded shrine Z had been built within the previous two years and demonstrates the legacy of communist practice of a using wooded shrine space for community needs. This construction was reportedly achieved through ritual communication.

Individual actions are also important in reducing wooded shrines in number and in size. As the land is passed on generationally, the title of *bokono* may not always be welcomed by the

inheritor. In one case, a person recently converted to Christianity sought to destroy the shrine; the community members averted this destruction by finding a new leader of the shrine (key informant P). In a separate case recounted by community members at wooded shrine At, the legal owner needed cash, and so sold the land with the woods surrounding the shrine. Elders within the community warned the seller to stop, especially before selling the plot where the shrine's statuette representations were located, or else incur the anger of the Vodoun divinities. With this warning, selling ceased.

2. Maintenance or increase in natural resources of wooded shrines

Respondents spoke of people on the individual and community level who acted in ways that maintained or increased the size and/or density of the wooded shrine space and vegetation. The *bokono* of wooded shrine Ka articulated his actions concerning the changes in the shrine he is responsible for. He inherited this land and title, and previously farmed nearly the entire space. However, at one point he

> *…consulted the divinity about planting trees. The divinity said only the one hectare needed to be replanted; this means I could continue farming the rest of the land. The divinity wasn't asking for more* (*bokono*, wooded shrine Ka).

The *bokono* of wooded shrine Ka put a lot of effort into protecting saplings, including creating a brush fire break and replanting too-closely spaced or poorly positioned saplings. He is quoted above in the section on spirituality, when sighting a panther pass through this wooded shrine indicated to him the spiritual importance of the site.

Key informants from the mayor's office shared their perception of their responsibility toward wooded shrines:

*[We are] partnering with the community members of the forest… working to build infrastructure such as fences to effectively delimit the area designated for the shrine* (key informant M).

The UNDP project initiated an effort to make wooded shrines a separate category of public land, creating a special category for these sites on the political map.

The structural aspects of a wooded shrine affected the appearance of the shrine, which also affected how people behaved toward it. One *bokono* said, "about 7-9 years of growth makes trees mature enough to use, and encourages respect of the shrine (*bokono,* wooded shrine Ka)." Members of community group At stated that after about 5-6 years of growth, people would recognize the site as a forest.

3. Tree species preferences

Key informants recognized the biological importance of wooded shrines:

*Conservation of rare species that are good for traditional medicine… From the environment side, wooded shrines provide habitat for rare species needing conservation* (key informant M).

*Animals, reptiles, snakes -each have their virtues. Animals, reptiles, ants, plants (plant leaves, roots, bark, and flowers) … All used in healing remedies, for illnesses* (community group, wooded shrine Ad).

Respondents spoke of certain tree species preferred and/or needed for healing purposes within the wooded shrines.

*Firstly, with indigenous species, we have more of the medicinal plants available* (*bokono,* wooded shrine G).

Specifically, people cited:

> *Caïcedrat [Khaya senegalensis], Iroko [Milicia excelsa], Samba [Triplochiton scleroxylon], Afzelia [Africana], Ceiba [petandra], and Kola [gigantea]* (community group, wooded shrine At).

Individual trees in a wooded shrine could be used frequently; what people could not find within the wooded shrine was found elsewhere.

> *There are 16 trees in the forest that we use a lot… We are lacking a lot of useful species from the forest, and must buy a lot from the market* (*bokono,* wooded shrine C).
>
> *The forest is lacking species, but we can find them in the surrounding [non-sacred] areas. We can find them in other sacred groves -can even bring the entire plant, but the plant must be ceremonially removed and ceremonially installed, the tree/plant plus the spirits from the home forest are also installed into the new forest with the plant. This is called* édama*, or espousing a plant* (*bokono,* wooded shrine D).

Introducing new plants to a shrine was not common, but was not unheard of. Some *bokono* reported planting *N. laevis* in their shrines because it is a frequently needed plant for Vodoun rituals.

While respondents were clear in articulating which species were important and why, the belief in the presence of the Vodoun divinities remained a strong point:

> *Any type of tree can be in a grove, and the spirits will direct the people on how to use that tree when necessary* (key information R).

Many trees and species of plants were well known to be useful for meeting people's needs, but these species themselves were not essential in recognizing a wooded site as sacred.

## 2.5 Discussion

We had two objectives in this research: to understand which ecosystem services, and especially cultural ES, were relevant to people connected and/or knowledgeable about wooded shrines; and to identify social and biophysical factors contributing to these services. These results show that wooded shrine stakeholders identify spiritual ecosystem services and other material

benefits, such as medicine, habitat, climate regulation, and provisioning, as in previous research (Alohou et al., 2016; Ceperley et al., 2010). Our results demonstrate people also identify cultural identity, cultural heritage, and a specific type of spiritual healing. These results offer empirical data that reinforce and expand concepts of non-material benefits from nature and suggest a novel category of ecosystem service. These results highlight social and biophysical factors about how people obtain these benefits, especially governance and structural components of the woods.

### 2.5.1 Cultural Identity

Wooded shrine stakeholders' responses resonate with the Millennium Ecosystem Assessment 2005 definition of cultural identity as "a current relationship between a group of people and their biophysical world" in the title and social position of the *bokono* and the associated ownership rights. Individual *bokono* have social responsibilities to people of the community and the perceived divinities residing in the shrines, fitting ideas about identity as a sense of self in relation to social and interpersonal links and roles, as well as the environment (Kelty & Kelty, 2011). Furthermore, people who have moved away from a community sometimes push the hardest for wooded shrine protection, which speaks to cultural identity described relationally, that culture is to society what memory is to individuals, and that we live by anchoring our self and our existence to places (Tengberg et al., 2012), providing people the benefit of a sense of belonging and feeling 'at home' (Bieling, 2014).

### 2.5.2 Cultural Heritage

Wooded shrines are appreciated for the memories of previous generations, and remain important to the current generation for the benefit of future generations, as was found in prior research (Daniel et al., 2012; de Groot et al., 2005). The stories, rites, and rituals include rules of access, faith systems, concepts of proper social behavior, and understanding of a human's

position in the world per Vodoun worldviews. For wooded shrines, heritage must be considered as both physical and intangible, an intergenerational process constantly in motion because the wooded shrine sites are only distinguished as such due to stories, knowledge systems, and traditions people employ to remember and create history (Tengberg et al., 2012), applying it to current situations and people's needs.

The CES of spirituality, cultural heritage, and cultural identity overlap at wooded shrines. Such overlap was also found in Hawai'i, USA (Gould et al 2014). The tight connection between cultural heritage and cultural identity is supported with research in cultural landscapes in Sweden and the Arafura-Timor Seas (Tengberg et al 2012). As per recent advances of concepts of cultural identity and cultural heritage about individual involvement and active sharing (Pröpper & Haupts, 2014; Tengberg et al., 2012), understanding spirituality, heritage, and identity at wooded shrines in Benin comes from rich descriptions heard in the origin stories of the groves themselves, and who was doing the telling. That is, the sharing of the stories and knowledge associated with the groves is a key component of heritage (Pröpper & Haupts, 2014; Tengberg et al., 2012), especially through language, legends, and institutions (see North, 1990). The *bokono,* professionals of those languages, legends, and institutions, are often descendants of the founder, and in any case have a title connected to the shrine itself. And as for a sense of belonging within the concept of cultural identity (Bieling, 2014), a number of responses about wooded shrines in Benin signaled how stakeholders felt such a benefit from wooded shrines.

### 2.5.3 Provisioning and healing

Wooded shrines across the continent of Africa are known as accessible, interactive, and dynamic sites (Fournier, 2011; Juhé-Beaulaton, 2010; Sheridan & Nyamweru, 2008). As respondents in this research stated, using materials from a wooded shrine for community benefit,

for consumption, and for healing, or even for farming and construction, is not uncommon. Plants as medicine is recognized as an ecosystem service in ES science theory (de Groot et al., 2005) and previously in wooded shrine research (Alohou et al., 2016; Ceperley et al., 2010). Research presented here from wooded shrines expands the idea of traditional medicines as a material benefit, into a benefit that is simultaneously material and non-material. Respondents identified 'healing' benefits to their well-being uniquely from wooded shrines that were more than material, and not immaterially spiritual. These medicinal materials are perceived to treat physiological, spiritual, and physio-spiritual ailments. While medical geography research has demonstrated similar conceptions of healing from the Jola of Gambia (Madge, 1998) and in Sierra Leone (Lebbie & Guries, 1995), more research is needed from the Republic of Benin. This type of ES confirms the challenge of dichotomous ES categories of 'material' and 'non-material' (Pröpper & Haupts, 2014).

The idea that an ecosystem service is simultaneously both material and non-material has been discussed (Chan et al., 2012); spiritual healing from wooded shrines offers a specific case. Additionally, female-specific uses of resources from wooded shrines, both as healers and consumers, is a large gap in information relevant to research on wooded shrines and Ecosystem Service Science.

### 2.5.4 Governance

Governance is important in understanding ES and how people benefit. Perceptions of wooded shrines as conveyed in this research suggests the Vodoun religion is the means of understanding the special ownership structure of these shrines as well as the perception of how people benefit, a structure familiar and understandable to many people in this study region. Rules noted by respondents at wooded shrines were perceived to be enforced spiritually, that an

offended Vodoun divinity would cause trouble in a person's life until the divinity was appeased. Elements of religion have been found effective means of achieving many governance principles (Cox, Villamayor-Tomas, & Hartberg, 2014). Additionally, rules of access related to menstruation and sexual activity reported from the study region in Benin resonate with anthropological research on ritual iron smelting and concepts of life-giving power (see Herbert, 1993). For believers of Vodoun, life-giving power includes non-sexual, non-human reproductive activity. *Bokono* are knowledgeable of the Vodoun concepts of how various forms of life-giving power can and should interact.

As noted by respondents in this research, the national government of Benin has claim to all land and all trees on that land. Of all forested space in the Republic of Benin, wooded shrines have the least deforestation and management conflict (UNDP PIFSAP-B Project). Where rules of access and use are clear around wooded sites in Madagascar, the less degraded the sites' natural resources (Elmqvist et al., 2007), and the same was found in the Brazilian Amazon (Nolte, Agrawal, Silvius, & Soares-Filho, 2013). Research from a complex social-ecological system in Spain demonstrate how provision of ecosystem services and the successful management of the ecosystem and services is dependent upon an interconnected governance system (Farhad et al., 2015), and is the recommended path forward concerning wooded shrines in Benin (Alohou et al., 2017).

### 2.5.5 Biophysical system

Respondents in Benin explained that wooded shrines should be respected regardless of the state of the biophysical setting, instead based on the perceived strength of the divinities residing within. Interviews followed by floristic studies of wooded shrines in Burkina Faso support ideas that vegetation composition has little to do with the perception of 'sacred' of the

shrines (Fournier, 2011; Sanou et al., 2013). Stakeholders in Benin acknowledged that some species are preferred within wooded shrines because of their usefulness in healing remedies and Vodoun rituals. Such preferences have been found in previous historical and ethnobotanical research on wooded shrines in Benin (Juhé-Beaulaton & Roussel, 2002). Some species, such as *M. excelsa* and *A. digitata*, are perceived as important spiritually wherever they are found, similar to species frequently venerated (Kokou & Sokpon, 2006).

Attributes such as degree of canopy closure and density of the vegetation, specifically after 5-9 years of growth, were mentioned as factors affecting people's behavior toward wooded spaces in this research in south-west Benin. In a study on timber harvests in West Africa, an average of seven years' growth sufficed for canopy closure for pioneer species (Duah-Gyamfi, Swaine, Adam, Pinard, & Swaine, 2014). This information suggests that less than a decade of some tree species' growth may influence how people interact with a wooded site, whether a shrine or not, perhaps encouraging protection of the trees and/or space for medicinal and/or spiritual needs.

The human-nature relationships evidenced in wooded shrines are complex; understanding them requires much deeper knowledge about the Vodoun religion and worldview, both of which are embedded in the culture of especially the south of Benin. Results from our research underline the powerful and pervasive influence of religion and spirituality in people's relationships with the biophysical, natural world. The sub themes of CES of spirituality, cultural heritage, and cultural identity, are relatively under-studied (Cheng et al., 2019); yet they contribute to how people know which plants to use, and in what way, to heal a headache, for example. Our results emphasize the need to remove limitations of understanding that come with distinct categories, and to think of CES differently, such as relational values (Chan et al., 2016).

## 2.6 Study Limitations

Our research in Benin should be expanded by purposefully including more diversity in respondents, especially in gender, urban-rural, religious practice, and ethnicity. Adding religion scholars specialized in Vodoun to our research team will further improve interpretation of our results. Our research can also grow to include wooded, non-Vodoun sites and previously wooded Vodoun sites. Such growth in the research will better inform ES trade-offs and aspects of governance while more accurately depicting people of Benin. Understanding distinctions between different portions of the Beninese population may offer another means of motivating care of wooded shrines, expanding the types of support people may have for wooded shrines beyond traditional religion and authority, especially where respect for traditional religion is diminishing.

There remain large questions about the role of cultural ES in understanding human-nature interactions. Future research about wooded shrines identified in this research include: gender specific use of resources, aspects of ownership that enhance and detract from ES benefits, concepts of healing, and correlations between people's behavior and forest structural attributes of canopy closure, vegetation density, and size in area. Collaborative research between social and ecological scientists should address these points. This research will in turn improve knowledge about how people benefit from natural resources and how ES interact, overall increasing the capacity for effective ES science-based decisions of natural resource management.

## 2.7 Conclusions

Our research on wooded shrines gives insight to the complexity of interconnections between people and natural resources, specifically about religion and spirituality as components of culture. Qualitative empirical data is effective in addressing needs for clarity and distinction,

as is the case for cultural ES. Our qualitative, exploratory research highlights the complexity of 'spiritual' ES of wooded shrines that stem from the specific religion of Vodoun. People benefit in many ways from wooded shrines, and the Vodoun religion provides a basis for understanding a person's place in the world. This affects how a person interacts with which natural resources, and when. This is evidenced with the Vodoun religion as a means of governance of natural resources. Thus in terms of saliency of ecosystem services from wooded shrines, all ES benefits, including provisioning, are identified through the Vodoun religion. And for the biophysical and social factors affecting the identification of these benefits, because people believe the Vodoun divinities reside in natural objects, ES benefits from wooded shrines are inherently tied to biophysical functions and structures; and at the same time these benefits are tied to socio-cultural practices specific to Vodoun.

Research presented here draws upon African Studies and qualitative methods, reflecting engagement across disciplines considered integral to the holistic goals of ES Science (Bennett, 2017; Daniel et al., 2012). Research in CES should contend with concepts about culture as process, emphasized in this research, that how people live and understand their lives affects their use of materials (Chan et al., 2016; Pröpper & Haupts, 2014).

# 3. Feeling connected: Cultural ecosystem services from forest stakeholders in Michigan, USA.

## 3.1 Abstract

Cultural ecosystem services (CES) of spirituality, heritage, and identity remain ambiguous and consequently inadequately addressed in ecosystem services assessments and Ecosystem Services science-based decision making. This research improves conceptualization and identification of spirituality, heritage, and identity as benefits from nature by exploring concepts of sense of place and connectedness to nature. This research relies on input from forest stakeholders in Michigan, USA, to learn which themes of non-material benefits are most salient, how people express these benefits, and how these services benefit human well-being. In addition to existing CES concepts such as spirituality and inspiration, we found a consistent theme of 'connectedness' throughout our data. This theme helped make sense of highly overlapping categories, suggesting 'connectedness' itself is a strong benefit from nature, however that connection may arise. As concepts with robust evidence, connectedness to nature and sense of place provide tools for making these CES more tangible and material. The improved capacity to identify and apply CES will improve the effectiveness of the Ecosystem Service science framework overall in decision-making, especially increasing capacity for input about how meaningful experiences benefit people from in nature.

## 3.2 Introduction

Ecosystem Services (ES) science was developed from a need to more comprehensively account for human-nature interdependencies, forging relationships of thought between the fields of ecosystem ecology and natural resource economics (Costanza et al., 2017). With the Millennium Ecosystem Assessment (2005) as an oft-cited point of departure, this relatively new

field emphasizes how nature provides for basic human well-being (Schröter et al 2014). ES science is increasingly used to inform policies and decisions about natural resource management (Bennett, 2017; Darvill & Lindo, 2015; Fisher & Brown, 2014).

CES are arguably the most personal ecosystem services to human well-being (Satz et al., 2013). In ranking importance of multiple ecosystem services (ES), stakeholders in Canada ranked CES higher than provisioning, demonstrating their social relevance and potential to enhance sustainability of resource use (Darvill and Lindo 2016). A current definition of CES is: the ecosystems' contributions to the non-material benefits that arise from human–ecosystem relationships, where 'benefits' could also be activities, capabilities and experiences (Chan et al., 2012). Additionally, CES are a means to understand the ecosystem's life-enriching and life-affirming contributions to human well-being (Ryfield et al., 2019). Study of CES is increasing (Cheng et al., 2019), but the concepts remain underdeveloped and under-researched because of their current perception as immaterial and hard to define (Blicharska et al., 2017; Fish et al., 2016).

The perceived intangibility of CES in part stems from the general understanding of 'culture' as nebulous (Fish et al., 2016). While 'culture' is a problematized term for use in ES science (Pröpper & Haupts, 2014; Ryfield et al., 2019; Satz et al., 2013; Winthrop, 2014), research has shown that social and psychological dimensions of human well-being are generally improved with exposure to nature in various forms (Howell, Dopko, Passmore, & Buro, 2011; Russell et al., 2013). This type of support for human well-being is unlikely, if not impossible, to be replaced by technology in a way similar to how a water filtration site might replace a forest for providing clean water (Brauman et al., 2007).

Within the CES literature, aesthetics and tourism/recreation are predominately studied, while themes of heritage, identity, and sense of place remain relatively under-explored (Cheng et al., 2019; Milcu et al., 2013). Heritage, identity, and sense of place themes overlap each other as well as with spirituality (Gould et al., 2014; Tengberg et al., 2012), thus all are included in the focus of this research.

### 3.2.1 Spirituality and Connectedness to Nature

Spirituality is a broad concept presented as a sense of wonder or awe, and/or knowing one's place in the world, which may or may not be affiliated with religious practices (Millennium Ecosystem Assessment, 2005). Spirituality is an innate human faculty to experience self-transcendency; religions are associated with certain beliefs, languages, and rituals intended to shape spiritual experiences (McClintock et al., 2016). The religion and spirituality complex (R/S) has demonstrated health benefits such as protection against depression and diurnal regulation of cortisol (McClintock et al., 2016).

A study of common traits, or phenotypes, across multiple nations provides additional structure for understanding spirituality as a benefit from nature. McClintock and colleagues (2016) analyzed individual surveys from people in the United States, China, and India, producing a skeleton of five common phenotypes of spirituality. Of these five types, unifying interconnectedness concerns the "conscious perception of connection to other people and forms of life (McClintock et al., 2016)," which specifically links in the concept of connectedness to nature.

Connectedness to nature (C2N) is the degree to which an individual perceives him/herself as part of, or belonging to, the broader natural world (Mayer & Frantz, 2004; Navarro, Olivos, & Fleury-Bahi, 2017; Perrin & Benassi, 2009). Feelings of connectedness to nature are linked to

psychological and social well-being (Howell et al., 2011) and the ability to reflect on a life problem (Mayer, Frantz, Bruehlman-Senecal, & Dolliver, 2009). Impediments to feeling nature connectedness is a focus on one's self, coupled with exploitative characteristics (Frantz, Mayer, Norton, & Rock, 2005).

Connectedness to nature is associated with pro-environmental (Mayer & Frantz, 2004) and pro-social (Moreton, Arena, & Tiliopoulos, 2019; Zelenski, Dopko, & Capaldi, 2015) behaviors. The strength of C2N is frequently assessed using the connectedness to nature scale (CNS) (Mayer & Frantz, 2004). The concept of nature connectedness is associated with pro-social and pro-environmental behaviors, and is a robust area of research in environmental psychology (Beery & Wolf-Watz, 2014; Gosling & Williams, 2010). The CNS is a well-established tool, corroborated in different languages and cultures (Di Fabio & Rosen, 2019; Navarro et al., 2017). The concept of C2N has been included in reviews on links between human well-being and nature (Russell et al., 2013) and recent empirical research in CES (Gould et al., 2018).

3.2.2 Sense of place

'Place' is a term from the geographical sciences as a "context specific experience with the more-than-human world (Beery & Wolf-Watz, 2014)". Sense of place is a meaningful relationship between people and a place, developed through repeated interactions (Chaudhary, McGregor, Houston, & Chettri, 2019; Hausmann, Slotow, Burns, & Di Minin, 2016; Masterson et al., 2017; Poe, Donatuto, & Satterfield, 2016; Ryfield et al., 2019; Urquhart & Acott, 2014). Sense of place involves elements of identity, both collective and individual, as well as the biophysical components of a space that affect human living (Urquhart & Acott, 2014). Sense of place is also known for conferring a sense of belonging (Andersson, Barthel, & Ahrné, 2007;

Urquhart & Acott, 2014). The CES of cultural heritage and cultural identity have components related to a sense of place via this sense of belonging (Bieling, 2014; Tengberg et al., 2012). Sense of place is one of the most neglected themes in CES (Hausmann et al., 2016), and is an effective point for interdisciplinary research in ES science by incorporating the tangible, material aspects of a place (Hausmann et al., 2016; Masterson et al., 2017; Ryfield et al., 2019).

For example, Poe and others (2016) used surveys and semi-structured interviews to elicit information from tribal and non-tribal community groups along the Puget Sound coastline in Washington, USA, to understand the effects of the physical components of the place upon the individuals' perception of well-being. Respondents reported shellfishing as a direct means to well-being physiologically as healthy foods; emotionally as something s/he enjoyed; and socially for spending time with others. The coast was also integral as reminding respondents where they come from and memories of the past, as well as financial well-being when jobs and income were involved. In this sense, a specific place and its ecology were interconnected with human well-being, all part of sense of place.

### 3.2.3 Cultural Identity

Cultural identity is "a current relationship between a group of people and their biophysical world (Millennium Ecosystem Assessment 2005)." Identity is also described as a sense of self in relation to social and interpersonal links and roles, as well as the environment (Kelty & Kelty, 2011). Cultural identity is described relationally, that culture is to society what memory is to individuals, and that we live by anchoring our self and our existence to places (Tengberg et al., 2012), providing people the benefit of a sense of belonging and feeling 'at home' (Bieling, 2014). Environmental identity and environmental self-identity are theoretically

similar to nature connectedness; however, these concepts relate to different components of the nature connectedness concept (Balundė, Jovarauskaitė, & Poškus, 2019).

### 3.2.4 Cultural heritage

Cultural heritage involves the memories of previous generations that remain important to the current generation for the benefit of future generations (Daniel et al., 2012; de Groot et al., 2005). Cultural heritage includes the stories, knowledge systems, and traditions people employ to remember and create history (Tengberg et al., 2012), applying it to current situations and people's needs. The tight connection between cultural heritage and cultural identity is further supported with research in cultural landscapes in Sweden and the Arafura-Timor Seas (Tengberg et al 2012) and in Hawai'i, USA (Gould et al., 2014).

Concepts of cultural identity and cultural heritage include individual- and collective-level involvement and active sharing of stories and knowledge (Chan et al., 2016; Pröpper & Haupts, 2014; Tengberg et al., 2012). Heritage and identity benefits are frequently identified by long-term residents who have developed strong relationships with the land, which corresponds with the concept of sense of place (Anderson et al 2007; Bieling 2014; Gould et al 2014; Kelty and Kelty 2011; Urquhart and Acott 2014). Furthermore, environmental identity is defined as a connection to some parts of the non-human natural environment, in part based on history, that affects the way in which people understand and behave toward the world (Clayton 2003 *in* Balundė et al., 2019). This point further supports the overlap of heritage and identity with sense of place.

This research explores CES themes of spirituality, cultural heritage, cultural identity using connectedness to nature and sense of place from forest stakeholders in Michigan, USA. The state of Michigan claims over 20 million acres of forested land, 34% of which is held

privately (Pugh et al 2016), and thus offers a rich landscape to study perceived benefits from forests. This research adds to a small collection of CES research based in the United States including some of the themes of focus here (Belaire, Westphal, Whelan, & Minor, 2015; Clay, Yurco, Agrawal, & Persha, 2018; Gould et al., 2014; Poe et al., 2016). CES from forests in Michigan are important to understand because the quantity and quality of this natural resource lies in the hands of people who value it, and in relevant forms of valuation.

Research objectives were to understand themes of CES salient to forest stakeholders in Michigan, develop CES themes of spirituality, heritage, and identity from these respondents while leaning on connectedness to nature and sense of place, and understand how these CES contribute to human well-being.

## 3.3 Methods

A qualitative approach was used to increase knowledge of CES and develop concepts about CES to facilitate more effectively incorporating CES into ES science-based decisions and assessments. ES and their benefits to human well-being must be identified by stakeholders (Costanza et al., 2017; Mouchet et al., 2014), therefore qualitative methods such as interviews and narratives are effective and build rich data sets for characterizing CES (Gould et al 2014; Bieling 2014).

Semi-structured interviews took place in the summer of 2018 throughout the lower peninsula of the state of Michigan, USA (see Figure 1). Respondents were sampled purposively from forest stakeholders via two land conservation agencies, one state-wide and one within a five-county region; and social groups who serve people of underrepresented race categories. One social group's goal is historic and culture conservation. Place attachment was found as a motivating component in participation in private land conservation, thus land conservation

agencies promise to be effective in identifying people for research on sense of place and associated CES-related benefits (Selinske, Coetzee, Purnell, & Knight, 2015).

The majority of these interviews occurred on-site at the interviewee's chosen 'preferred place' in the woods, and the questions were directed to benefits about that chosen site. The interviews asked about how people experience benefits related to spirituality, heritage, and identity, especially at their 'preferred place.' The final section of each interview was an oral version of the connectedness to nature scale (CNS, Appendix I.), which is an effective tool to measure connectedness to nature (Mayer & Frantz, 2004). The CNS is a consistent and reliable measure of the latent variable of an individual's cognitive beliefs of his/her connectedness to nature (Perrin & Benassi, 2009) as tested in English (Mayer & Frantz, 2004), Italian (Di Fabio & Rosen, 2019), and French (Navarro et al., 2017).

Interviews were transcribed and coded using qualitative analysis software (NVivo12). Coding data for characterizing CES began deductively based on the questions for the structured interviews. We also used open coding to allow for additional themes from the data. A sample of transcripts was coded by a team of social science researchers to check consistency of themes and interpretation. This inter-rater reliability test produced an average agreement of 82%. Any discrepancies were resolved and codes were further clarified. The 'R' program (R Core Team, 2017) was used to compute descriptive statistics such as average age and reported income.

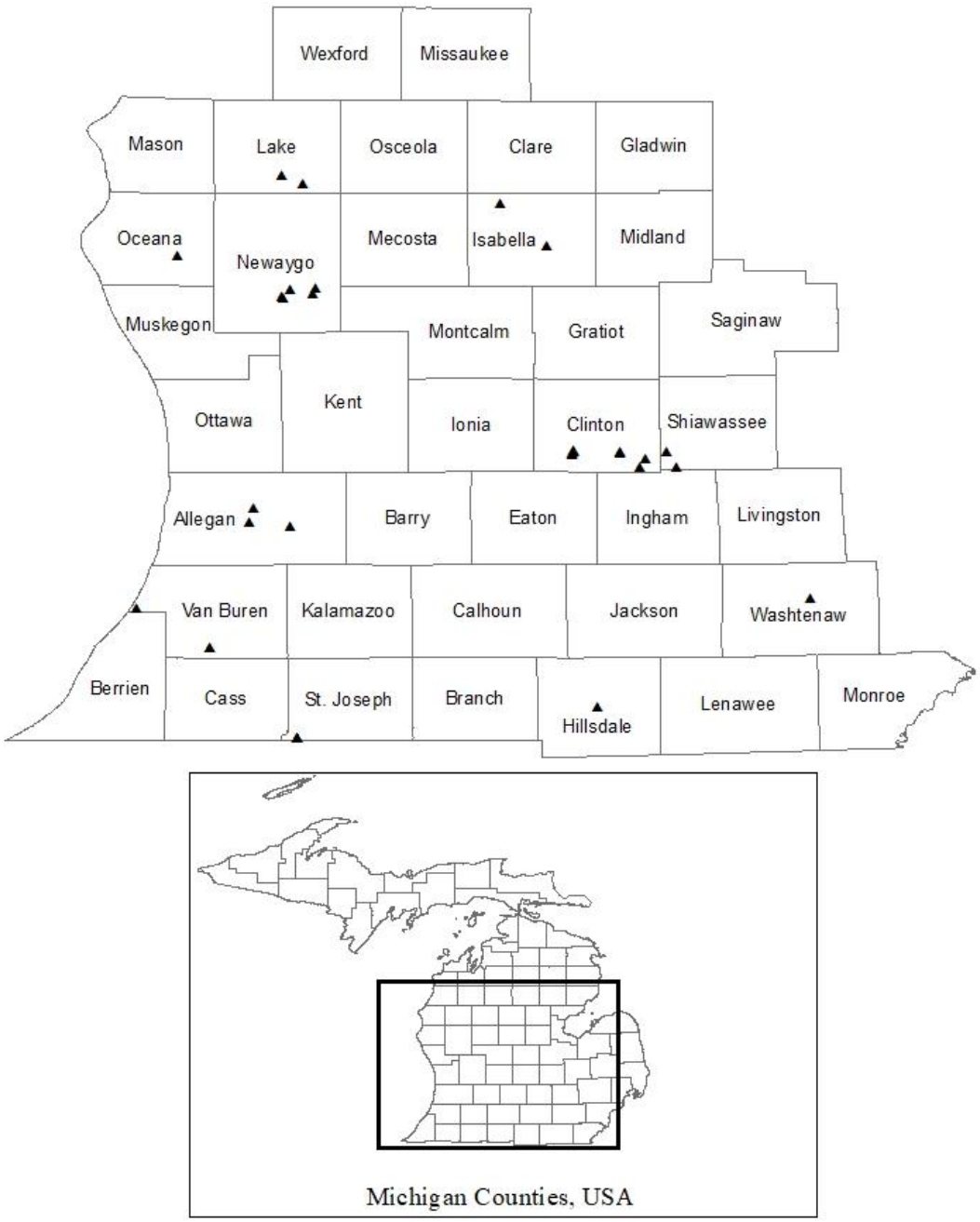


*Figure 5. Map of study area in Michigan, USA. Created by author.*

## 3.4 Results

A total of 35 people participated in this research, some of whom participated as couples. The respondents in this research were generally older, Caucasian, long-term residents of Michigan, slightly more likely to be female, and owned the location of their ‘preferred place’ (see Table 1.).

*Table 3. Summary of demographic information of respondents.*

| *Variable* | Respondents |
|---|---|
| *Gender* | |
| *Female* | 57.1% |
| *Male* | 42.9% |
| *Age* | |
| *Range* | Min.: 43 years, Max.: 93 years (both female) |
| *Female* | 67 years |
| *Male* | 72 years |
| *Number of Children* | |
| *Two or fewer* | 62.8% |
| *Three or more* | 37.2% |
| *Average Income* | $72,000 (Min.: $20,000; Max.: “upper 10%”) |
| *Race* | 94% Caucasian, 6% Two or more races |
| *Average Years Lived in Michigan* | 56.4 years |
| *Identify with Religion* | |
| *No* | 57.1% |
| *Yes* | 42.9% (Roman Catholic, Judaism, Christianity) |
| *Believe in God (or by another name)* | |
| *No* | 25.7% |
| *Yes* | 71.4% |
| *Education Level* | |
| *High school* | 11.4% |
| *Technical degree* | 2.9% |
| *Associates degree* | 5.7% |
| *Bachelor’s degree* | 22.9% |
| *Graduate degree* | 57.1% |
| *Employment* | |
| *No* | 62.9% (retired) |
| *Yes* | 37.1% (full- and part-time) |
| *Ownership of Preferred Woods Site* | |
| *No* | 37.5% |
| *Yes* | 62.5 |

Interviewees reported their area(s) of expertise regardless of employment status. Professions and expertise included machinist, educators (classroom teachers, curriculum developers), social workers, wood workers, lawyers, financial planners/investors, organic farmers, engineers, professed religious in the Roman Catholic rite, speech pathologists, medical researchers, and writers/authors. Notably, many respondents were experts in practice beyond their formal education and/or training, such as organic gardening, mycology, event planning, ecological restoration, and forest management.

These professionally diverse people chose a preferred location they associated with the non-material benefits we discussed in the interview. Many interviewees owned wooded property and chose a preferred location within that space (62.5%, see table 1, above), just over a third chose a preferred location on public land, including national forests and county parks. These spaces were preferred by the respondents for various reasons: they resided there, having taken family photos there, for the view of their home the spot afforded them, because s/he participated in the building of a bridge or installation of a trail or bench, the site was near their home and accessible, or some other of many reasons. All respondents had spent many years of their lifetimes participating in outdoor recreation on the property and within the preferred location they referenced during their interview. Activities included: birdwatching, organic gardening, tree planting, walking, hiking, dog walking, horse riding, trail building, fuel wood harvesting, tree harvesting, and more.

### 3.4.1 Connectedness to Nature Scale

The CNS was useful in this study to evaluate respondents' self-perception of connectedness to nature. Themes within the CNS and associated literature, including

environmental behaviors, resonate strongly with concepts in CES. Means and standard deviations of responses for each question were calculated (Figure 6.).

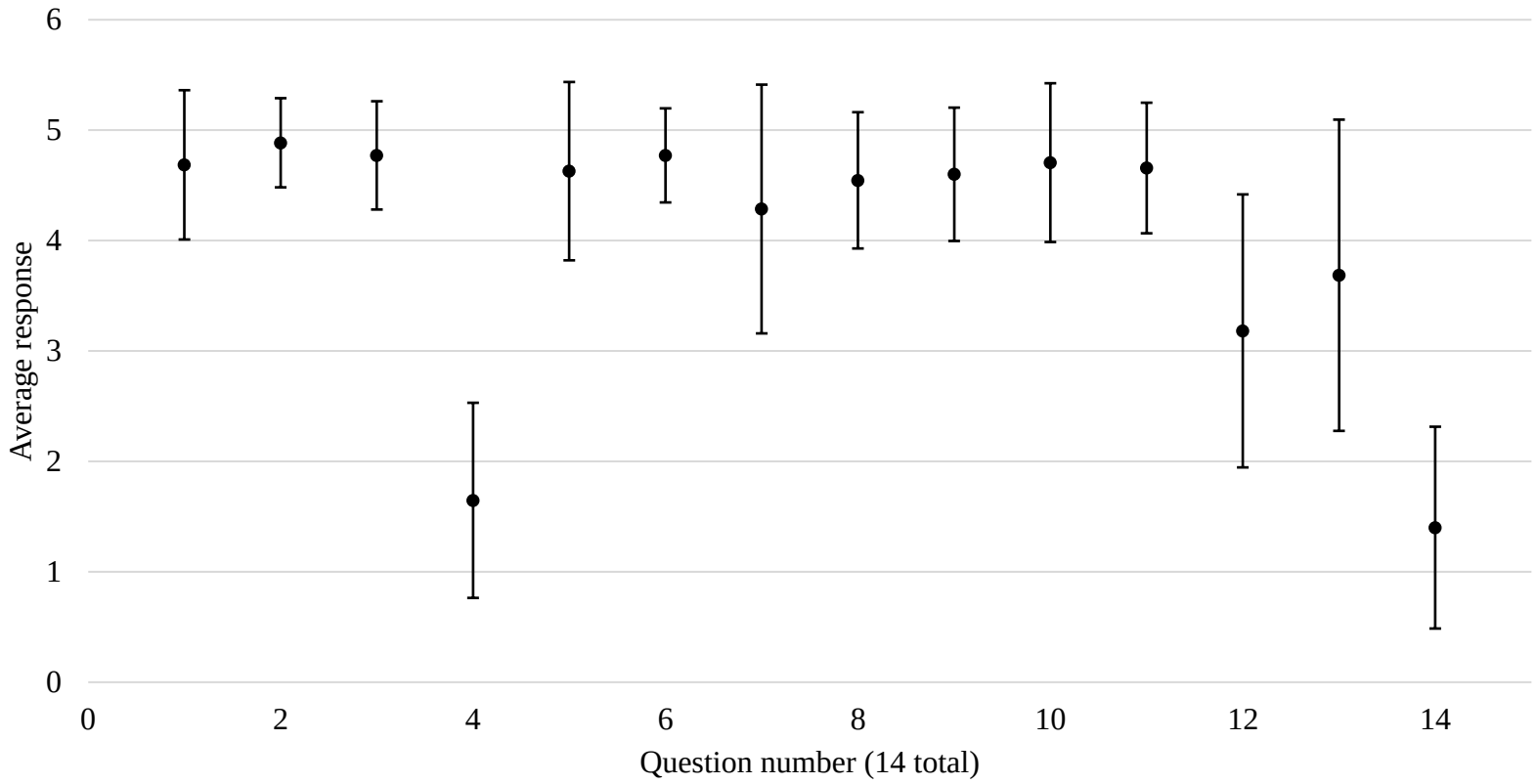


*Figure 6. Connectedness to Nature scale (CNS) with 35 responses. The CNS uses a 1-5 Likert scale; responses are averaged per question here, with standard deviations included.*

As a group, the respondents averaged a score of 4.03, with a standard deviation of 0.78, and ranged from 3.4 to 4.5. Questions 2 (“I often think of the natural world as a community to which I belong”), 3 (“I recognize and appreciate the intelligence of other living organisms”), and 6 (“I often feel a kinship with animals and plants”) have the lowest standard deviation, while questions 13 (“I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees”) and 12 (“When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature”), respectively, have the highest standard deviation. The questions with the highest standard deviation frequently caused the most hesitation by the respondents who found the questions challenging. Questions 4 and 14 are negative questions: ‘I often feel disconnected with nature,’ and, ‘my personal welfare is independent of the welfare of the natural world.’

3.4.2 Thematic coding

1. Feeling connected

The respondents had an overall high perception of their nature connectedness per the CNS. Quotes from their interviews emphasize this strength. As anticipated, CES themes in this research were tightly intertwined, and a theme of ‘connectedness’ threaded many responses and themes. Respondents spoke of connectedness to through time, connectedness to nature as an extension of one’s self or one’s space, and connectedness with non-human beings.

Speakers are identified by number (for example, ‘speaker (1)’) to maintain anonymity. Throughout the following quotes, quotes retain some of the hesitation to demonstrate the manner in which these benefits are communicated, which is another means of understanding how people articulate their experienced CES; that is, deeply, and in a way that is unpracticed, and sometimes a challenge to accurately express.

a. Connectedness through time

Respondents reported feeling connected to other people from the past, feeling connected to future generations, and as gaining perspective of the significance of their life when acknowledging the longevity of trees, woods, and stones, by generally placing themselves along a timeline much longer than their own. This aspect of 'connectedness' captures how respondents felt part of a greater whole.

The longevity of trees' lives was a point of reflection for two people who understood the relevance of their lives in comparison to trees'.

> *I think often about this woods way beyond my lifetime and so some years ago, just to get something started, to get something out there besides weeds, I planted a bunch of sumac… at the same time I was planting seedlings of large, long-lived hardwoods amongst the sumac. So in my mind I know in 70 or 80 years that sumac is going to be all dead, and so will I, but I look beyond my own death quite often when I think about that. And you have to if you want to think about forests in any sensible way, because they're such a long-lived creature or whatever you want to call a forest, a community, so in my mind I just planted the solution. The sumac was a temporary way to get some coverage, some canopy and it'll eventually be gone. So the biggest and long-lived trees are an essential part of it I think, my connection to [the woods] (5).*

> *You know I see [the trees] as being, it's gonna sound really corny, but I think of them as being sentient beings. I mean they are here, and they will be here no matter what kind of stupid crap people pull, unless we kill them. They're gonna be here when we're long gone. And I feel that connection when I'm in the woods, you know, I see a young healthy beech tree and I think about well, that's gonna be here in a couple hundred years, as long as we protect where it's at, and don't do stupid things. I don't know, there's like, a continuity in the forest and a feeling of being connected to this incredibly complex world and every piece of that world is just as important as humans are. And it kind of puts my problems in perspective. So, it grounds me, I mean it makes me feel calm, and okay, and up to the challenges that I have in my life (16).*

Other respondents sensed a connectedness to a larger sense of life or as part of a greater whole in noticing relatively small details, such as a seedling, or a stone.

> *Actually as part of doing this I found, I could show it to you, a little- I'm sure it's a blue spruce seedling out here, and I carefully took that seedling and I have a nursery, I have this vision of that little thing being out there and it just (pause) it's just so big that it always can enrich me and excite me (2).*

*Okay, but it isn't just the trees. It's all the animals, and this is gonna be weird, it's the stones, the stones. I have always loved stones… one of [my stones] has an actual, honest to God, thumbprint of the person who made it from 2000 years ago… To me, we're- it's all one: Our bodies, the stones, the trees, the flying squirrels, the flowers, the sun… there's a spirit in everything. And now these rocks, they're the catalyst of life (2).*

Individuals spoke of connectedness through time to future generations within their relationship with the woods, and distinctly from their perspectives of having contributed significant effort in planting the trees (speaker (5)) and building the trail (speaker (15)).

*It is my distinct hope that I am creating a heritage here. Even though I started from scratch in a personal heritage sense, our long-term goal, [my wife's] and mine, is that before we die we would like to get a written agreement with the township that they would accept [the woods] as a permanently wooded park,… open space at our death… in a sense, kind of leaving a legacy for whoever is in this area next (5).*

*I think of … this trail just being here forever… and so people who, you know, are just being born now will be using this trail when they're older and when I'm long gone… (15).*

b. Connectedness to non-human other/nature

This category highlights direct connections the speakers felt and perceived between their personal well-being and the well-being of non-human others. Speaker (1), who did not claim belief in God or a higher being, expressed her mental, emotional, and spiritual response to her immediate surroundings:

*If I see there's a ton of garlic mustard* [Alliaria petiolate]*,… then that has definite negative impact on how I feel… If I'm doing the vernal pool monitoring and I wade out into the swamp and discover some little island out there that's full of cool plants I've never seen before and I wanna identify them, then that has a totally different effect. It gives me more of an expansive feeling like: oh there's just so much here: it's so interesting, it's beautiful to look at, that's the opposite of when things are not thriving (1).*

Another respondent, who did claim belief in God, described how hunting affected his mental, emotional, and spiritual status in relation to a non-human being's cycle of life and death:

*I had a change of heart on things. I started hunting sometime soon after we bought this property… [Previously] I thought hunters, well, what a bunch of rednecks going out there just seeing if they can kill an animal. But it's a lot harder than it looks… Even if you don't shoot something, it's a rush just sitting out here and, "is that a squirrel or a*

*deer!?" (laughs). But you know, I think part of that, I don't want to… (long pause/tears). When you shoot a deer and it dies like three days later and it's been out here suffering, I mean, ... I remember one of the first times I hunted, I nicked a deer, I took a stupid shot, shouldn't have taken it, I didn't know any better, there was some blood. We tracked the blood trail and came back in the morning and this was in the evening, [we] were back there looking for it, and I puked (sobs). Because I couldn't think of that deer [suffering]… but here I am shooting it and killing it, but if it's not a quick shot, if you can get it down right away, but even then, if you think about that… It's almost like a brotherhood. It's like a worthy adversary. It's all part of the cycling, it's all part of the spirituality. I think that's where you feel the spirit, I'll say the Holy Spirit, through that… (24).*

A third respondent, claiming no belief in God, stated his joy in 'being' with a non-human being, each fully aware of the other (speaker (3)). Speaker (11) supports this idea:

*I've been with one pileated woodpecker for over 45 minutes. He just flew from tree to tree and I would walk with him. He knew I was there, didn't care. That is really to me the most exciting thing in the world, almost (3).*

*I want to be a part of it. I am an animal. And you know most people, if I say that to them they will look at me like, "I'm not no monkey," and you know, we are animals (11).*

One respondent spoke of air as the direct connection between people and 'nature:'

*In* shavasana *and you're meditating and you're thinking about your breathing and I think: I am breathing in the universe and I am exhaling a piece of me. And that's what I think about the forest: I breath in these trees and I give them some of me… (4).*

Connectedness to non-human other was also identified in how people noticed cycles and change in the woods. Respondents felt 'connectedness,' or part of a larger whole, in witnessing growth and change over time of plants and animals in the woods. Speaker (17), male, speaks of how his well-being is enhanced by watching the annual cycle of animal life:

*It's a big part of my being mentally and emotionally, [being] healthy, to sit there and watch the cycle of food every year. The [nature center] which is just up-river, [has an] osprey nest. So, I can watch the osprey with their little ones, and I can see it in person. So that's just a really healthy thing for me (17).*

Speaker (23), female, speaks in a similar way about how being in nature improves her well-being by shedding the 'synthetic' aspects of life to know once more the 'raw' elements.

*There's a rhythm to each of our days, the way the months go, your sense of light, opportunity and oxygen. It's all very apparent out here, very obvious, and I lose track of*

*all that when I'm in a city for too long. But when I come back out here any time of year it is it's like "oh, right." And I can sort of reconnect with even literally the sun and moon. These are rhythms. And the smells, and being able to smell everything, it opens my olfactories and I think, "oh this is what things are supposed to smell like," and I can tell the difference between healthy food and junk food again, because I'm closer to the way things are supposed to smell. Even water, I mean I'm not drinking this water a lot but I'll taste it a lot, and I'll smell it. Just the pristineness of it makes me feel like, "ah, this goes towards things that smell, taste, think, interact, and move like that… (23).*

Another respondent shared the depth of her relationship with nature in thoughts overlapping spirituality and identity, and specifically meaning and purpose. She claimed belief in God/higher being.

*To me it's really important how I start my day. So I will face east, and in the winter the sun's not even up yet. And I get to watch it rise. And I do sun salutations, yoga sun salutations. And sometimes with a mantra going in my head. I'm just honoring the morning. This is part of the Native American medicine wheel. The east, in terms of what season it is, is springtime. The south represents summer. The west represents autumn. And north represents winter. So based on the season, I honor according to what direction it is. Because it's part of the connection. And the energies according to the seasons. Even if that's true, morning is the eastern direction, the afternoon is the southern direction, the evening is the western direction, and night time is northern direction, so every day we're going around the wheel. I'm just bringing that up because I do that. I'm not going to call it a religion, but it's part of my honoring and getting to feel the energy more and more, and it's not just wake up and you're going to be that way all day because everything's fluctuating, and I just want to honor that and flow with it (18).*

c. Connectedness as an extension of one's self, one's space

This section highlights how individuals responded about their sense of 'nature' as an extension of him/herself or their space.

*This place, it's a character in my lifelong story. But it's a specific character. This woods is for me, it's a character, but there's all sorts of characters in it that are particular to this particular place… (23).*

*I always kind of feel like outside is, it's like a room to me, and yet it's not; I stop and think sometimes that if I kept going, I'd, where would I end up this way? My sister spends a few weeks each winter in Mexico, and so I'll turn the way they are sometimes and think, you know I could walk all that way, and at night, it's really neat, there's kind of more of a closeness, I can't describe it really (26).*

2. Cultural Ecosystem Services

The theme of 'connectedness,' emphasized above, is part of spirituality, heritage, and identity. The data is replete with overlapping themes; the manner in which the results are presented highlight different aspects of the saliency of CES-related themes, how people express them, and the benefits people claim to their well-being. The following sections support existing CES themes, such as spirituality, heritage, identity, and inspiration, and continue to show how many people perceive these CES-related benefits as tightly intertwined.

a. Religion/spirituality

Religion and spirituality as a theme covered the range of respondents, from those who actively practiced an organized religion, to those who claimed no belief in God/higher being. The theme of connectedness facilitates the inclusion of spirituality where there is not belief in God/higher being, especially in producing feelings of wonder and awe, or gaining perspective on one's position in a larger whole. This section displays how respondents have consciously linked nature with spirituality, as well as those who did not directly respond to spirituality, but whose responses fell under the theme.

Speakers (5) and (29), both male, describe their spiritual relationship with their preferred places.

> *They,… they give me,… [the woods] give me a connection to the creative force in the universe on a daily basis, and also for this part of the world a very natural basis and that's,… that's the biggest spiritual benefit there for me, the connection to the natural world in a location that is surrounded by very unnatural circumstances and land covers… If a woods is too small the ecological processes that would connect with a woods or a forest are seriously compromised. I mean shrink it all the way down to there's a single tree standing in my front yard here and that's just a tree and that's not a forest, it's not a woods... The essence of a woods is closed canopy, at least in this part of the world. That closed canopy then creates a physical space in which the non-tree ecological consequences of a woods can start to grow and flourish. The bigger the woods, the more fully that orchestra of ecological consequences can unfold. My spiritual connection is to*

*the intricacy of, of God's presence in the natural world and God's presence in the fungus, in the beetles, in everything (5).*

*Well that's basically what it is, it's like a spiritual experience, I've always had that with the woods, various places… Well, I was raised unchurched. I never went to church until I was 28 years old. But before that I still felt a connection in the woods. Out in the woods I did feel a connection with whatever was out there, God has to be something, and I think we read the histories of all the tribes of mankind and I think everybody did that. Try to understand through nature. But becoming churched did not change it. Had no change whatsoever… It's always been a 'yen' to go there (29).*

Speaker (21), female, describes hers:

*How could you not believe in God and live here? I mean it is awesome. It makes us almost cry because, you know when you see the woods bare in the winter and then all of a sudden, all this stuff, the birds, and the worms, it just makes you feel like you're part of it… I just have a real connection with nature… How could you doubt that when everything comes as a pattern in the spring and keeps doing that, how could you not believe there's somebody bigger than us (21)?*

In response to the question, 'Do you practice your religion or faith?', speaker (18), female, responded:

*I do, this is my cathedral [referencing her preferred place], and I practice all the time. In relationship with nature. I feel like that is absolutely essential, to understand how everything is connected, and how it all matters, how we treat the woods, how we treat everything, every person, every animal. It's hard to explain in words sometimes but it's a very deep feeling in my heart… (18).*

She continued:

*I think of the Earth mother, and all of this, even rocks, are her children, and me, I'm her child too, it all is. It's all equal, and anything that's here, needs to be here, for the balance. That's part of my feeling. And trees in particular, because it's a lot of trees that make up the woods, but not just that it's all the life that's here, and I can hear it and know it exists, and the different sounds: the birds, the night sounds, it's amazing and I do feel connected with that because I'm witnessing it. And it's touching my heart… On a still day like this, I'm out walking and I'll stop, and the trees are very still and there's not much of a breeze, but the connection is the breathing. They're giving me oxygen and I'm giving them what they need, and there's this connection that's always there. I think the difference is I know it's there, and I make a point to be conscious of that… (18).*

A common trait of the theme of spirituality as a benefit from nature is where one may gain perspective of one's place in the world in relation to others, with respect to the individual's religious and/or spiritual point of view. The ecosystem's contributions to these services is the

absence, or minimalization, of other human noise (speaker (16)), and the complexity of ecological interactions (speaker (1)). Both of these speakers claimed no belief in God and neither practiced an organized religion.

> *The solitude, or the feeling of solitude of being out in the woods is really a big one I guess. That's what I took away from that retreat I went to in college that kind of changed my view of nature and being out in nature. We spent an entire weekend out there and, you know, you didn't interact with anybody, you're on your own. And there was no such thing as cell phones for people to play around with then, so you were really on your own, by yourself, with yourself, and you had time to think, and so that's just very beneficial on its own (16).*

> *… I think it's kind of the complexity of life, lifeforms, and all this; or the sort of dynamic nature of living things. Each thing individually and the interactions among them, and the way they change over time are definitely a source of wonder and pleasure to me (1).*

Individuals responded to the question of spiritual benefits from nature in a number of ways, including specifically related to a religion he or she practiced, gaining inner peace, and appreciating the present moment. For those who identified as practicing a religion, their responses reflected their perceived personal understanding of how nature enhanced their faith practice. In their comments, the speakers acknowledge that the relationship between their spiritual benefits from nature and their religious practice is personal, and not necessarily an explicit component of the given organized religion he/she identifies with. For two respondents who practiced Roman Catholicism, speaker (2) finds the connection with the organized religion through his personal faith practice and interactions with nature.

> *I guess for me, again I am a practicing Catholic, the property tends to just reinforce that there is something higher, something bigger, it just creates a sense of wonder. They're not directly related, but they are. To me, my religion is one way of expressing the idea of something higher, and this property is another way of expressing that there's some higher order of things. This is not a random event. So that's how they tie for me (2).*

However, speaker (9), female and professed religious in the Roman Catholic rite, stated that she benefitted from the woods as a place to say her prayers, an example of practicing organized religion out of doors.

People spoke of spirituality outside of an organized religion, sometimes emphasizing this was perhaps a religion they had "made up (4)." In other words, people believed in something, and that belief was evident and/or reinforced by being in nature.

> *That's God, nature. I mean it's not, it's pretty loose… There's something, you know, I do. I think that there's a higher power... Do I think it's like got ultimate control of everything? Well, yeah, in the sense that it's going to go on, but it's not about, you know, bowing down or going to church or any of that. I mean I have certainly a reverence for this [indicates woods] … [Lawrence] Ferlinghetti and about the rebirth of wonder and we are patiently awaiting the rebirth of wonder, … wonder and awe are pretty important... (10).*

A couple responding together in an interview related how they had attended a church, but ceased; instead, they called their faith practice the "church of the forest pathway (16)". This simple statement indicates how the husband and wife couple practiced their faith apart from any organized religion. Speaker (12) states: "I guess my faith is just in what nature provides me (12)," indicating her satisfaction with what she has.

Those who stated no belief in God also spoke along the lines of spirituality, thus offering perceptions from a non-religious, non-spiritual point of view. For example, speaker (19) states no belief in God or a higher being and does not identify a faith practice. Her response to the question about spiritual benefits from nature related her perspective on her self-importance and place in the world:

> *Well I guess it's all encompassing. It's difficult to break it into segments to discuss. Its who I am, it's what I value, it informs decisions that I make, how I live my life, how I've spent my time. Much time has been spent in fights to prevent destruction of important places… I remember when [my husband] brought it to my attention, he read that over the course of a year, hundreds of species use an oak tree. The oak tree was at the apex. More species used that species than, say, a spruce. It may have been between three and four hundred. So much goes on at the crown of a tree where none of us see anything. And for instance, the insect world, … there's a whole different world at the crown, and at the center, and then farther down, then at the level, and then below the level… (19).*

Within the theme of spirituality, 'inner peace' is claimed when nature provides people respite from the 'busy-ness' of life. Elements of beauty and meditation overlap with this theme.

Speaker (2), female, who believes in a higher presence without identifying a religious practice, caught herself noticing the view of the stars and the quiet of her home after a busy day of driving:

> *I came home for the third time the same day and I said, "why the h*** am I doing this?" and I can remember opening the car door and slamming it shut and it's dark out and the stars are out, and I thought – we didn't have the interstate then – and there was just this sense of peacefulness and it's like, that's why I do it.*

Speaker (11), male, who spent much of his life in a large city, changed his location after retirement.

> *I don't care how crazy it gets, down there in the rest of the world, I know that I got a quiet,… this is my happy place, right here. And it's always been here, and now I live here… I can hang out here with my horses, and the critters and stuff and absent myself from all that human monkey business, you know?*

Speaker (12), who has spent over ninety years on the same family farm, acknowledges the peace she feels is part of her practice in appreciating her space:

> *Well, just the beauty of it, you know? I mean it,… you go back in the woods and hike around and it's just peaceful, and you don't think about other stuff… I think everybody gets some kind of a feeling, even though they don't know it.*

Respondents identified how being in the woods provided opportunity to focus on the here-and-now, as opposed to the anxieties and/or worries of things past or to come. Speaker (9), female, said:

> *… This is a nice sanctuary, it's peaceful and then my mind gets elevated. See, away from whatever is going on or whatever anxiety I have or things like that. So, it's like clearing my mind to come in here.*

Some speakers used the term 'grounded' in expressing their experiences with nature:

> *Well I always notice when I'm out in the woods I feel a sense of calm, and sense of connectedness, and I think it also, I like to observe a lot, so it causes me to wonder and to think about the environment. I guess the biggest thing would be just, it's very grounding*

> *to me, and somehow when I walk through the woods or sit in that particular space it just, it's very meditative, like it takes my mind away from everything else that might be going on in my life… (14).*

The 'discovery' of species reinforced the idea of spiritual benefits, regardless of religious/spiritual orientation, from the complexity of life people observed. Discovery in this sense is about noticing detail that facilitate being in the present moment and/or bring joy to the individual. People spoke with a joy in 'discovering' how other beings, plant and animal, were living in the space people shared with them, and sometimes the very space the respondents cultivated. 'Discovering' and noticing detail about nature is distinct from the theme of connectedness to a non-human being in how well known the thing of notice is to the observer.

Speaker (17), male, found joy in seeing a place nearby, but previously unknown to him, and per speaker (30), in seeing new-to-her flora.

> *I thought "yeah, you know, I've never been there", so I went there for the first time and it's just gorgeous! The little Muskegon comes from the south and the big Muskegon up from Big Rapids, and they come together… and you can go to that bluff and you overlook that, [whispering] and it's just beautiful! I'd never been there before and there's all kinds of lupines there, all kinds of plants there. It's just about finding out what was up there. It was kind of fun too (17).*

> *It had been wet for a while and all of these mushrooms, I mean so many different types of mushrooms just popped up around the property and we were like, oh look at this one! And I guess that added joy and wonder to the experience that I hadn't felt before (30).*

b. Heritage

Heritage and memories, such as feeling connected to one's ancestors, are part of connectedness through time and a sense of place in that a specific space has meaning originating from long-term, repeated action and interaction. This meaning expands with knowledge of the human history of the space, especially when the people previous to the respondent are of the same family line or social group.

Heritage overlaps strongly with spirituality for speaker (7), male, who also speaks to the effect of aging in his positive experiences with nature.

*I probably and maybe too closely link heritage with spirituality. Um, I feel very close to my ancestors when I'm on that land. It meant a great deal to me. It meant more to me as I aged than it did when I was 17 and going to college the first time, with my grandfather… I came to appreciate the beauty of the land and the people that made it the way it is today (7).*

Speaker (12) referenced her lifetime relationship with the land, over nine decades.

*My grandparents came to this property in 1900… they were hired to run the sugar bush that's in the woods. It was owned by our neighbor and I was born July, and in March [of the following year] when they were doing the sugar bush, that's when I got acquainted with the woods cause they took me down and put me in a box while they did the sugar bush. Ha ha! Work. So, and you know I rambled around in it,… (12)*

The couple in interview (2) readily respond to the question about heritage-related benefits by stating the importance as the place where they had raised their family. Additionally, they acknowledged the labor their children added in planting trees on the land the respondents enjoy as their home, although the children have moved away.

*Woman: Certainly, it was where we raised our children. I mean the kids were integral parts of planting trees.*
*Man: They have these memories of being out here like I was a slave driver. (laughter)*
*Woman: They say it with a smile on their face…(2).*

Connected through time envelops the theme of heritage both in thinking of the past and the future by reflecting on activities, memories, and repeated interactions with a space, and is more than heritage simply in that these responses emphasize continuity.

Heritage includes personal- and collective-level memories from the past that improve people's well-being, as well as thoughts on the active exchange of knowledge, stories, and practices with future generations. Personal-level heritage is restricted to within-family comments; collective-level comments connect the individual respondent to a group she or he identifies as belonging to and overlaps with identity benefits on a collective-level.

Speaker (1), female, said:

*I think my engagement in nature was fostered by some extent by my father… I think I was the one who connected with my father around the garden when I was a kid. Particularly the part of the garden that we called the wild garden (1).*

When asked about benefits concerning heritage, or memories from the past, most people responded with memories of their childhood, a personal level of heritage. Many responses concerning heritage as memories of the past were about woods and being out of doors in general, while some few others identified a specific location with memories from the past. These responses relate more to a sense of belonging, or feeling comfortable, with the out-of-doors, rather than to a specific, distinct space.

Speaker (8), male, remembers his childhood and credits his parents for the exposure to nature as a child.

> *As a young boy, my mother and father bought some land out in the Ozarks, in Missouri. And I spent a lot of time in those woods, and… and that's where I really, generated my love for the out of doors, and for woodlands… for all natural areas. And so, my folks, my family provided that opportunity for me to be involved in, in the Ozark woodlands (8).*

The female of the couple in the interview with speakers (16) had an especially tender memory as she grieved the recent passing of her mother. Her memory indicated a connection with a specific species, in addition to the general warmth she associates with being out of doors:

> *It was just something I grew up with… I can remember walking down a wetland trail with my mom and I must have been really young and we came across a button bush, and she had me learn it's Latin name, you know, and every time I see a button bush* [Cephalanthus occidentalis]*, I think about that (16).*

b.1 Heritage: future thinking

When considering heritage as inter-generational, speaker (1), female and identifying Jewish heritage, spoke from a collective-level point of view about future-thinking heritage in a positive way:

*There's certainly a great many exceptions, but a lot of Jewish people …seem to have a strong sense of social responsibility. So, wanting to do the right thing with respect to future generations or nature might connect with that heritage (1).*

Heritage as 'future thinking' in this research was mostly in individual-level responses, which includes the respondent's family. People responded with both positive and negative ideas specific to intergenerational family relationships.

> *We've raised our kids to enjoy and take advantage of the quiet, peaceful, nonjudgmental backwoods. Our youngest, who's 33, uses that when she's angry or frustrated or depressed. She automatically goes to take a walk in the woods, whether it's [our woods] or another, she's like [her father], the woods is her source of spirituality and groundedness (3).*
>
> *… and I would say that all of our kids have a good attachment to the outdoors. Being outdoors, going hiking, going camping, they all thoroughly enjoy it… I think if anything you could see we've started a tradition that is important. I hadn't thought of that (2).*

However, when considering the spaces and sentiments toward nature going forward, whether through their own family line or others, respondents reported less benefit, and more anxiety.

> *It's hard to project out with the state we're in right now [laughs] you know what I mean? Simply because it's so horrible. To me anyway… I've got one [child] out of the three, one almost has no contact with nature. One is kind of in between and one is a little bit more like me. It seems like I'm seeing less and less of people being concerned or enjoying the natural things. Though, there may be an uptrend. It may have hit bottom and be climbing out, I don't know (20).*

Many respondents had articulated their ultimate 'future thinking' by donating their woods and their land to a land conservancy, either in full or through a conservation easement, so that the 'nature' they had cultivated and benefitted from would remain in relative perpetuity.

> *Where we see the future of the land and in respects to our family, we have set aside two partials on the property. One is eight acres and one is ten. And we have told our son that's for him to build his home on with his family. We will be here. He could be out there and we could interact with the grandchildren. Right now, that's where we see the future, because the rest of the land is donated to conservation, so it will never be built on. But those two partials are for family, to keep it all for the family to use. That's our vision for*

*the future. We've thought about being buried out there. I don't know. But yeah, we've thought of that (22).*

These reflections were spoken sometimes with conviction, as speaker (22) above, and other times with conflict when the future of the land was uncertain. A strong aspect of this form of 'future thinking' concerned who among the respondent's family/people were trusted to care for the property as determined by the respondent. For example, one respondent, male, was active in a state-wide land conservation agency and actively cared for one of the agency's properties near his home. He considers his conservation work as his "gift back to the world (29)." However, he had identified a grandson to inherit his personal property, a grandson who helped him in his conservation work.

Where no close associates (family members or neighbors) were identified, the land conservation agency was a viable option. Speaker (6) related how she and her husband, who had planted over 20,000 trees on their property in addition to harvesting fuel wood and hiking and walking the woods, made the decision to donate their land.

*Our three children are in Michigan but not any closer than an hour away, and [my husband] was looking ahead to when we were no longer able to use the property… None of [the children] could come and check on us periodically that sort of a thing, … and none of the three kids were interested in that particular piece of property. [My husband] decided that he would like to [donate the land], to keep some green space, and I guess that's probably an important part of our answer here, is that [this town] is a small town right now, but it will get bigger, that's a given, and he wanted to keep an area open… (6).*

Lacking a readily identifiable person or people upon whom they could bestow this trust, the respondents spoke with some despair out of concern for their 'preferred place' and their family members.

*Well, I think that's why we're donating the land to the conservancy… We have 16 nieces and nephews, and 30 some grand-nieces or nephews, and none of them has ever said, at least to us, "oh, I would love to live in a place like this." And that just kind of bothers me in a way that because, but I realize I can't see the world the way they do, you know,… But to me, if someone had said that, they'd probably be in our will, but that's why going*

*forward I just think it's so important to preserve areas and protect them. Because without planning places like this to run to when you need to, it's not good (26).*

*Well, [grandson] is not gonna, he doesn't love it like I do, but I don't know how, because, the time that he spent with me. I don't know how that's gonna affect him later, okay? When he's 24, 30 and all lost, you know I hope he'll come back here and plant his spirit here too, and continue it. So, I don't know. I wish for that (11).*

b.2 Sharing

Sharing is a sub-theme of 'heritage' because the responses concern interactions between people that perpetuate practices and increase knowledge of the outdoors. Respondents spoke about sharing their wooded space intergenerationally and/or within age groups not amongst family, and particularly through K-12 education. Some respondents were clear in stating the joy they felt in watching others enjoy their preferred places, purposefully inviting and guiding others through the property; other respondents were clear in stating their despair about their perceptions of how little people cared about the status of nature. The following quotes share the joy and pride people found in purposefully inviting and guiding others in the spaces.

*We want to preserve the environment and we want to introduce it to more people and get them to enjoying it, and being concerned… Well, yes, I feel very strongly about preserving this for future generations. One of the things I like to do most is introduce young children to the woods (29).*

*We hold classes here. We just had the state, it's State Department of Ag., MAEAP (Michigan Agriculture Environmental Assurance Program). Forest, wildlife and habitat techs for that… So yeah, we've done that, you know, and MSU usually sends their organic people out here… I mean there's always somebody that wants to, "Can I bring the kids out?" Yeah, that's good. That's good (10).*

*One of the things we always talk about with the national scenic trail, here the North Country Trail, … we're always talking about building a legacy. That's one of the things I think that motivates me in this process now and motivates other volunteers is that we know that it's something that we're doing not just now but for generations to come, to enjoy being able to walk through these forests (14).*

Speaker (2), female, stated that she enjoyed bringing people to share in the 'wonderful things' of her property, including woods, wildflowers, and an overlook of a pond, often people of her own age set. Speaker (23), female, said:

*I do make maple syrup in the Springtime, but that ends up also being an attraction for people to come - an invitation to come and enjoy the Spring burst. I mean the syruping is just the excuse (23).*

In a different portion of the interview, speaker (23) also spoke of conflict within her family on how best to conserve the space she loved so much.

Speaker (27), female, invited and guided people through her preferred place on an island off Michigan's upper peninsula.

> *I bring other people there who can't go off in a tent or a kayak like I can, … my second guest was I think in her 90s. She was going blind, had hearing aids, and she could still see the land and the colors of the fall trees, and the joy that it brought her. And I bring other friends… and it's a treasure to me to be able to do that for other people, it's what I give back. I took my friends down the trail and then on out and they just loved it (27).*

The K-12 public education system is a specific part of the theme of sharing. The K-12 public education system was a particular point of both negative and positive views for a number of respondents. Some respondents had developed expertise in ecological restoration through their own practice and had donated their land in some way to a conservation agency. Many actively invited the public, and especially K-12 school tours, to learn about nature at their site.

Speaker (8) had actively managed the property to restore biological diversity, including oak-hickory woods, wetlands, and prairie meadows. His thoughts about heritage as an intergenerational process and how that affected his well-being ranged from concern to hope, and revolved around his experiences in sharing his ecological restoration work with school-aged children.

> *I'm concerned about the human species and what we're doing to the environment… But if they can see an area gunned by one person, me, worked on by one person, trying to transform this into a very viable, rich woodlot… the students that come out here, they're out here for a couple days, they see my successes, they can see my failures too – I point those out. But uh, they leave and say "Oh, I wanna do this." It stimulates their interest in restoration, ecological restoration... These young kids in the K-12 system come out here and look at my grassland and they're just thrilled to be able to do this. And now, how*

*much of this joy is just getting out of routine classes, I don't know. But I know they leave having said, "Hey this was worthwhile" (8).*

*… it's fun when you hear them, when they write letters or come back and they say, "this is the best field trip we ever had." It is important to us. We do school programs, we talk about it when we go to kids, but the best is to get them out here (3).*

K-12 schoolteachers who incorporated nature education into their classrooms shared their joys and frustrations. The joy was found in recalling memories of activities and events, and reflecting upon their influence on other's thinking.

*When I was teaching we used to use [these woods, her preferred place] as a place to take the Girls Athletic Association (GAA) camping, we'd go camping back there [in the woods]. I had a little campground,… I meet students today that might be grandparents and they say, "Remember the time we,…" And yeah, lots of memories. The time I had a Saint Bernard named Duchess, nice dog, and she crawled into a sleeping bag one time with one of the women who wasn't a camper, and she was cold cause it was cold, it mighta even been snowing, anyhow, the dog crawled in, snuggled up to her and kept her warm (12).*

Speaker (12) participated in this study at 93 years of age. Echoing her experience, a recently retired teacher reported a very similar effect on her students because of her teaching:

*I had kids keep an ecological journal of a spot. That was a big part of their work and they had to identify one place and go out to it multiple times during the week, sit in it and record what they were seeing and how they were feeling, identify plants and animals, watch the birds, listen to things, and that was a big part of their grade, which they loved, most of them, some of them were very frightened to begin with. I had one little girl say, "Mrs. [], I think I saw a UFO, there was a milky disk in the sky!" I said, "Heather, honey that was the moon!" I mean… these are rural kids and when I go and speak with those kids and some of them are pushing 50 now, and I say what do you remember about class? "Oh, I remember my spot. Do you know they cut those trees down and built condos there?" It's obviously just kind of transformative to a lot of them, and I think that's really cool (16).*

Speaker (13) brought her classroom students to her preferred site to participate in work attempting to control invasive species. She too, as the above speakers, found joy in watching her students experience 'nature;' however, she also articulated negative perceptions of future generations finding benefits in nature:

*I do know as an educator it's really disgusting to me that we don't get kids outside more. I say that in talking with other teachers and principals a lot because I feel like, you know,*

*we have all these ADHD and dahahahadada and you know, if you get the kids outside that might help. But my biggest thing is, we are expecting our children to grow up to respect the environment and we don't even let them out in it. And it really bugs me. Cause I'm like, how can you ask them to respect it when some of them are scared of it, and some of them don't like it, and some of them love it but they can't get excited about it because they know they're coming to school to sit in a desk and work. So, it's frustration looking forward, I guess, I would like to see that change (13).*

Heritage is about memories and purposeful consideration about sharing with future generations. People shared positive and negative thoughts about the capacity for people, themselves and others, to identify benefits from nature. Respondents participated in heritage as an intergenerational activity with their own family and in various social groups. Respondents identified ways in which heritage both benefitted and detracted from their well-being.

c. Identity

Respondents reported a stronger sense of self-knowledge and a sense of belonging because of the woods. Identity, as a theme, overlapped in many ways with spirituality. For example, speaker (15), female, shared a remarkable story about her self-growth intertwined with her sense of faith and spirituality.

*Well this whole trail has been part of my personal and spiritual development. … One of the [church] staff members brought me out here and we walked the property and in that moment when we were walking the property and I saw the creek, … when we walked it, the Holy Spirit just came over me and said, there has to be trail here! There just has to be a trail here! And that was the beginning of it... I had never built a trail so the whole thing when you talk about identity, and spirituality, it was a mix together. [One day after working with volunteers on the trail] I left feeling a little defeated and questioning, who I was and what I was doing, and is it even worth it, and I had, I had been working through approval addiction, so I want people's approval and um, I had learned that I only needed God's approval,… [I was] totally on my own with God, and I didn't need anybody else [to build this trail]. The experiences on the trail have been life-changing for me because they helped develop my character and having belief and feeling closer to God. So that's how the trail came about, bit, by bit, by bit (15).*

In response to a question about spirituality, speaker (20), male, responded more in line with identity, as the woods and his work in them were, he felt, a part of who he was:

*I have never thought of as being spiritual. In fact, until you contacted me, I had never really thought it out that well,… Trees have been such a huge part of my life from birth, almost. They still are, … My dad was into trees. I've done a lot of lumberjacking, between years in high school, summers, and college summers. I've always enjoyed spending my time in trees, woods. That's been from way, way back... Even now, I do a lot of transplanting on my own properties, because there's certain trees that aren't going to get anywhere where they're at if they're growing next to another one. I'm always moving trees around so that they will do better…, but [trees have] always been such a powerful part of my life, and I'm always at ease in forests, and comfortable and feel good. Some of these categories are big, so it's hard… I rest more easily in the natural elements, because there's no other power that I specifically believe in (20).*

Speaker (2), male, shared how his work in ecological restoration satisfied a personality trait he had expressed first in his professional career as an engineer:

*From early on I have been a collector and a builder and to me this has turned out to be my ultimate project… it consumes a high percentage of my time during everything but winter, and even there I'm thinking about it. It's also one of those things that I take a lot of personal pride in, that this has been created and I had a lot to do with it, and that's very satisfying (2).*

A benefit within the theme of identity speaks of a person's sense of knowing, in a way, his or her true place in the world, where he or she feels most comfortable with him or herself; in essence, that being outside is simply who the person is.

*It's, it's. I can't even tell you how. It's just so much part of me that it just, I don't even think about it anymore, just is, you know, and that's really, I mean, it's good. It's really good… It's an expression of being able to express myself creatively in this environment because that's what this is [indicating woods]. I mean, I'm not saying [I've touched] every stick, but most,… [These woods] have been a really important outlet for me in terms of preserving my, um, psychological integrity for sure. Is that this outlet, you know, allows me to ignore the frustration – I don't have a cell phone. I don't, we don't have an antenna. I don't watch [political news outlets], but I lived in the political world enough to know that it was really important for me to come home and be home (10).*

Speaker (5), male, expressed how his forest is part of his identity, which is also part of his spirituality:

*These woods are at or near the heart of my sense of belonging in this space, in this particular geographical location… they are the center of my world frankly… I'm uh I'm psychologically and personally not well built for the path that most of my life has followed... I have three college degrees and I've filled professional positions all my working life. I've lived mostly in suburban settings and none of that really is me. So I've lived superficially, or from the outside view I've lived a life, most of my adult life, that*

*isn't really the person I am. And I'm still living in a suburb as you can see, this is a 40 by 80 foot lot, so that woods is more the kind of person I am. If I had the opportunity and the money, that woods would be 100 acres and I'd be there every day… but some, some piece of ground that is fully stocked with trees and then all the other things that go along with a group of trees ecologically is uh, is very much, that's how I, at my core that's how I relate to being alive on this planet. And everything else, all the buildings and the cars and everything else and the offices that I've worked in, they're all kind of secondary (5).*

Speaker (13), female, responded to a question of identity benefits from nature by attesting to how much she needs nature, in comparison to other people she knows.

*I need places like this to go to… I need to escape to something like this, in order to just kinda breathe. I feel like as a teacher life gets pretty stressful, love the job, it just gets really stressful sometimes, and you know coming to a quiet place is very important to me, and it's become more important to me as I get older because I just feel like it makes a difference for me, it helps me calm down, it helps me know that everything is going to be okay, you just gotta ride it through… And knowing that grounds me, you know, I feel like it's just a part of me… (13).*

Speaker (22), female, reflects in a way similar to speaker (13) in response to the question about identity:

*I was the oddball [in my family]. I'm the black sheep, I do everything different. I would be the one in the woods, I would make a little play area out in the woods. I would cut down the brush, I'd get loose bark to make a sidewalk, I did that stuff. I would make a little playhouse for myself. I was always outside, and none of my sisters were really interested. I don't know why it was me. And to this day, I'm the most active, going kayaking and running and all that stuff, out of my family. I don't know. It's odd. I always thought I was adopted [laughs], but I look too much like my sister for that dream to come true. I know I need to be in nature (22).*

Speaker (16), male, considers his and his wife's identity benefits from nature by imagining the loss of their experiences in nature.

*I reflect on the most … the potential absence of this sort of experience in the forest, and what that would do to us. It's hard to fathom there would ever be a time in our life that we couldn't get out and enjoy spots like this, … I think that says a lot about being wrapped up in identity because we would miss it too much (16).*

In response to a question about how, if at all, racial and/or ethnic group identities the respondent identified with affected his or her sense of benefit from the woods, speaker (4), female, who identified as Caucasian but whose close family identified other than Caucasian,

shared how racial and ethnic identities played a role, in her case, about identity benefits from the woods:

> *Well, I think I don't really think I fit in anywhere. I'm kind of tribe-less or all-tribe and (pause) I think this suits me. I think this house and these woods have been able to shelter me and my family (4).*

Speaker (11), male, shared similar sentiments:

> *…it's been important for me personally, being a Melungeon, an "African American"* [quotes by speaker] *and you know coming up in this country, um, when I was younger, cultural identity was important to me. My lack of cultural identity, what am I? I live in the city, and most uh, black people that identify as urban culture, that is not me. I'm a foreigner here. Uh, I don't, I'm a black man, I'm a foreigner in my own country, okay? Um, my grandfather was half Cherokee and half Irish, and he's my, my closest associate, so now what do I do with that? … I feel like an orphan, you know, nobody saying "This is my child!" You know? "You belong to me." So I had to, you know, forge my own identity, okay? And now, at the point where I'm 64 years old and this is my place, so I am learning to be comfortable in my own skin, so this is what I am, alright? This is what I am. I don't feel like I have to go out to try to belong to any group, this is what I am, and well, you know, my heritage and my bloodline start from here (11).*

Expressions including race and ethnicity are very specific cases of how people feel such strong benefits in terms of identity because of the woods. Within the theme of identity, people speak of benefits from the woods as a contrast to the very human and social world where politics, race, gender, and other identities and activities are heavily emphasized and contested. When these respondents are in their preferred place in the woods, they feel themselves relieved of those social pressures, and feel good about themselves again, feel complete and whole.

Respondents also expressed identity at a collective level, related to a group he or she belonged to. The groups speakers identified with were the African American community, specifically at an historically African American resort; as people from Michigan; extended families; and as part of a religion. These statements demonstrate how people connect with a site as part of a group she or she identifies as belonging to, and his or her thoughts on the importance

of that group's connection with the site. This meaning comes from knowledge of the human history of the space, with people previous to the respondents belonging to the same family and/or social group.

Speakers (11) and (30) responded in ways characterizing how group identity affects their benefits from nature. They spoke in the context of an historically African American resort, and emphasized their perspectives that without the collective-level attention to the site, this place, distinct in American history, will disappear.

> *You know as far as that Black Eden concept,… we're trying to, we are trying to make this, to bring about a renaissance, that, this place was a significant, culturally significant for black- I mean, culturally significant for black people and if we lose it, it will be gone (11).*
>
> *Well specifically in [this place] one of our reasons for being business and community advocates in [this place] is so that we are preserving the lakes and the forested areas, for continued generations to appreciate it, appreciate what has come before them and to keep the authentic cultural and historical feel and membership in the community so that there is always this, so that it will continue, and it will not disappear (30).*

Speaker (29) shared how his identity as a Michigander (person from Michigan) was emphasized in the woods and the trees of the state:

> *Michigan became a state in 1837, and about that time every township had an administrator of shade trees. They had these rows of trees along every road so that the horses would have shade. And they usually used sugar maples because they spread and are very cooling. And when I grew up a lot of these roads around here were just lined up with sugar maples on each side, and there'd been a lot that had died out. We in this township, and we have a piece of property down the road by the cemetery, we replanted a single row of sugar maples to recreate that. Did that in 2006, been there 12 years now since we planted those, we're recreating history you know. Trying to bring it back, a section of it, to show what it was. That was a good, yeah trees are our history too (29).*

Speaker (30), female, adds thoughts about identity from the perspective of a certain family and ancestral line:

> *So my mom grew up on the islands and, so it's just kind of, when we went back to visit, people were still, you know very connected to and interacting with the land, working, playing, where their homes were located, so I kind of feel like maybe that's why I have a stronger connection with the natural wooded areas and lakes and water, streams. And*

> *then I just, I dunno, I guess, I do feel like the ancestors, you know? Are definitely watching over these areas and then I feel a connection with them (30).*

Speaker (25), male, speaks to a collective level of identity in sharing that he is like two of his cousins who like to go to "cabins way up north, where you can't see anybody, they don't talk to anybody (25)." Speaker (25) identifies himself and some of his extended family as people who need to be immersed in 'nature.'

Other respondents state collective-level identities related to religious groups and consider how this plays a role in their relationship with nature. Speaker (24), male, investor and restoration ecologist, identifies with the Anabaptist religion and says, "I think it's very Anabaptist to care for the environment in my opinion," although he simultaneously acknowledges the organized religion as a whole might not agree with him on that.

d. Meaning and purpose

People spoke of gaining meaning and purpose from nature. This overlaps with spirituality and is specific to people having found meaning and purpose to their lives while spending time in the woods. These statements reflect a motivation to wake up in the morning, an individual's *raison d'être*, because of nature. Speaker (5), male, articulates the sentiment:

> *I've thought often that these trees are my children because I don't have children in the conventional sense of that word. My nurturing tendencies are being poured out on those trees… you birthed those children probably or adopted them maybe as young and then you spent every day of your life doing something that you think, you hope is positive. Pouring some positive energy and activity into your children's lives and um, I think I'm having a very similar experience and relationship and that's, that's a big part of what keeps me going back. It would be like if you had a 10-year-old and you said "well, okay kid you're on your own," you wouldn't want to do that... I mean you see these children grow, and, so at every stage in their lives you're just looping back and enjoying their growth process and what you are able to contribute to that. I think, I think it's a really good analogy (5).*

Speaker (8), male, who cultivated a forest at a site that had been clear-cut previous to his ownership, says:

*I really feel that this woodlot has given me an opportunity because of something I see very meaningful, and has an impact for a lot of wildlife and the human species, for generations to come. So yeah, it's important for me to do this and so I, what I do in retirement is as important as what I did in medical research. Equally important… It's very meaningful to do something that's positive, that's worthwhile. And one of the reasons I went into medical research is that I could do things that are positive for people. Well, this is not only positive for people, this ecological restoration, but it's positive for all living organisms. It's very important (8).*

Some people orient their lives around the strength of their positive relationship with nature.

*I mean, my sense of meaning in life, meaning of life I guess, is very deeply connected to nature there's no question about that, and has been from childhood (1).*

Speaker (27), female, considered meaning as memories, and that these meaningful memories, overlapping with heritage, was one reason why she had positive relationships with nature, and others around her did not.

*[Nature] has meaning to me,… My parents loved it, I've been taught the love of it, it was the source of fun times to go to the beach and have a picnic, in the snow to stir the cocoa until your hot dog fell in or the marshmallow fell in and then we laughed all the way home and stuff like that. Camping in Canada we had bears in camp, bear tracks up the car; it's memories, and we lived in the tent for five months of the year (27).*

e. Inspiration

Inspiration relates to artistic products and actions, and in this research to prayer, as well. Artistic products and actions include writing, painting, and photography. In many cases, the artwork reflects the artist, thus also overlaps with identity. Speaker (1), female, grew up gardening with her father. She says:

*I told you that I write fiction, and the first story when I was in college I won an award for a story, it was kind of a novella. It was called the wild garden, so there's sort of a deep thread there (1).*

Inspiration for artistic products overlap with memories and meaning of a place as well. Speaker (4), female, shares how her art also resonates with her sense of self and personal meaning.

> *When I would garden I would find these stones and I would just keep them. They're all over the house, these stones. And I would drill them… and make necklaces and bracelets out of them. And when my daughter went off …to college I gave her a bracelet with stones from here. She helped me design the garden, because it was her and I, 'cause my marriage broke up shortly after we moved in here. So, the stones mean something, they've always meant something (4).*

Speaker (9), female, is an expert in mycology, which she learned from her father and grandmother. Her mycology practice is also a means for inspiration in sharing knowledge with community members.

> *Well, you heard me talk about mycology, certainly use [these woods] for that, I have all these years really. I do take pictures; this year I decided my project would be to take photographs of any species of mushrooms I see while I'm walking and then I'll make a slideshow. I'm also involved with the watershed conservancy, see, and with the new manager we have … he is doing programs once a month at the library, so I'm sure one of those programs for the winter would be presenting the mushrooms of [] county parks or something,… (9).*

Speaker (27), female, relates how one form of benefit evolved into another, from gaining knowledge and skills, to inspiring artistic products, to satisfaction in identifying plant species in the woods:

> *I needed money for our son when he was approaching college and I started this stationary business and one of my friends got me in the botany club, I learned so much from those monthly meetings, she got me into the wildflower show and I was selling my stationary which were scenes of wildlife and nature and then I would do poetry with them, and I learned so much. Now I took that knowledge and now I see it in the woods where I'm walking, I know how to look up what a plant is, I know how to key, mostly I take pictures, maybe I'll do a painting of them, but it's using what I have learned and the experiences,… (27).*

Other speakers felt inspiration from a different angle of understanding. Speaker (18), a self-described 'body person,' which is to say her expertise was reading movement in others, was regularly inspired to 'move' with the trees:

> *And when it's windier, and the trees are moving, you can hear the wind in the trees, and that's awesome. Some people know this about me; I don't care. I'm kind of a body person, so when I look high and they're swaying, I dance with them. I bring my arms up and start dancing and sway with them and I swear they know it. Not, like we know something, but we're connecting, and I'll go like this (waves arms back and forth above head) and I'll spend time out there, dancing with the trees (18).*

Speaker (27), female and practicing Roman Catholic, described her preferred place as "…a house on the lake [that] inspires spontaneous awe and reverential prayer to me (27)."

## 3.5 Discussion

This research explored CES from forested land, specifically spirituality, heritage, identity with connectedness to nature and sense of place, as benefits to Michigan forest stakeholders. The respondents scored strongly connected to nature on the CNS, and their interviews, analyzed qualitatively, supported this point. Connectedness as a theme facilitated interpretation of spirituality, heritage, identity, and sense of place, but all these themes are strongly overlapping in the results and in previous research. This means this research supports the developing modification of the definition of CES: as benefits from a relationship with nature that contribute toward one's sense of a life lived well and full of meaning.

Research has found sense of place to be comprised of four large dimensions: personal, such as aesthetics and emotions; social; activity, such as harvesting; and heritage, such as family ancestry, livelihoods, and traditional ecological knowledge (Poe et al., 2016). As seen in research in Hawai'i, USA, residence time in an area appears to correlate with the strength of overlap between heritage and identity (Gould et al., 2014). These dimensions are supported in research presented here, where people in Michigan feel good when in nature, appreciate the social aspects that contributed to their positive association with nature, frequently recreate or actively cultivate their 'preferred place,' as well as through the theme of connectedness through time to other people as heritage.

Connectedness to nature, environmental identity, environmental self-identity, and place identity as part of sense of place, all relate to a similar theory: about how one perceives oneself as part of nature (Balundė et al., 2019). Self-identity is also formed in relation to others, so that individual and collective-level heritage of where one comes from plays a strong role in understanding one's identity. Sense of place relates to heritage through place attachment and place meaning, such as a farm where a person meets their material and/or financial needs, and has meaning as a multi-generational site and/or livelihood. Spirituality via unifying interconnectedness is important, as individuals with a strong sense of place may feel connected to the human others that preceded them on the land or in the practice.

Research on the R/S complex indicates that a common theme of spirituality is 'unifying interconnectedness' that includes nature connectedness (McClintock et al., 2016). Unifying interconnectedness is the conscious perception of a connection to other people and forms of life (McClintock et al., 2016). This sense of 'being with' human and non-human beings threaded responses from speakers regardless of religious and spiritual beliefs. People felt part of a larger whole in recognizing their interdependence upon nature, such as via clean air to breathe or water to drink, or food to eat. The theme of connectedness was also found as feeling nature as an extension of self and/or space, as well as to other people through time. Spirituality overlaps identity by way of an individual gaining a sense of self-knowledge and feeling like they belong. Spirituality overlapped with heritage, especially where the individual had a specific image of his/her ancestors.

Personal spirituality is an innate human faculty, with or without religion; spirituality and religion are highly overlapping in and of themselves, and revolve around "relationships with the transcendent, sacred, and ultimate dimensions of existence (Emmons 2000 *in* McClintock et al.,

2016). Spirituality is also understood as an individual's inner experience and/or belief system that gives meaning to existence and allows one to transcend the present context (Kamitsis & Francis, 2013).

Results from this research show spirituality is a large umbrella under which people may feel wonder and/or awe at the complexity and resiliency of ecological interactions, or in empathy toward non-human beings. People felt 'grounded' and inner peace. Spirituality was practiced formally in an organized religion, or was one's sense of being part of a larger whole, regardless of belief in God or a higher being. A sense of spirituality was found to be achieved per instant or developed over time through 'discovery,' or the purposeful noticing of details in nature; or through recreation and activity that enabled people to feel in a meditative-like state. As some respondents stated, "everybody feels something," it's just a matter of what they call it.

Elements of sense of place and heritage were part of the connectedness theme as 'connected through time.' Sense of place is defined as the meanings and attachment to a setting held by an individual or a group; thus the concept envelopes place attachment and place meanings (Masterson et al., 2017). Heritage as memories or sites from the past is enveloped in this consideration of sense of place. Nature, either a specific site or generally, provided people with a physical connection to their family lineage. For some, this type of connectedness from the past and/or meeting current needs included thoughts about future generations using the space in a similar way to meet their needs and feel some benefit. Place meaning emerged from respondents whose property was inter-generational and thus tied to a specific setting, as well as from respondents who generally felt 'at home' in nature because of memories of their childhood, and/or an extrapolation of comfort in one type of environmental setting to another.

Research in environmental psychology suggests two types of well-being affected in association with connectedness to nature. Eudaimonic, or feeling that the person lives a meaningful life; and hedonic, or 'feeling well,' such as with positive emotions. Nature connectedness affecting both types of well-being. Connectedness to nature has been researched as a trait, or an individual's experiential sense of oneness with the natural world, and in relation to human well-being (Howell et al., 2011). Because connectedness to nature engages with a sense of meaningful involvement in something larger than oneself, the aspect of human well-being affected is eudaimonic, or living a fulfilled life and having a sense of meaning (Howell et al., 2011). Eudaimonic well-being is associated with psychological and social health (Howell et al., 2011).

Both eudaimonic and hedonic well-being is supported in the case of Michigan forest stakeholders. While being in 'nature,' in their woods and their 'preferred place,' the individuals reported feeling well, relaxed and without stress. However, their perceptions of others' lack of concern about nature, as well as their activities toward conservation, from participating in natural history indexes to advocating for city or county policy, caused frustration and sadness, and a lot of hard labor. Thus, as a couple respondents put it, their relationship with nature was integral to their being, and also a cause for emotional, spiritual, and mental distress as favorite nature-places were plowed under and developed. Individuals experienced 'feeling well' in the woods so much that they felt motivated to behave in ways to conserve the space, which resulted in meaningful experiences that may not always have been happy or of a 'feeling well' kind of state, although they did feel they were living a good life.

There are many statistically significant correlations between the themes in this research and nature connectedness. Spirituality has been found to mediate the relationship between

engagement with nature and psychological well-being, so that the benefits associated with exposure to nature may be in part due to, or enhanced by, an individual's sense of spirituality (Kamitsis & Francis, 2013). "Connecting with the earth" was commonly used to describe a component of spirituality (Kamitsis & Francis, 2013), which resonates with the Michiganders who described their experiences in nature as beneficial to their well-being because it was 'grounding.' Stronger perceptions of C2N was also correlated with more 'immersive' outdoor activity such as walking (Wyles et al., 2019). Other research has found that meaning in life potentially mediates the relationship between C2N and well-being (Howell et al., 2011). The researched population of Michigan supports this trend, as all respondents had years of history spending time immersed in the woods, and many were 'older.' The C2N literature did not specify race and/or ethnicity correlations.

Per psychological well-being, mindfulness is the ability to attend to the present moment, and/or of being in state of high awareness with no judgement (Howell et al., 2011). Mindfulness increases a person's ability to think from a different perspective (Wang et al., 2016), and greater mindfulness is associated with more positive and less negative emotions, greater life satisfaction, and greater autonomy (Schutte & Malouff, 2018), as well as reducing biases (Wang et al., 2016). Mindfulness is significantly correlated with C2N, suggesting a strongly reciprocal relationship (Schutte & Malouff, 2018; Wang et al., 2016). Results from this research provide many instances where respondents relied on nature to achieve a meditative state, or at least as a means to withdraw from high-stress busy-ness of daily living.

Per social well-being, people have an innate desire to belong, and connectedness to nature and social connectedness both satisfy this need, in theory (Moreton et al., 2019). In their study, Moreton and others (2019) found a positive relationship between nature connectedness

and social connectedness, although this relationship was the strongest for more abstract, rather than specific, social ties. This result can be understood with the idea that a strong connection to nature is important, and maybe equally as part of one's self-perception as a member of a certain nationality, but connectedness to nature is not as important as one's best friend. While C2N was positively correlated with both psychological and social well-being, researchers noted that the social measures reflected more eudaimonic types of well-being (Howell et al., 2011). This is reflected in the results through the theme of sharing, where people were pro-environmental in cultivation or conserving somehow their 'preferred place,' and pro-social in thinking of others who will also be able to use the space.

There is an on-going quest to understand the theory of how connectedness to nature promotes caring for nature, which in turn promotes pro-environmental behaviors (Balundė et al., 2019). This is important because ES science research is intended to understand the inter-dependencies of people and nature, and CES are heralded as the benefits most likely to engage people in conservation of the world's natural resources (Daniel et al., 2012; Satz et al., 2013). This research gives evidence that CES themes of spirituality, heritage, and identity may be captured in part through connectedness to nature.

Sense of place specified for 'natural' environments may promote pro-environmental behavior, but generally, place attachment does not directly correspond to pro-environmental actions (Masterson et al., 2017). There is a general understanding that people-place relations reinforce protective behavior, especially between place attachment and conservation (Masterson et al., 2017).

The correlations of connectedness to nature and sense of place to natural resource conservation behavior was studied amongst Australian farmers (Gosling & Williams, 2010).

While the results are tempered by the fact that farmers have multiple goals on their land, and whose decisions about the land are constrained by the fact that they must make money to live, and use time and machines to enact natural resource conservation, Gosling and Williams found a moderate positive association between C2N and conservation behavior, and little association between sense of place and conservation behavior (2010). Conservation behavior in their study was conceived as higher cost activities, such as tree planting, fencing of native vegetation, and/or setting aside areas for native planting, all of which were activities respondents in this research either had done or considered doing.

Authors argue that place, as a concept, has more meaning and thus more potential power in predicting conservation and pro-environmental behavior (Beery & Wolf-Watz, 2014). These authors advocate replacing the vague, general, and non-specific term 'nature' with 'place' in the environmental connectedness perspective that includes connectedness to nature. These authors also argue that the term 'nature' and the measurement of people's connection to it presumes a dualistic 'nature vs. culture' perspective (Beery & Wolf-Watz, 2014), which is also argued as problematic in the categorization of some ecosystem services as 'cultural' (Pröpper & Haupts, 2014; Ryfield et al., 2019; Winthrop, 2014).

In the context of CES, which are the ecosystem's contributions in the benefits, experiences, capabilities, and/or knowledge that benefit human well-being, this research in Michigan shows people are capable of forming strong, meaningful relationships with particular places and 'nature' overall. This relationship is beneficial to human well-being, both hedonic and eudaimonic. That is, the ecosystem's role in human well-being pertaining to spirituality, heritage, identity, and sense of place depends upon the individual's relationship with the ecosystem. The idea of benefits to people originating in human-nature relationships, rather than biophysical

structures and functions alone, corresponds with relational, as opposed to instrumental, values (Chan et al., 2016). Other contributions, such as social capital, infrastructure, or financial capital, may also contribute to non-material benefits from nature (Costanza et al., 2017). These particular themes of cultural ecosystem services – spirituality, heritage, identity, and sense of place, here overlapping with ideas of connectedness to nature and sense of place – should be understood as relational ecosystem services.

In applying this data to decision-making situations, this research suggests that using the connectedness to nature scale (CNS), in addition to demographic data, is effective in assessing the presence of components of spirituality, heritage, identity, and sense of place. The CNS has been used quantitatively in environmental psychology in relation to environmental behaviors, but this research is novel in using the CNS as a descriptive statistic of a responding population. While overall respondents from Michigan were strongly connected to nature, both via the CNS and qualitative analysis, qualitative analyses of this research also suggests the presence of the Dunning-Kruger effect. That is, a pattern that the more detailed knowledge an individual had about complexity of human-nature and ecological interactions, then the more that individual was aware of the unknowns, thus responding with a smaller number on the CNS; conversely, the less detailed knowledge an individual had about human-nature and ecological interactions, the more likely the individual would respond with a higher number on the scale. Furthermore, another critique is that the CNS was not used in the multi-nation study about common phenotypes of spirituality (McClintock et al., 2016), thus while conceptually probable, this link should be purposefully explored.

## 3.6 Future research

Aspects of governance have informed ES science by presenting evidence that a co-managed, multi-level governance system enhanced and increased interaction of multiple ES benefits (Farhad et al., 2015). Further research in aspects of governance would strengthen this research in Michigan because of the differing ownership structures, including transferred land rights via family inheritance, conservation easements, and land donations, respondents included in their responses and at their preferred places.

Connectedness to nature has been found stronger in older (>65 years of age) populations, and especially in female-identifying respondents (Schutte & Malouff, 2018; Wyles et al., 2019), although most CNS data is from undergraduate student populations, a majority female (Balundė et al., 2019; Wyles et al., 2019). This research supports this trend, and should be expanded even more to better capture human diversity and people's relationships with nature.

Finally, connectedness is a concept that has a significant role in natural resource management from a traditional ecological knowledge (TEK) standpoint (Pierotti & Wildcat, 2000). The idea that people and nature are all related is a fundamental aspect of how people indigenous to the United States understand their world, and that physical characteristics of a setting have an important role in how people interact with it (Pierotti & Wildcat, 2000). Future research and ES applications in management should integrate TEK of this kind.

## 3.7 Conclusions

This research addressed the challenge of improving conceptualization and identification of CES. Per this research, CES are found strongly tied to meaning of nature people have developed over time, in a way that contributes to their sense of living a good life. The results demonstrate that identity, sense of belonging, and biophysical settings are interconnected, and

overlap with concepts of connectedness to nature and sense of place. Tools used to measure and understand mindfulness, C2N, and sense of place may be very effective in identifying and operationalizing CES in ES assessments. This improved capacity within ES science to identify and apply CES will improve the effectiveness of the ES science framework overall, especially in increasing the attention on meaningful experiences people have in nature.

Factors of age, positive experiences in nature, and relevant knowledge and skills about being in nature should be explored to understand the role of connectedness to nature in CES benefits of spirituality, heritage, and identity, as well as how these factors contribute to pro-environmental and pro-social behaviors.

# APPENDIX

Appendix: Connectedness to Nature Scale

"Next, I'm going to ask you to use a scale of 1, strongly disagree, to 5, strongly agree, to respond to a number of questions. These questions and your responses here will direct some more discussion.

Please answer each of these questions in terms of the way you generally feel. There are no right or wrong answers. Think specifically of the land in question when responding to these questions. Using the following scale, in the space provided next to each question simply state as honestly and candidly as you can what you are presently experiencing.

(Mayer, F. S., & Frantz, C. M. (2004). The connectedness to nature scale: A measure of individuals' feeling in community with nature. *Journal of Environmental Psychology*, *24*(4), 503–515. https://doi.org/10.1016/j.jenvp.2004.10.001)

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Strongly disagree | | Neutral | | Strongly agree |

____ 1. I often feel a sense of oneness with the natural world around me.
____ 2. I think of the natural world as a community to which I belong.
____ 3. I recognize and appreciate the intelligence of other living organisms.
____ 4. I often feel disconnected from nature.
____ 5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.
____ 6. I often feel a kinship with animals and plants.
____ 7. I feel as though I belong to the Earth as equally as it belongs to me.
____ 8. I have a deep understanding of how my actions affect the natural world.
____ 9. I often feel part of the web of life.
____ 10. I feel that all inhabitants of Earth, human, and nonhuman, share a common 'life force'.
____ 11. Like a tree can be part of a forest, I feel embedded within the broader natural world.
____ 12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.
____ 13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.
____ 14. My personal welfare is independent of the welfare of the natural world.

Thank you, that's the end."

# 4. Causal loop diagrams and system behavior of cultural ecosystem services.

## 4.1 Abstract

Cultural ecosystem services (CES) are most commonly understood as non-material and non-economic benefits from natural resources that contribute to human well-being. In being defined by what they are *not*, incorporating these benefits into ecosystem services assessments and natural resource management policy is a great challenge. Researchers are working to redefine CES for what they *are*, such as relational values or material components of sense of place. Characterizing CES gives positive definition and shape to these essential benefits from natural resources, enabling researchers and practitioners to include them in the overall comprehension of the interdependencies between people and nature and reduce the ambiguity of CES. This research uses systems thinking to explore the effect of change in CES upon change in forested area over time. Empirical mixed-method data from the Mono-Kouffo region of the Republic of Benin and Michigan, USA, are used to develop causal loop diagrams to explore the role of CES-related benefits in natural resource conservation. Results identify sense of belonging and social institutions as mechanisms for conservation and feeling benefits from nature. Based on this research, there are tractable ways to understand how and when CES and ecological structures and functions matter to each other.

## 4.2 Introduction

Ecosystem services (ES) science was born of a need to more comprehensively account for human-nature interdependencies, forging relationships of thought between the fields of ecosystem ecology and natural resource economics (Costanza et al., 2017). This relatively new field emphasizes how nature provides for basic human well-being (Schröter et al 2014). ES

science is increasingly used to inform policies and decisions about natural resource management (Bennett, 2017; Darvill & Lindo, 2015; Fisher & Brown, 2014).

Research in CES have long been part of social and behavioral sciences (Daniel et al., 2012). However, CES as 'non-material' and 'non-market' have yet to gain traction in their integration into Ecosystem Services science research, valuations, and assessments (Cheng et al., 2019; Fish et al., 2016; Ryfield et al., 2019).

Recent clarification of CES concepts and definitions more accurately account for the complexity of 'culture' and incorporate different world views (Chan et al., 2016; Fish et al., 2016). Initially conceived as combinations of social and natural capital (Fish et al., 2016), CES definitions expanded to include experiences and capabilities, in addition to benefits, that emerge from human-nature interactions (Chan et al., 2012). A framework advancing CES as 'relational processes and entities that people actively create and express through interactions with ecosystems (Fish et al., 2016, p. 211)' offered a means for CES research to move away from the simplified linear process of benefits to people from nature, and toward an understanding of CES as a series of interactions. Fish and colleagues advanced this definition of CES with their framework: contributions ecosystems make to human well-being in terms of the identities they help frame, the experiences they help enable and the capabilities they help equip (Fish et al., 2016).

Relational values are about people's sense of relationships and responsibilities with 'nature,' distinct from instrumental values of nature for humans' sakes, and from intrinsic values of nature for nature's sake (Chan et al., 2016, and see chapter 3). In addition to the instrumental value of nature for people, and the intrinsic value of nature, relational values incorporate the value people place on a relationship with nature. The concept of CES as relational values

resonates with CES as relational 'processes and entities' people form through interactions with nature. For example, people may develop a sense of belonging through place-making by spending time in an environmental space doing some kind of cultural practice (Fish et al., 2016). Relational values also correspond with eudaimonic aspects of well-being, or a sense of living a good life, which is supported with empirical research on connectedness to nature and psycho-social health and characteristics of CES-related themes of spirituality, heritage, identity, and sense of place (Chan et al 2016; also see chapter 3).

Relational values and processes draw attention to CES as benefits, experiences, and/or capabilities people gain *over time*. Understanding human-nature interactions through temporal change beckons the application of systems thinking in CES research. Systems thinking and causal loop diagramming are effective tools in articulating a complex reality (*The Systems Thinker*, 2011), and are used to structure a problem and understand the relationships amongst the various components (Duggan, 2015; Kopainsky, Huber, & Pedercini, 2015; Van Mai & To, 2015). Furthermore, if CES are akin to sense of place and connectedness to nature and thus correlated with pro-environmental behavior, then understanding the causal connections, more than the correlations alone, between these themes and pro-environmental behavior will advance knowledge of people-nature dynamics.

An example of modeling systems thinking is the problem of swidden agriculture in Vietnam (Van Mai & To, 2015). Using focus groups and interviews, these authors conceived the problem boundaries and structure by developing a causal loop diagram based on stakeholder input, and then analyzed the behavior of the diagrams by identifying the number and type of loops (Van Mai & To, 2015). In swidden agriculture in Vietnam, the authors identified within the system diagram how a quick fix by managers worsened the original problem: banning swidden

agriculture practices with agroforesty to reduce soil erosion was a ‘fix that failed’ because it was a symptomatic solution that aggrieved the problem (D. H. Kim, 1994; Van Mai & To, 2015; Wolstenholme, 2004). Adding agroforestry and banning swidden agriculture caused a lack of land for cultivation, causing an increase in swidden agricultural practices with shorter fallow periods (Van Mai & To, 2015).

Systems thinking and causal loop diagramming have also been applied with acclaim in research related to natural resource conservation, specifically agriculture and food provisioning (Duggan, 2015; Kopainsky et al., 2015). There are calls for systems thinking in ES science research (Bennett, 2017; Rieb et al., 2017); however, systems thinking has not yet been applied to the realm of CES. Using these tools, this study addresses the problem of rendering operational the essential benefits, experiences, capabilities, and relationships that comprise CES within the ES science framework. This is achieved by relying on empirical mixed-method data from case studies in the Republic of Benin and the United States of America to generate, respective to each case study, causal loop diagrams (CLDs). CLDs structure the components of the human-nature system that enable CES. Each case study’s CES model is compared and contrasted to contribute to the overall knowledge of how CES are part of natural resource conservation and how ecological structures and functions are part of CES.

Given that models are representations of points of view (Meadows and Wright 2008; van den Belt 2004; Daniels and Walker 2001), two different CES models, one from the Republic of Benin, another from the United States, are expected to be different. Analysis of these models will reveal significant similarities and differences about concepts and mechanisms of cultural ecosystem services. These points will indicate where further research is needed in order to

increase the clarity and applicability of ES science and cultural ecosystem services in natural resource conservation.

## 4.3 Research Objectives

The goal of this study is to conceptualize how changes in CES affect changes in forested area over time. The causal loop diagrams that give structure to each case study are hypothesized to reflect CES as part of social-ecological systems, thus advancing a definition of CES as eudaimonic and hedonic benefits from a social and/or personal relationship with a nature/place to human well-being that change over time with knowledge, skill, and age.

## 4.4 Theoretical Framework

In systems thinking, the general role of diagrams is communication (Lane 2008). While ES science and cultural ES are yet insufficiently understood for fully informed systems modeling (Bennett 2017), causal loop diagramming communicates the causal relationships between variables, including feedback loops (Schmitt Olabisi et al 2016; Richardson 1986), and can be used appropriately qualitatively to give structure to and explore a problem. Conceptualizing problems in systems diagrams is useful in determining relevant variables and developing dynamic hypotheses (Luna-Reyes et al 2003). The utility of the causal loop diagram as a tool depends upon a constant consideration of system behavior over time as the causal loop model is being drafted (Richardson 1986), noting delays, accumulations, and non-linearities.

Interviews and narratives are appropriate for conceptualization of systems (H. Kim & Andersen, 2012; Luna-Reyes & Andersen, 2003). Qualitative methods in causal loop diagrams are utilized by a number of authors to increase knowledge about a complex problem (Olabisi, 2010; Van Mai & To, 2015; Yurike, Elmhirst, Karimi, & Febriamans, 2018).

## 4.5 Methods

In systems thinking, the process is to develop a polarized causal loop diagram, analyze the number and types of feedback loops, and relate the diagram to a system archetype. Polarity in causal loop diagrams is intended to make system behavior explicit without quantitative, predictive modeling of the system. Polarity of a causal loop diagram assigns behavior to structure, and behavior-over-time graphs and graphical function diagrams describe the relationships amongst system components (Schaffernicht, 2010). A reinforcing link, indicated with a '+', is assigned where the effect of the first system variable causes a change in the same direction in the next system variable, so that an increase or decrease in one increases or decreases, respectively, the next; a balancing link, indicated with a '-,' is the opposite, where the first variable causes change in the opposite direction (Richardson, 1986; Schaffernicht, 2010).

Loops are created between the system variables and the polarized links between them. Loops are described as reinforcing or balancing. Reinforcing loops are a series of links that create an increasing or declining feedback system; balancing loops suggest equilibrium (Meadows & Wright, 2008; Van Mai & To, 2015).

System archetypes are simplified representations of common system behaviors, which may be identified through the number and types of loops in a causal loop diagram (D. H. Kim, 1994; Wolstenholme, 2004). System archetypes are useful in understanding the specific system of study and highlighting effective entry points to make change. System archetypes are generalized and recurring system structures whose behaviors may improve understanding of specific, novel system conceptualizations (D. H. Kim, 1994). System archetypes are not always intuitive, but facilitate identifying appropriate spaces for intervention (D. H. Kim, 1994; Van Mai & To, 2015; Wolstenholme, 2004).

The behavior and structure of the causal loop diagram representing CES of wooded shrines in Benin and the diagrams representing CES of 'preferred places' from forests stakeholders in Michigan, USA, are compared and contrasted based on feedback loops around components of interest. The similarities and differences between the two models will direct further research in Ecosystem Services science on CES.

### 4.5.1 Data Collection

Data for this research was generated through mixed methods in the Republic of Benin and in the United States of America. Semi-structured interviews were used to ask questions about benefits people identified from nature, and data plots within forested sites were used to collect information on tree density and species diversity. Methods and data description from Benin are detailed in chapter two, and for the USA in chapter three. The coding process in each case study included themes that captured causal statements. These causal statements were analyzed by following the methods laid out by Kim and Anderson (2012): 1) identify variables and causal links; 2) transform text into word-and-arrows diagrams; 3) generalize the word-and-arrow diagrams into a causal loop diagram. This process includes a method for retaining links to the original data source that enable reading the diagram with original data and understanding behavior over time (H. Kim & Andersen, 2012).

For Benin, the context of wooded shrines is important to understand. The inception of wooded shrines varies across groups and contexts, from hunting reserves to burial grounds to ancestor groves (Kokou & Sokpon, 2006). For this research, most wooded shrines are 'ancestor' woods, where a founder of the community or family line, or other significant leader of the community, is said to have disappeared (a euphemism for death) into the woods. The Vodoun divinities the person affiliated with or relied upon during their lifetime become part of the woods

where the founder disappeared. At this point, the woods come to be part of the shrine where these Vodoun divinities and the spirit of the ancestor now reside. Data generated in Benin started from this basis. The causal loop diagram thus depicts behavior after this process of inception.

In the USA, respondents were requested to choose their 'preferred place' in the woods where they identified benefits to their well-being. The respondents' chosen sites ranged from public to private land, and included sites distant both in time and geography, as land they'd grown up on that had since been donated to a land conservation agency. The system components attempt to balance detail and generality.

## 4.6 Results

### 4.6.1 Republic of Benin

The relationship of ultimate interest in the causal loop diagram of wooded shrines in the Republic of Benin, seen in Figure 8, is between spiritual benefits and wooded shrine limits and size. With the CLD, this research explores how change in spiritual benefits affects change in wooded shrine limits and size in area over time. Figure 7 hypothesizes this relationship in a graphical function diagram. Spiritual benefits from wooded shrines depend upon spiritual needs as practiced through belief in God through the Vodoun religion. This belief comes with distinct rules to follow about access and withdrawal of wooded shrine resources, which affects wooded shrine size in area. Ultimately, spiritual benefits are largely defined by the perceived satisfaction of the Vodoun divinities, and some ecological aspects of wooded shrines help satisfy this aspect.

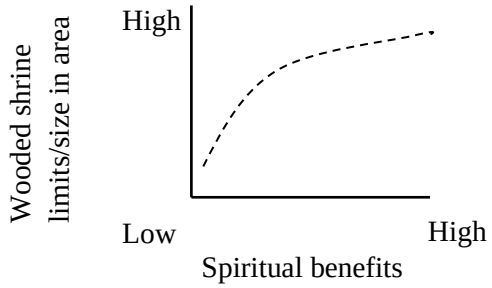


*Figure 7. Hypothetical relationship between spiritual benefits and wooded shrine size in area.*

There are three overlapping and interacting feedback loops in Figure 8 that contribute to the dynamics between spiritual benefits and wooded shrine limits/size in area: spirituality (benefits-driven and fear-driven), healing, and biophysical. In addition, a number of drivers outside of these loops contribute to system behavior. Table 4 lists each loop's system components names and numbers, and identifies the loop type.

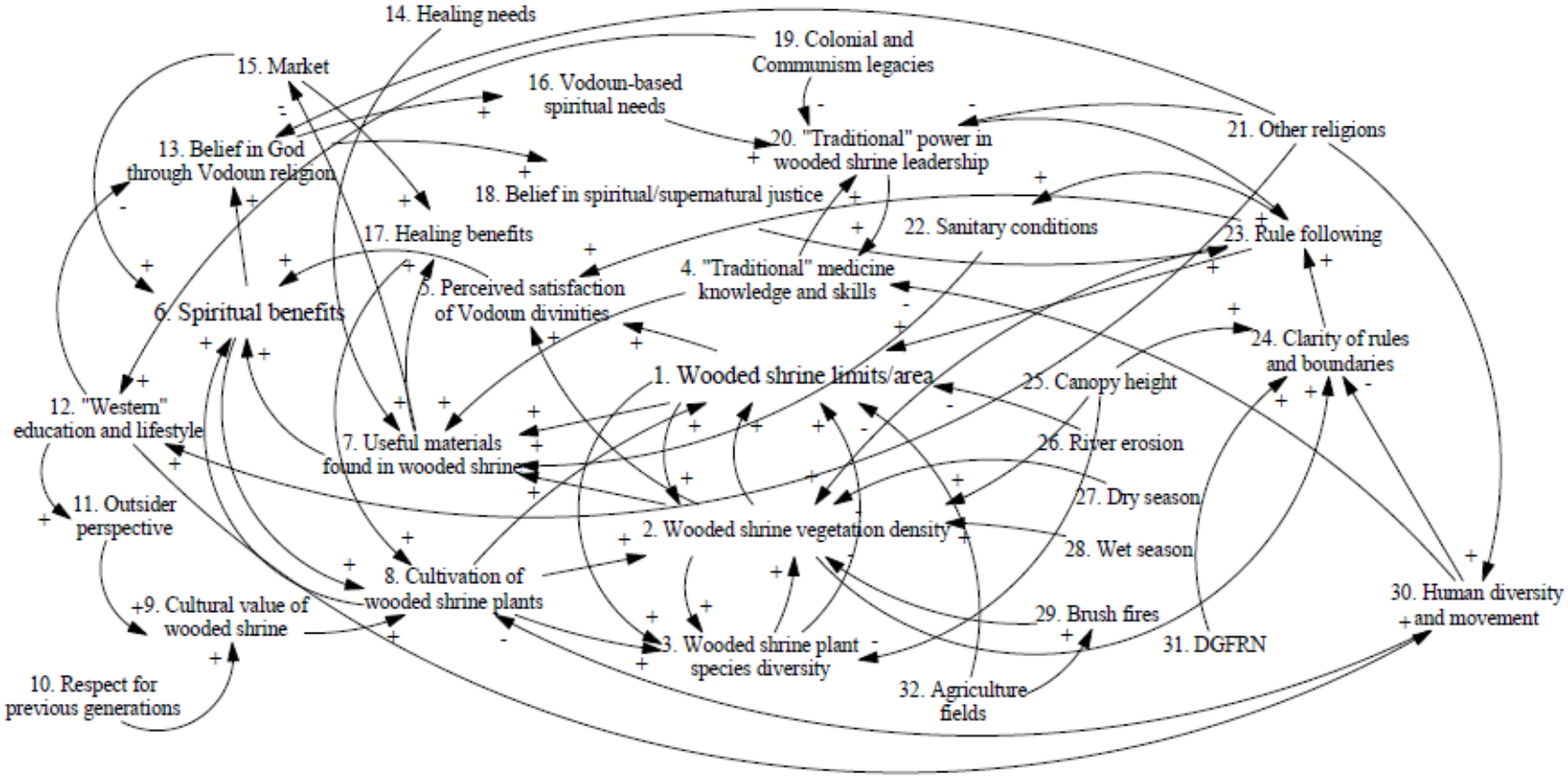


*Figure 8. Causal loop diagram based on wooded shrines in Mono-Kouffo, Benin.*

*Table 4. Causal loop diagram loop names and types from wooded shrines in Benin.*

| Loop name | Loop type | System component number | System component name |
|---|---|---|---|
| Spiritual - benefits driven | Reinforcing | 13 | Belief in God through Vodoun religion |
| | | 16 | Vodoun-based spiritual needs |
| | | 20 | Traditional power in wooded shrine leadership |
| | | 4 | Traditional medicine knowledge and skill |
| | | 23 | Rule following |
| | | 5 | Perceived satisfaction of Vodoun divinities |
| | | 6 | Spiritual benefits |
| Spiritual - fear driven | Reinforcing | 13 | Belief in God through Vodoun religion |
| | | 18 | Belief in spiritual/supernatural justice |
| | | 23 | Rule following |
| | | 5 | Perceived satisfaction of Vodoun divinities |
| | | 6 | Spiritual benefits |
| Healing | Reinforcing | 13 | Belief in God through Vodoun religion |
| | | 16 | Vodoun-based spiritual needs |
| | | 20 | Traditional power in wooded shrine leadership |
| | | 23 | Rule following |
| | | 22 | Sanitary conditions |
| | | 4 | Traditional medicine knowledge and skill |
| | | 7 | Useful materials found in wooded shrines |
| | | 17 | Healing benefits |
| | | 14 | Healing needs |
| | | 5 | Perceived satisfaction of Vodoun divinities |
| | | 6 | Spiritual benefits |
| Biophysical | Balancing | 1 | Wooded shrine limits/area |
| | | 2 | Wooded shrine vegetation density |
| | | 3 | Wooded shrine plant species diversity |

*Table 4. (cont'd)*

| | | | |
|---|---|---|---|
| | | 7 | Useful materials found in wooded shrines |
| | | 6 | Spiritual benefits |
| | | 17 | Healing benefits |
| | | 8 | Cultivation |
| | | 5 | Perceived satisfaction of Vodoun divinities |
| | | 24 | Clarity of rules and boundaries |
| | | 23 | Rule following |

1. Spiritual

The spiritual loop is driven by collective and individual spiritual benefits and is a reinforcing loop with a fairly constant rate after a certain equilibrium is found. This means the system components comprising this loop, listed in Table 4, affect each other in a way that increases or declines the system. The spiritual loop as denoted in this CLD, highlighted in red in Figure 9, demonstrates how Vodoun may be practiced apart from wooded shrines. Belief in God through the Vodoun religion shapes people's spiritual needs in this religion: needs for blessings, giving thanks, and seeking direction and meaning in life.

> *The importance of the wooded shrines includes protection: it provides treatments for illnesses, can ask for water for agriculture, protects both the environment and the spirits, and improves lives of people who come and ask the spirit for help (wooded shrine Z).*
>
> *We know one grove's fetish is very strong because of how quickly it has resolved problems for people requesting help (wooded shrine A).*

*Bokono*, a title in the Fon language for the religious leaders of Vodoun, hold a position of social and religious power. This power includes mediating interactions between members of the community and the Vodoun divinities perceived to be residing in the woods of the shrine, both at individual and collective levels (see chapter 2). There is a direct feedback loop between the traditional leaders' power and their knowledge. Their knowledge and skills relate to pharmaceutical as well as spiritual success. Additionally, *bokono* are generally responsible for rule following, which includes interpreting and communicating the rules of access and withdrawal of wooded shrine resources, as well as conducting necessary rituals. This all contributes to the degree to which the wooded shrine stakeholders perceive the satisfaction of the Vodoun divinities, which drives and enables their collective and individual spiritual benefits.

The spiritual loop via 'belief in spiritual/supernatural justice' is also a reinforcing loop and is fear-driven. Belief in God through Vodoun religion drives this belief, but instead of interactions motivated by blessings, thanksgivings, and life-guidance, interactions in this loop are motivated by avoidance of behaviors perceived to anger the divinities, which causes people to respect the rules about access and conducting necessary rituals.

> *Regardless of belief, something would happen to a person if s/he knowingly tested a deity's strength (key informant H)*
>
> *Cutting a tree without consultation results in the fétiche following the person until they correct their action (Wooded shrine Ka)*
>
> *Regardless of how the national justice system would deal with this event, everyone, everyone, knew that the person who had cut the tree down would get his comeuppance one day. It could be death, but it could be something else that would render his life very difficult, in compensation for killing a tree that housed an important spirit (key informant DGFRN/RCEPN)*

The benefits-driven and fear-driven paths through the spiritual loop are not necessarily mutually exclusive and may occur simultaneously. However, the fear-driven loop may be more predominant in certain portions of Beninese society, specifically those who do not practice Vodoun, evidenced in that they do not claim spiritual needs via Vodoun, but are familiar with Vodoun in general. The end effect remains: following the rules increases the perceived satisfaction of the Vodoun divinities, which drives and enables spiritual benefits at individual and collective levels. When belief in supernatural justice is decreased, rule following decreases also, and thus the perceived satisfaction of Vodoun divinities decreases. The degree to which people perceive the satisfaction of the Vodoun divinities residing in the woods of the shrine

affects their spiritual benefits. Furthermore, where ‘traditional’ knowledge and skills are transferred, neglected, or lost, there is a delay in regaining them.

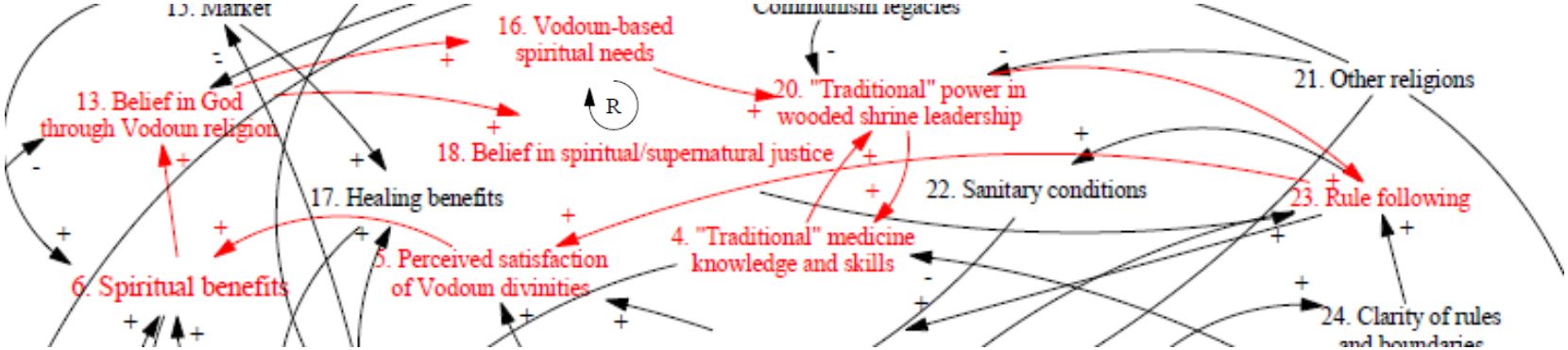


*Figure 9. Spiritual loop system components, benefit and fear driven, highlighted in red.*

2. Healing

The healing loop, also reinforcing, interacts with the spiritual loop. Healing loop system components are highlighted in green in Figure 10. Traditional medicine in the context of south-west Benin and the Vodoun religion is more than physiological healing; traditional medicine includes social-spiritual aspects of health which are treated with prayers and ritual consultation in addition to the physiological aspects of an illness (see chapter 2).

> *Ask for help for any problem, 2-3 months will be resolved; then give thanks; Sacred forests specifically provide blessings, aesthetics, traditional pharmaceuticals (wooded shrine D)*

> *Can ask for anything desired; can ask for or look for materials needed for ceremonies and healing (wooded shrine C)*

Healing may be a spiritual benefit through rituals, blessings, and socio-spiritual insight, as well as physiological treatments. Spiritual healing relies upon the traditional leadership for help in interacting with the divinities of the shrines. More medicinal knowledge on the part of the traditional leadership means an overall greater knowledge or familiarity with materials found in the wooded shrine that are useful in healing applications, which increases spiritual benefits and reinforces belief in God through the Vodoun religion. Healing remedies may also be physiological alone, with no need for spiritual intercession. From this perspective, the *bokono* do not perform ritual, spiritual consultation with the divinities, but do provide guidance on the harvest and preparation practices for relevant plants for physiological treatment.

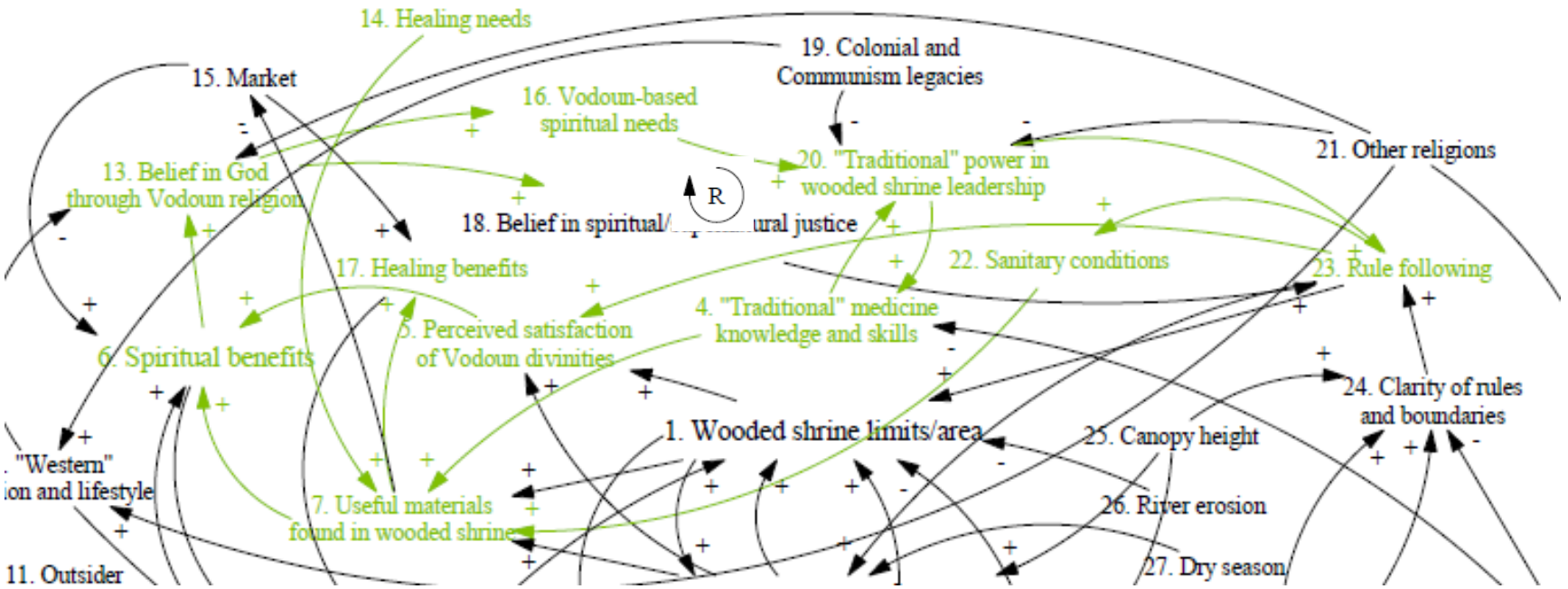


*Figure 10. Healing loop system components, highlighted in green.*

Whether spiritual healing, spiritual-physiological healing, or physiological healing, the same rule following (see chapter 2) is expected for access to and withdrawal of wooded shrine resources, which increases the sanitary conditions of the useful materials, and thus makes these materials more desirable to be used in treatments. Plants well-reputed for treating common illnesses such as gastrointestinal complaints, headaches, and nutrient deficiencies are included in the component of 'useful materials from wooded shrines.' Availability and effectiveness of treatments potentially brings more people with healing needs to the shrines.

3. Biophysical

The biophysical loop connects to the spiritual and healing loops, and its components are highlighted in orange in Figure 11. Overall, the biophysical loop is balancing, producing a level of equilibrium in the system. The wooded shrine limits and size in area, vegetation density, and plant species diversity interact and affect each other, with a larger area allowing more space for potentially more species; vegetation density may vary throughout the size in area, and affects species diversity. While there is a delay in achieving a certain level of growth and accumulating a certain amount of useful materials, these three ecological aspects of wooded shrines reinforce the useful materials found in the shrines. The more useful materials found in the shrine increases the ability to benefit spiritually and through healing.

Per the spiritual loop, the ecological structures of the woods provide shade for the Vodoun divinities, contributing to their perceived satisfaction, and specific species serve in certain rituals and healing treatments. Through the belief in God through the Vodoun religion, rule following about access and withdrawal restrict common entrance and use of the resources in the wooded shrine, which means the vegetation density increases as rule following is increased. Dense vegetation and closed-canopy woods signal to people that the resources in that place are

treated differently than other wooded spaces; this increases the clarity of rules and boundaries of the shrine, which reinforces rule following and maintains the limits of the shrine.

> *T[…] didn't die, was ill and taken by the earth. He doesn't like to be with lots of people around, so he's happier with a good cushion of trees to keep people away (bokono,* wooded shrine T*).*

As spiritual and healing benefits increase, attention to cultivation of wooded shrine plants increases. Cultivation of wooded shrine plants directly feedback into spiritual benefits, and drives the system to maintain and/or increase wooded shrine limits/area, vegetation density, and species diversity, depending on the type and intensity of cultivation activities.

> *The divinity likes to have a lot of different species, so to bring other species is a good thing (bokono,* wooded shrine Ad).

The biophysical loop supports healing in that increasing the measurable area and species diversity increases the capacity of the shrine to provide habitat for flora and fauna needed in spiritual and physiological healing. Healing and spiritual benefits motivate cultivation and care for the useful materials found in the wooded shrine. Cultivation activities include transplanting to properly space trees found within the shrine, planting new trees within the shrine, and creating fire breaks around the individual trees or the entire site, among other activities. Cultivation along these lines serves to maintain, and possibly increase, biophysical aspects of the grove including vegetation density, limits, and species diversity.

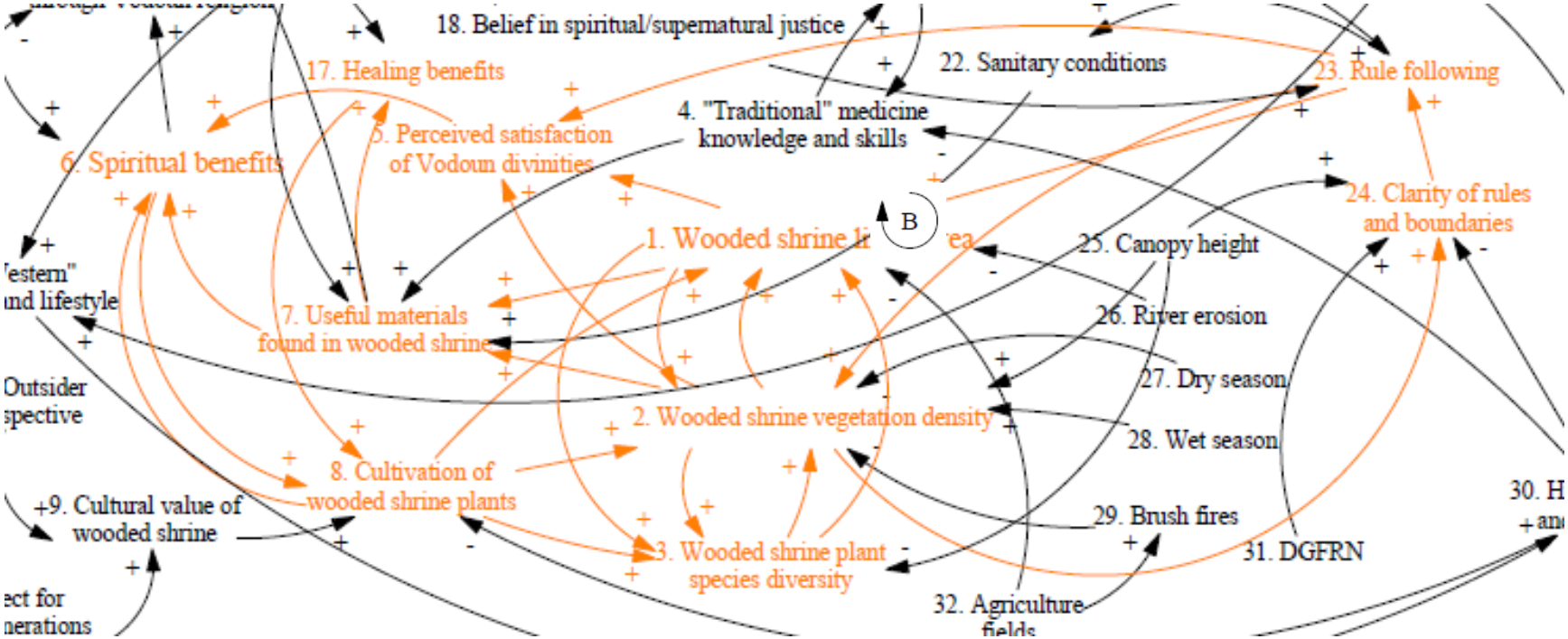


*Figure 11. Biophysical loop system components, highlighted in orange.*

The biophysical loop is reinforcing when considered apart from the spiritual and healing loops. The three components of measurable area, vegetation density, and species diversity interact. The measurable area delimits the space where vegetation can grow, and the density of the vegetation (as well as the canopy coverage) and the amount of space influence the diversity of species. Drivers affecting these ecological processes are brush fires to clear land for agriculture, seasonal changes, erosion due to Mono river flooding, and cultivation and management activities, all of which vary from site to site. Within the context of heavily reduced wooded areas because of the legacies of colonialism and communism, combined with the modern-day demands of a growing population, there is sometimes little space available for the woods to self-propagate. These ecological interactions enable growth and habitat for flora and fauna actually and potentially considered useful by *bokono* and community members. Where the wooded shrine's vegetation density and diversity are low, the useful materials found there is accordingly low, which affects the degree to which people are able to identify spiritual and healing benefits of the shrine. That is, whatever forest structure and species present in the shrine supports the spiritual and healing, even when the ecological processes are limited.

4. Non-loop variables

Variables contributing to system behavior outside of these loops include legacy effects of colonialism and communism, when tree harvesting practices drastically reduced wooded shrine resources and undermined the Vodoun religion; similarly, Christianity and Islam have negatively impacted Vodoun practices, including wooded shrines. Human diversity and movement is intended to capture portions of the Beninese population not purposefully included in this study - those who practice different religions and have a lifestyle more distant from 'traditional' Vodoun practices. However, there is an important component of the cultural value of a wooded shrine on

the part of an individual who, having moved away from his/her natal community with a shrine, grows to value the shrine if not for spiritual needs, then as culturally valuable. This makes cultural value of the shrines a slow but effective driver of care for wooded shrines -and this usually comes with money and resources.

Furthermore, while the Vodoun religion is shared intergenerationally, some people outside of those practicing Vodoun value wooded shrines out of respect for previous generations. Although these variables are external to the main loops and slow drivers, they are significant in understanding the non-linearities of wooded shrines as human-nature systems.

> *[A larger shrine would] firstly, with indigenous species, would provide more of the medicinal plants. Also, is would show to younger generations what we were able to preserve, and thus in turn encourage those younger generations to also conserve the space. Keeping the forest also benefits the environment (wooded shrine G).*

5. Graphical function diagrams

Following are graphical function diagrams depicting relationships between two selected system components of wooded shrines. The CLD gives structure to the system of study; graphical function diagrams depict the rate and direction of change between the variables. Figure 12 shows how rule following is directly related to the perceived satisfaction of the Vodoun divinities. The linear relationship hypothesized in Figure 12 emphasizes the direct causal relationship between these two variables.

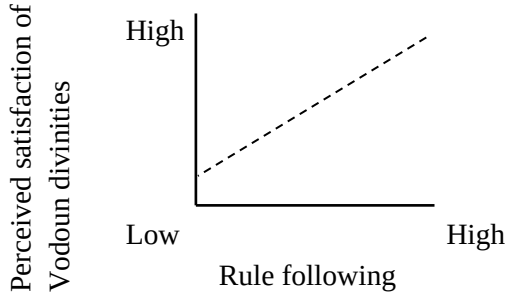


*Figure 12. Graphical function diagram of effects of rule following on perceived satisfaction of Vodoun divinities.*

Figure 13 shows how the woods of the shrine may range from low to high in terms of measurable area, but the perceived satisfaction of the Vodoun divinities may remain high regardless of the measurable area of the woods of the shrine, depending on the level of rule following.

> *No matter the size, the forest must be respected. All the restrictions must be obeyed regardless of the size of the forest (Wooded shrine Ad).*
>
> *Mostly spiritual restrictions keep people away from the grove, but those same people need the space for fields. When consulting the divinity about planting trees in 2007, the divinity said only the one hectare needed to be replanted; this means I could continue farming the rest of the land. The divinity wasn't asking for more (wooded shrine K).*

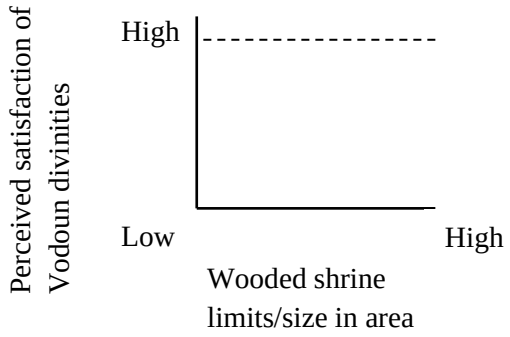


*Figure 13. Graphical function diagram of effects of wooded shrine limits/size in area on perceived satisfaction of Vodoun divinities.*

Figure 13 overlaps with Figure 12 by demonstrating the effect of rule following in the wooded shrine system. The woods of the shrine may be of variable area in size, but, as long as the rules of access and withdrawal are being followed, which includes the esoteric, generational practices the *bokono* maintain via traditional power in wooded shrine leadership, the perceived satisfaction of the Vodoun divinities residing in the grove will remain high. However, if the rules are neglected, and this includes the rites and rituals performed by the *bokono*, then the Vodoun divinities will be perceived as not being satisfied. While rule following limits access to and withdrawal of resources of the wooded shrine, the rules do not exclude using those resources. Through ritual communication, shrines' resources may be harvested, typically for some community good, like school benches.

> *Vodoun live in the forest, require the forest, the leaves for their rituals require the forest; The power of Vodoun is in the forest (wooded shrine S).*
>
> *Importance of this forest is spiritual protection for the entire community against illnesses, a good place to relax and study, get fresh air. A tree cut down from this grove can serve the community in some way -a church or school needing benches (wooded shrine D).*

While the rules are effectively respected and followed, the woods of the shrines may be variable in size in area, but remain relatively high; where the rules are not followed, the woods of the shrines are generally low. This pattern is evidenced in the variability of size, density, and species diversity as summarized in Appendix I. Where the rules are followed and the woods have low area, the divinities are presumed to have been ritually communicated with about the community's need for the woods' resources, be it for agriculture or school building. But where the rules are not followed and the woods are small, there is likely conflict and neglect about the wooded shrine.

Figure 14 shows the relationship between healing benefits and the wooded shrine size in area. Healing benefits promote cultivation of wooded shrine plants, but this is not a linear relationship because not all plants useful in healing treatments can be grown in every wooded shrine, and sometimes the best time to harvest a certain material from a shrine may not be allowed because of religious rules about entry. Therefore, healing benefits reinforce wooded shrine limits/size, but then drops off.

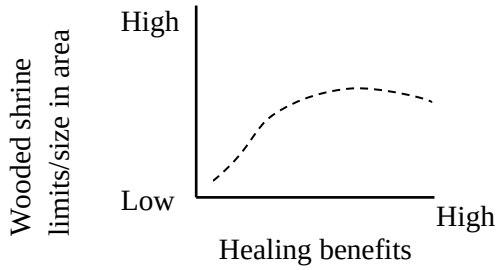


*Figure 14. Graphical function diagram of effects of healing benefits on wooded shrine limits/size in area.*

The Benin CLD demonstrates that wooded shrines may still be shrines and the Vodoun divinities satisfied with any given size of the woods; and, this CLD shows how the woods *are* important to the system, while still not being the 'core' aspect of the religion. While respondents

identified belief in spiritual and supernatural justice through belief in God through Vodoun as a key driver of the wooded shrine system in maintaining these spaces, we also learn that improving the clarity of the rules amidst the human diversity and movement inherent to human populations, and developing the cultural value of wooded shrines apart from the shrines' religious value can also be drivers that can perpetuate the woods of the wooded shrine system. These two drivers may add value to the shrines in addition to the Vodoun-specific spiritual value; such as cultural identity and cultural heritage for those Beninese who do not practice Vodoun, as well as supporting and regulating services and benefits for many. There is also a suggestion of the added benefit of healing treatments, outside of Vodoun-related spiritual healing, that can further contribute to improving people's lives in providing useful and attainable medicines.

The graphical function diagrams depicting anticipated system behavior help identify a system archetype relevant to the wooded shrine system, and the accumulators and flows within the system. The Benin CLD system behavior resonates with a 'drifting goals' system archetype. The system archetype of drifting, or eroding, goals is identified by the dynamic tension between symptomatic solution and a fundamental one. The failure to meet the set goal is addressed by changing the goal, rather than the performance. Observing behavior of the system archetype of 'eroding goals' is to examine behavior in the present that is the result of forecasts of the future made in the past. This is relevant in the context of historically dominant colonial information of natural resources on the African continent (Fairhead & Leach, 1995; Ribot, 1999; Sheridan & Nyamweru, 2008).

The system archetype is useful in this case because it provides entry points for thinking about the system. A recommended action step in a 'drifting goals' system is to examine the goals of the system and determine where there is conflict amongst them. In the case of wooded shrines

in the south-west of the Republic of Benin and the legacy of literature surrounding them, reviewing the perceptions of the wooded shrine system is important in understanding the conflicting goals. There is a clearly stated goal per the Vodoun practitioners of respecting the Vodoun divinities and spirits who reside in the grove and keeping these divinities and spirits satisfied, regardless of the size of the woods sheltering the shrine. Closely connected to that goal is that the vegetation density and diversity, along with the size in area, promote meeting this goal. However, per Vodoun belief, the Vodoun divinities and spirits want to meet the needs of the community, which can and does include land for agricultural fields, space and material for building schools and roads, allowing power lines to pass through, and other activities that benefit people living nearby.

The 'drifting' of goals may be evidenced in allowing a shrine to get 'too small' (an undetermined limit), where people no longer recognize the site as a 'woods,' and don't know, or don't choose, to respect the shrine. Another 'drifting' of the goals may be in decreasing interactions with the Vodoun divinities (an undetermined amount). Successful interventions that keep the Vodoun happy and the woods of the shrine at acceptable and useful amounts have been external encouragement to plant trees and 'cultivate' the space, as well as a UNDP project that collaborated with *bokono* and locally elected authorities to legally delimit wooded shrine space, reinforcing the clarity of the rules and boundaries about wooded shrines.

Where people are actively relying upon and caring for the materials of the wooded shrine, whether through religious belief or cultural value, the wooded shrine size may be mostly maintained. However, there is a lot of human demand and environmental and ecological aspects that work against wooded shrines, such as need for agriculture space, seasonal changes, and Mono river flooding. Where wooded shrines are not valued or are neglected for either religious

or cultural reasons, they will surely diminish. There is always potential for re-growth of the shrine once people commence to value the site again for the trees and some aspect of Vodoun.

4.6.2 United States of America

The goal of the diagram in Figure 16 is to understand how 'feeling enriched' from forested spaces affects conservation of those resources over time. Figure 15 demonstrates the hypothesized relationship between these two components. Conservation is defined in two ways: first, as the legal and relative security that a piece of land will remain undeveloped, as a forest or woods. Second, conservation is defined as avoided development, which is a result of people forgoing development. Achieving conservation in this system per Figure 16 is entirely dependent upon identifying and legally transferring ownership to an appropriate inheritor. 'Feeling enriched' is a large umbrella for the myriad ways people described their benefits from nature, and thus encapsulates cultural ecosystem services and relational values.

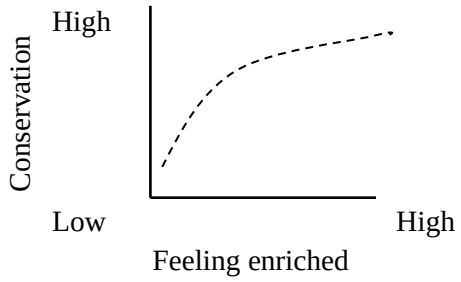


*Figure 15. Hypothesized relationship of the effect of people feeling enriched from the woods upon conservation of wooded sites.*

The shortest feedback loop incorporating conservation, feeling enriched, and appropriate inheritor is listed in Table 5 and highlighted in blue in Figure 17. This begins at feeling enriched, which motivates conservation efforts. Conservation efforts include activities that work toward conservation, such as participating in policy-making or environment groups like land conservation agencies. Ultimately, these efforts require identifying a willing and appropriate

inheritor who will care for the land and avoid development. Such an inheritor may be an individual or a group who has been deemed appropriate by those participating in conservation efforts. Achieving conservation of natural resources is a source of enrichment, as well. This is a balancing loop, even when conservation is not achieved, with a variable rate, because conservation efforts sometimes succeed, and because feeling enriched comes from other loops. This loop is hypothesized as being engaged only after a threshold has been met through other loops, described shortly.

For the respondents, the appropriate inheritor was frequently a land conservation agency, although in some situations, a family member or neighbor was deemed suitable. A couple of respondents chose 'preferred places' on public-access land, such as a county park or national forest. Speaker (10) shared an experience of buying land from his long-time neighbor:

> *He just felt he had to sell. He cried in the end, you know. I'll be there someday, quicker than that. So that's the sense of place and how that fits into the future. He sold me that, you know, and he knew that I'll take care of it. That's what's going to happen a little bit [to me]. [The land] will get passed on in, in, in good form, cause that's the goal (10).*

As depicted in the CLD in Figure 16, from the point of feeling enriched from nature, there are three main loops beginning with conservation efforts, hard work, and sharing. The remainder of these results about the causal loop diagram explore how 'feeling enriched' from nature drives conservation of natural resources via conservation efforts and identifying an appropriate inheritor. There are three major loops that drive feeling enriched: recreation, cultivation, and learning. Table 5 lists these loops by name, identifying loop type and system component numbers and names.

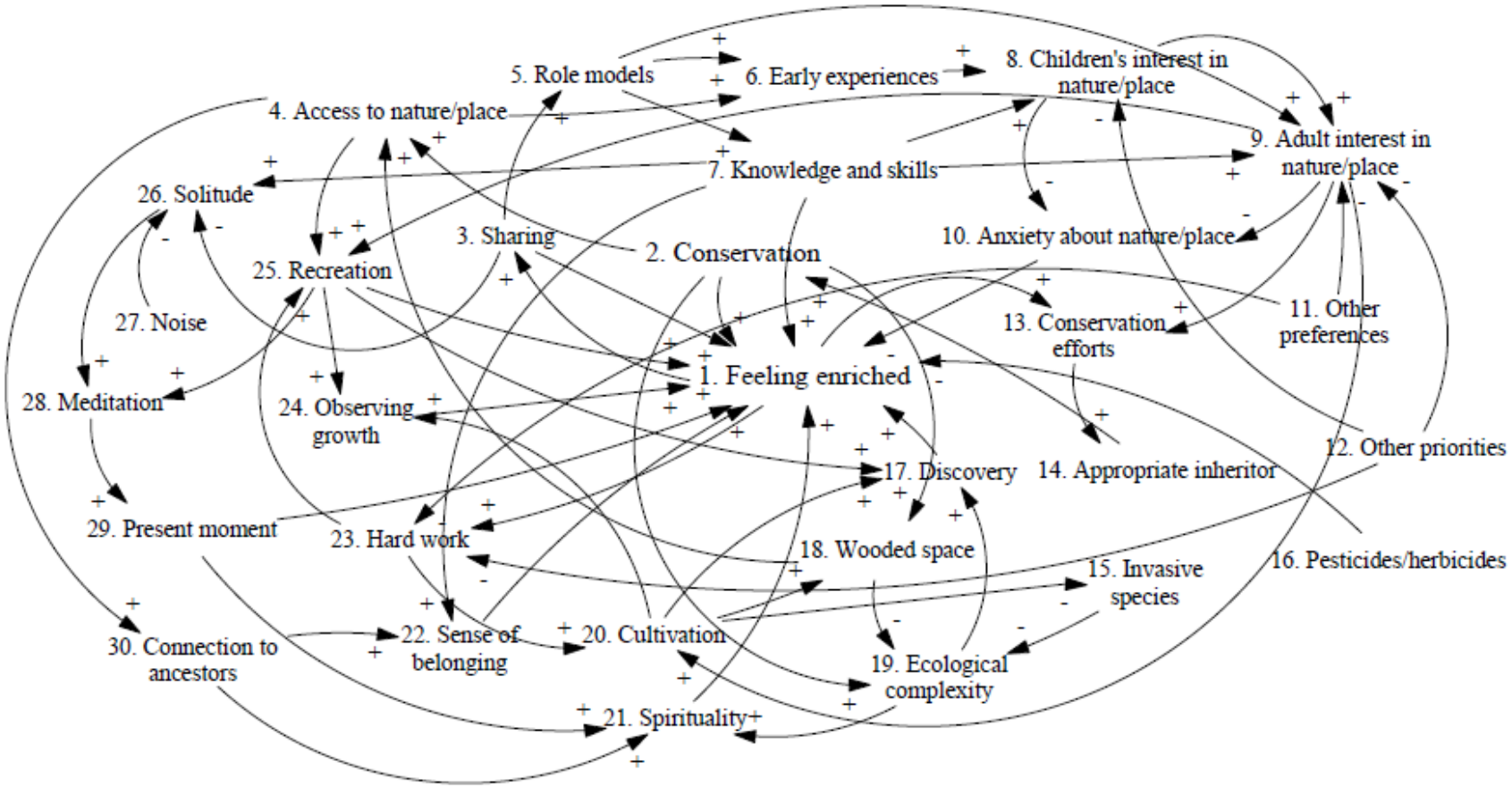


*Figure 16. Causal loop diagram based on 'preferred places' in Michigan, USA.*

*Table 5. Causal loop diagram loop names and types from 'preferred places' in USA.*

| Loop name | Loop type | System component number | System component name |
|---|---|---|---|
| Feeling enriched - Conservation short loop | Balancing | 1 | Feeling enriched |
| | | 13 | Conservation efforts |
| | | 14 | Appropriate inheritor |
| | | 2 | Conservation |
| Recreation | Reinforcing | 25 | Recreation |
| | | 1 | Feeling enriched |
| | | 23 | Hard work |
| | | 24 | Observing growth |
| | | 17 | Discovery |
| Cultivation | Reinforcing | 1 | Feeling enriched |
| | | 23 | Hard work |
| | | 20 | Cultivation |
| | | 17 | Discovery |
| | | 18 | Wooded density |
| | | 15 | Invasive species |
| | | 19 | Species diversity |
| | | 24 | Observing growth |
| | | 21 | Spirituality |
| Hard work -reward | Reinforcing | 23 | Hard work |
| | | 20/25 | Cultivation/Recreation |
| | | 17 | Discovery |
| | | 24 | Observing growth |
| | | 1 | Feeling enriched |

*Table 5. (cont'd)*

| | | | |
|---|---|---|---|
| Hard work -discourage | Reinforcing | 9 | Adult interest in nature/place |
| | | 11 | Other preferences |
| | | 23 | Hard work |
| | | 20/25 | Cultivation/Recreation |
| | | 17 | Discovery |
| | | 24 | Observing growth |
| | | 1 | Feeling enriched |
| | | 10 | Anxiety about nature/place |
| Learning | Reinforcing | 1 | Feeling enriched |
| | | 3 | Sharing |
| | | 5 | Role models |
| | | 6 | Early experiences |
| | | 7 | Knowledge and skills |
| | | 8 | Children's interest in nature/place |
| | | 9 | Adult interest in nature/place |
| | | 10 | Anxiety about nature/place |

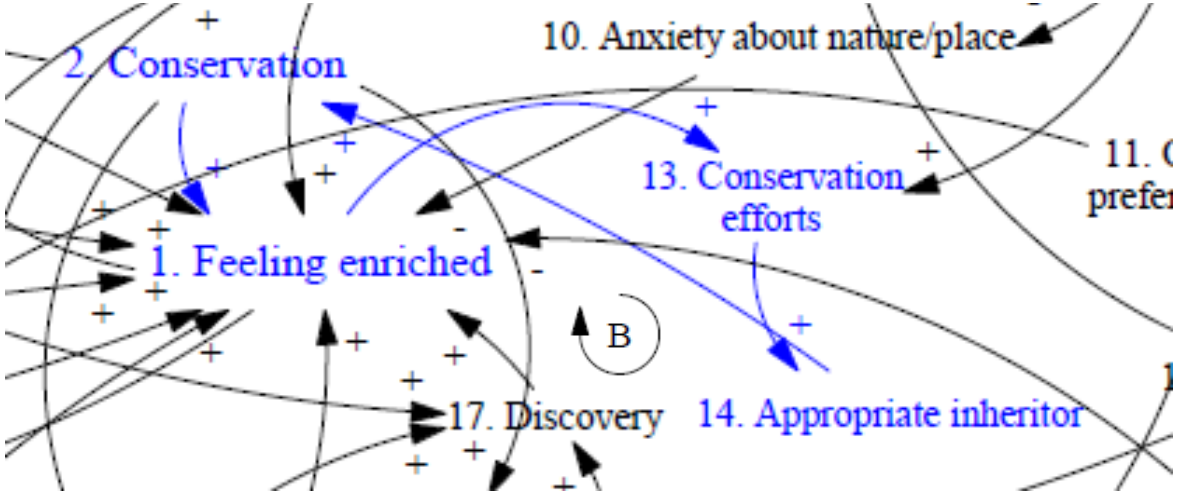


*Figure 17. Feeling enriched – conservation loop, highlighted in blue.*

1. Recreation

Recreation means activities like hiking, walking, dog walking, hunting, fishing, wildlife and wildflower viewing, and monitoring or surveying activities for scientific databases (for example, the Michigan Herpetological Index). Highlighted in orange in Figure 18, recreation is a reinforcing loop. Participation in this kind of outdoor recreation enriches people's lives, which encourages them to put more time and/or effort into their recreation activities, which again rewards them with feeling enriched. From there, the loop to conservation as described in the shortest loop is engaged. Recreation, such as identifying species for citizen science databases, caused an opportunity for discovery, which fueled joy and feeling well, looping back to feeling enriched. Later, recreation is also seen looped in through meditation.

> *If I'm doing the vernal pool monitoring and I wade out into the swamp and discover some little island out there that's full of cool plants I've never seen before and I wanna identify them, then that has a totally different effect. It gives me more of an expansive feeling like: oh, there's just so much here: it's so interesting, it's beautiful to look at; that's the opposite of when things are not thriving (1).*

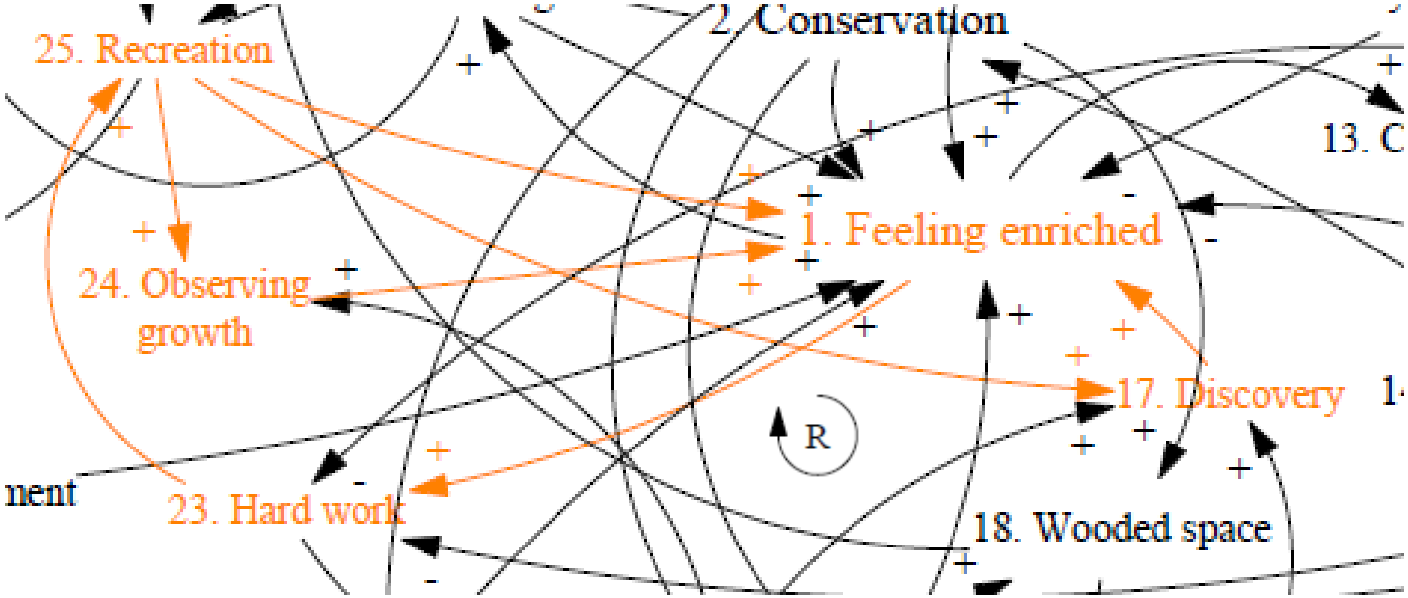


*Figure 18. Recreation loop, highlighted in orange.*

2. Cultivation

The system component termed ‘cultivation’ is highlighted in green in Figure 19 and is a reinforcing loop with a slow rate. Cultivation here means hands-on efforts to grow healthy forests and ecosystems, and includes what speakers referred to as ecological restoration, such as tree planting, prairie meadow restoration, timber management, and invasive species removal. Some speakers in this research were self-proclaimed small, sustainable farmers who also planted and harvested annual crops, baled hay, and kept livestock.

An important component of the cultivation loop is hard work. Several respondents who cultivated their land made clear the intensity of non-glorious labor required to remove invasive species and plant trees, among other activities. For these respondents, cultivating their land was opportunity for discovery and observing growth, both components part of feedback to feeling enriched.

> *In the last couple of days I’ve spent time cleaning out a brush called autumn olive, Russian olive… I was out and my process is: you cut it, and then you spray the roots so that it can’t come back, so I’m out there. And I feel good about,… by itself it’s not glamorous, but I’m out there, but in the process of being out there, the next thing I discovered was, well two things. One was a tree, a cottonwood, the seed blew in I didn’t plan it particularly, but there’s a nest in the tree. You look at the nest and there’s a couple of eggs in that nest, wow, I mean this is life returning to this area that would not be here without that. So, I felt very good about that (2).*

The hard work respondents declared requisite for cultivation have a balancing link to invasive species, so that with higher amounts of hard work put into cultivation activities, invasive species were decreased; and less hard work in invasive species management allowed more invasive species. With the reduction in invasive species, more ecological complexity was enabled. Some speakers were specific in saying that ecological complexity enhanced their sense of spirituality, or enabled more discovery, both of which feed back into feeling enriched and encouraged and provided reward for their intense, hands-on efforts.

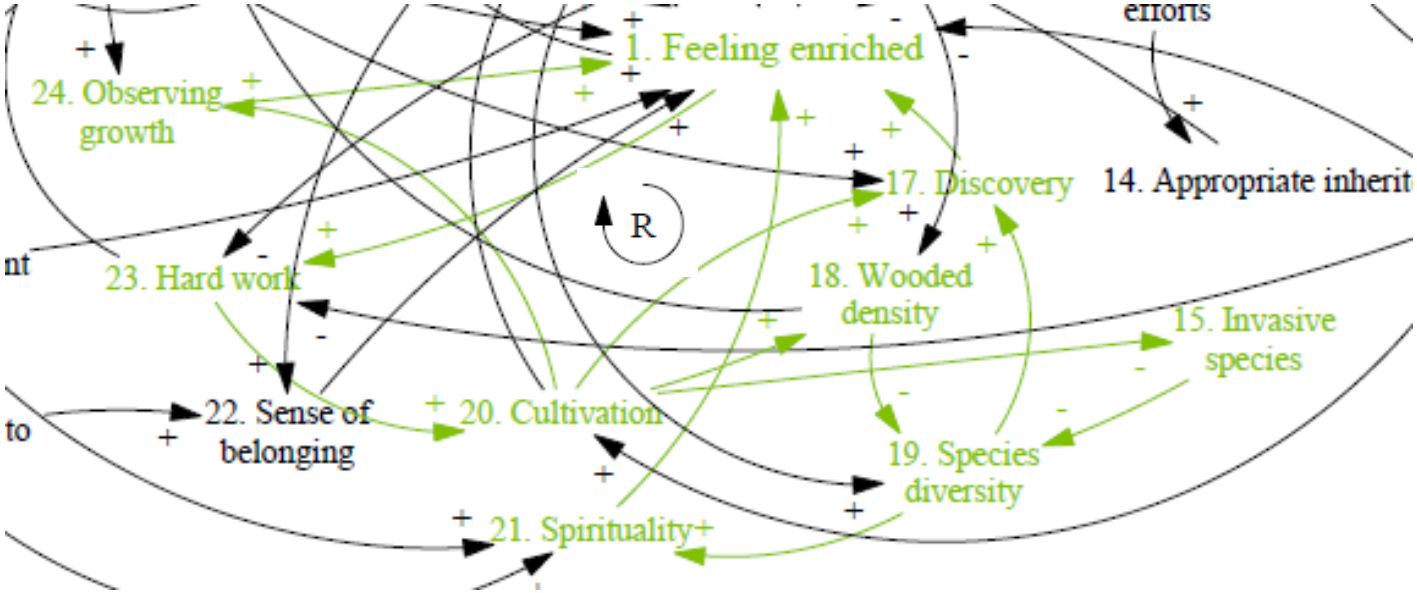


*Figure 19. Cultivation loop, highlighted in green.*

While the component of ‘hard work’ has a balancing effect on the behavior regarding feeling enriched through recreation and cultivation, it is part of an overall reinforcing loop. These variations are listed in Table 5. The first set of components in Table 5, numbers 23-1, show hard work as part of a reinforcing loop that increases conservation and feeling enriched. The second set of components in Table 5, numbers 9-10, show a reinforcing loop with a decline in ecological complexity and wooded space, so that feeling enriched is coming from elsewhere in the system.

Some speakers found much reward for their hard work in cultivation and/or recreation efforts by observing the growth and change of the woods and land over time, which makes a reinforcing loop in which people are encouraged to put in more hard work.

> *I feel that uh, very satisfying, it’s very satisfying to enrich what I already have here. And this is why I do it, because the wildlife has increased dramatically in my woodlot, when I came here in ’74… there wasn't much, and uh, it was clear cut in the 50s but I came in the 70s. So, it was not, not in great shape, but I do take great pride in working on its restoration and increasing its biodiversity and increasing its status for our wildlife (8).*

However, these speakers also acknowledged that not everyone would be willing or interested in a life requiring this level of effort, thus there are reasons why people would not invest such effort, demonstrating hard work as a part of a declining reinforcing loop. Distraction or preoccupation with other preferences and/or other priorities reduced adult interest in nature, which increases anxiety about nature and/or a specific place. This anxiety is about people apparently not caring about conservation of natural resources.

> *… Many people wouldn’t choose this because it’s too hard of work for one thing. You’re, I mean, there’s a lot of moving parts around here. A lot of moving parts. And every now and then I have a year like this where not only is it a drought year, but it’s a year of machines behaving badly. I’d bet even our refrigerator is behaving badly. So you know, I know that for some people this life is too complicated… (10).*

The hard work component, specifically referenced in the cases of cultivation, was generalized to capture the effort other people put in to their recreation-type activities.

3. Learning

The loop called ‘learning’ is comprised of sharing, role models, early experiences, and knowledge and skills. Figure 20 highlights the system components in red. Many respondents noted exposure to nature in childhood as the origin of their positive relationship with the woods, from running barefoot with their siblings, participating in summer scout camps, to exploring with their parents and hunting with uncles. Regardless of the geographic location of these experiences, respondents expressed this exposure, labeled early experiences, as critical in the development of their well-being, or capacity to feel enriched from nature.

While individuals important to certain speakers had acted as a role model that developed the capacity for the speaker to feel enriched from nature, the speakers also acted as role models in ways that shared knowledge and skills and created experiences potentially important to future generations. When individuals shared knowledge, skills, and experiences, they acted as role models, which enabled early experiences, increases knowledge and skills, engages children’s interest, and sometimes even increases adult interest. However, this interest in nature competes with other preferences and other priorities that demand people’s time and attention, which are sources of balancing links in the system.

> *So I think having wild places, … partially wild, or just a city park, really close to schools and shopping centers and nursing homes and churches, where people can have fun and enjoy themselves and feel comfortable outside, that’s what builds the ability for those people to, well once they have fun there, then they want to learn about it, and once they learn about it, then they want to preserve it, and that in turn preserves us. Because we can’t survive without this, we can’t survive without the natural world, most people don’t realize that, but we can’t (16).*

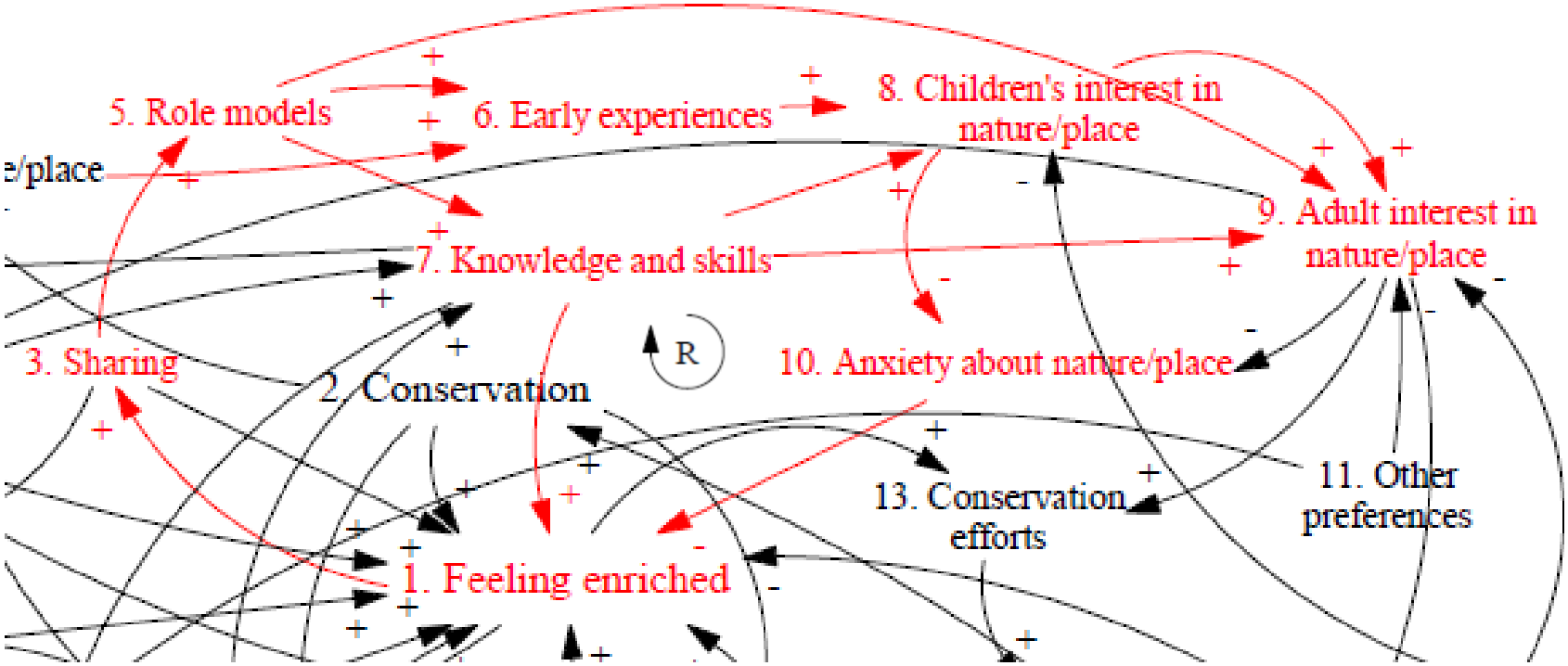


*Figure 20. Learning loop, highlighted in red.*

The recreation, cultivation, and learning loops overlap and interact in a number of ways. Cultivation and recreation are opportunity for discovery and observing growth. Cultivation links to recreation in that planting trees, removing invasive species, and other such efforts increase the ecological complexity and maintain or increase wooded space, which provide access to nature to participate in recreation and allow for discovery, or meditation and present moment, feeding back into feeling enriched. Speaker (28) articulated some of this overlap. She invested effort in cultivation efforts, including invasive species management, which reduced invasive species, therefore enhancing ecological complexity and allowing for an increased occurrence of discovery, which she enjoyed in her recreation activity of recording amphibian observations.

Recreation is also a means to feel enriched through meditation and present moment via recreation. That is, participating in recreation, such as hiking or walking, enables the respondent to meditate, which brings his/her mind to the present moment and forgetting, momentarily, all the business and pressures of social and human life, thus helping them feel well.

> *For me it is, it's getting away from everything else. With meditation you're supposed to just focus on- to be able to meditate and put everything else out. Just walking will get you into that mode, a walking meditation (3).*
>
> *Well, you know, I think of meditation too, and like mindfulness, stuff, and I've taken some classes on that and try to work that into my life for, even though a lot of it is spiritual, it's spiritual, and it's also physically beneficial, I think one of the things, one of the benefits of meditation is that it keeps you in the present moment, … you don't think about the past or the future, I mean you're really like in the moment (28)*.

With such positive experiences recreating in nature, they sought such recreation again. Some people added the component of spirituality after meditation and present moment, which these individuals stated contributed to their well-being. Paying attention to the natural world is a practice, a habit an individual must form, and being in a state of meditation and practicing being in the present moment are effective vehicles to notice the details of non-human life around a person (see Chapter 2).

‘Knowledge and skills’ is an interconnecting component for these three loops, and an accumulating component of the system. This component means gaining knowledge and skills that facilitate people feeling more comfortable in the woods, such as identifying useful and dangerous plants and animals, and responding to encounters with either type of creature, as well as dressing appropriately for the weather. This component also means knowledge of human history of a particular site, relating stories about previous generations in a family line and/or a collective group. Within the learning loop, knowledge and skills are gained through role models, and could also be gained in self-motivated study through books and other resources. Recreating and cultivating contribute to knowledge and skills as learning-by-doing. As knowledge and skills increase, feeling enriched increases as well, including via a sense of belonging.

> *I started learning more, just in the last handful of years, about the natural communities. That has just made it a bigger experience and appreciation of Michigan. And Michigan is one state, I can learn the reptiles and the amphibians, I can do that, I can learn that in one state, and now I know them and I care about them, so the more I know about a place, the more I care about a place. So now I think it has, getting into this and having this land, and participating in that extension conservation program, has made me more tied to Michigan than I even ever was before, or thought I would be (28).*

Most importantly, conservation of wooded spaces, sometimes significant sites for families or collectives, ensure access to this site, where future generations connect with previous generations. This all contributes to feeling enriched, both through a sense of belonging and spirituality. However, access to the site appears to be insufficient. This CLD suggests that spending time in the woods in a way that increases knowledge and skills is a big contributor to feeling enriched, which motivates conservation efforts that ultimately, hopefully, ascertain conservation of the site.

Size of the space, in some ways, matters. Respondents’ preferred places ranged in size in area (see Appendix II); however, a common theme was the ability to achieve a sense of solitude. Considering the characteristics of the interviewed population (see Chapter 2), the desire and

willingness to feel solitude in nature is likely correlated with level of knowledge and skills. In efforts to understand the dynamics between feeling enriched and conservation, the point that small spaces may provide relatively high amounts of feeling enriched, and that large spaces, even for those with a high level of knowledge and skills, may not be necessary or always desired, is critical.

> *Someone just recently said, "When you're here by yourself, aren't you scared?" And I was like, I was a little nervous the first couple of nights, but then you get used to the quiet. And that's the other thing, some people are like, it's too quiet here (30).*
>
> *There's benefits to every setting I believe, because if you're alone especially if it's quiet that's a whole different genre, … I've got a different education and different experience about things. It's not a good or bad thing, it's just stage. So there's a gift for many of those settings (9).*

4. Graphical function diagrams

The following graphical function diagrams show relationships and rates of interaction between variables in the Michigan, USA wooded 'preferred places' under study. Figure 21 demonstrates the relationship between recreation and feeling enriched. As people participate in outdoor recreation of many kinds, they feel increasingly enriched.

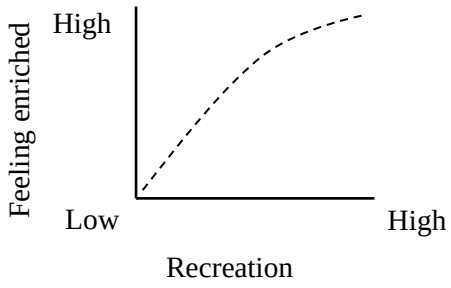


*Figure 21. Graphical function diagram of effects of recreation on feeling enriched.*

Figure 22 depicts the relationship between feeling enriched and cultivation. The hard work respondents stated requisite for this kind of effort slows the rate of feeling enriched

because of cultivation, as well as due to the time delay in seeing the effects of cultivation efforts. However, once people sense feeling enriched from cultivation efforts, the feedback is strong.

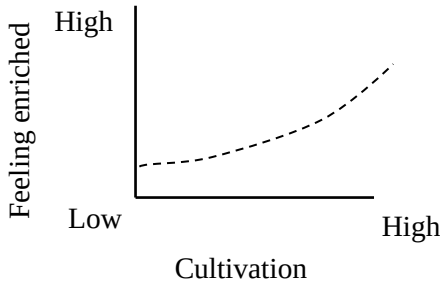


*Figure 22. Graphical function diagram of effects of cultivaiton on feeling enriched.*

> *When we bought the place it was 1980 and it was a farm field, so our first thought was: let's dig a pond, and then we'll have that pond, and then of course you've got to have the fish in there, then the fish caused fishing for food by great blue herons. We started building wood duck boxes, and right away they were taken by wood ducks and hooded mergansers, and in the wintertime that same box was being used by screech owls. This is all stuff that you kind of know but you- or I did, but when it happens- when I put up the wood duck box I never thought that: oh but this winter we'll have a screech owl in there. Knowing it and seeing it, it's two different things. So all the habitats that we changed, including the ponds that we built, … All these things that we did with the property are coming back and surprising us with things that we never thought would happen (3).*

Figure 23 shows the relationship between feeling enriched and gaining knowledge and skills. This is represented as a linear relationship, especially because of how the three highlighted loops of the CLD interconnect in the variable of knowledge and skills.

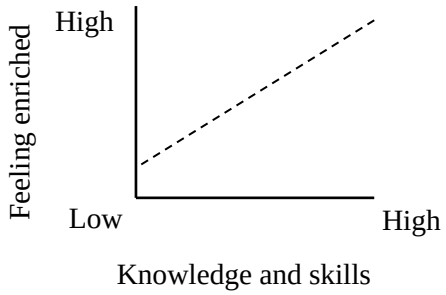


*Figure 23. Graphical function diagram of effects of knowledge and skills on feeling enriched.*

> *I think it just has to do with your level of comfort and your level of knowledge and your experience that you've had, … for me it's probably been a balance from learning from other people, whether it was my parents or teachers or girls scout leaders, [and from]*

*reading, 'cause I used to love to read about nature and nature books, animals and so I did a lot of self-study too (14).*

For the respondents in this study, drivers of their conservation efforts came from their sense of feeling enriched by knowledge, skills, and experiences in nature, and often in a particular place. From previous work (chapter 3), we understand that practical knowledge about insects, plants, and the ability to identify what is dangerous, as well as how to dress appropriately for the weather, contributes to a person's sense of feeling enriched. Spending time in nature through recreation, in addition to the knowledge and skills, builds people's sense of 'connectedness to nature.' Furthermore, if an individual gains knowledge and skills, recreates and potentially also cultivates a particular place (or places), and the knowledge includes family or social group historical connections, people develop a sense of belonging due to the sense of place they have built through their efforts, and from there seek to conserve the natural resources on their land via an appropriate inheritor.

With this causal loop diagram (Figure 16) built from input by people who self-identified as having strong, positive spiritual/emotional relationships with nature, we can see the suggestion of a 'fixes that fail' system archetype. The 'fixes that fail' system archetype is identified with behavior where a symptomatic fix directly worsens the problem, perceived in a reinforcing loop with a delay. In this case, a space may be conserved, but there is a delay in people identifying benefits from the site, which decreases the likelihood of more natural resource conservation. This fail can be addressed by maintaining more means of 'connectedness' to the site (see chapter 3).

Both case studies have major points of difference; yet there are also points of interesting similarity. Sharing knowledge of plants and animals, as well as human history; developing a sense of place and/or belonging; important moments in a person's lifetime to develop the ability

to benefit from nature; the laborious effort involved in conservation of spaces; and the variability in size and diversity of the ecosystem supporting benefits to human well-being.

Sharing knowledge of wooded shrines in Benin, as studied for this research, was through individuals in religious institutions. The Vodoun religion provided the structure and the process for communicating rules of access and withdrawal of resources, who was an effective religious leader, and how to use certain plants and animals in rituals and healing, as well as when those rituals should happen. In the United States, per this research, knowledge of natural and human history of a place was via individuals who shared their knowledge sometimes as classroom teachers or scout leaders, etc., but also through informal, one-on-one methods. Where an organized religion was important to an individual, the religion did not reportedly provide a structure in the same sense Vodoun in Benin did. Above these differences, the similarity is how the knowledge and skills were *shared* through some form of human interaction, or social institution.

Sense of place and belonging were important in both cases. In Benin, respondents reported family lineages from the founder to include the families currently living in the community, as well as knowing that each family was part of a wooded shrine lineage somewhere. While this provided a direct sense of belonging to a wooded shrine, some others also developed a removed, or indirect, sense of belonging as cultural value of a wooded shrine, once moved away from the community. In the United States, people spoke of a sense of belonging with knowledge of either, and sometimes both, natural and human history of a place. Again, the Vodoun religion played a large role in the wooded shrine system in Benin, while in the United States the means for developing this sense of belonging was less structured.

Analysis of responses from the United States' systems of study identified both childhood and adulthood as moments for developing the capacity to feel benefits from nature. These two categories are less distinct than they might seem; because some respondents were nearing 100 years of age, youth was a relative term. Essentially, respondents reported enjoying nature as a child, but being concerned about the 'youth' caring enough about nature to conserve it. In other research, adolescence was noted as an important moment in one's lifetime to develop a sense of spirituality, understood broadly (McClintock et al., 2016), and this resonates with the experiences and perspectives of respondents. Furthermore, although not very developed in the wooded shrine system in Benin, the Vodoun religion has formal training for religious leaders where knowledge of human and natural history is shared, typically with youth, although not necessarily. In both cases, sharing knowledge with youth facilitates developing the capacity to feel benefits from nature, but sharing with adults is also rewarding and effective.

Evident throughout both cases was the level of effort and hard work people chose to invest in their respective woods. There were many ways in which people identified benefits from nature, but those from cultivation efforts seemed to be very strong; however, the time and desire to put in such effort is not negligible.

## 4.7 Discussion

The goal of this research was to explore how changes in CES affect changes in forested areas over time. This research supports the hypothesized modification to the CES definition, that CES are benefits to human well-being from a relationship with nature/place, and these benefits change over time with knowledge, skills, and age. These benefits also change with changes in the nature/place, such as canopy closure, measurable area, and ecological complexity. This study

achieves this by comparing and contrasting two cases of tightly connected human-nature systems.

### 4.7.1 Benin

Throughout the continent of Africa, there are many types of wooded shrines, but they are generally historical markers and sites for initiation, burial, and sacrifice (Sheridan and Nyamweru 2008, p. 20). In Sierra Leone, some sacred groves are used by 'secret societies' to form youth in the ways of the adult world, from caring for their spouse to making war (Lebbie & Guries, 1995; Martin Martin, Martinez de Anguita, Vicente Perez, & Lanzana, 2011); in Benin, a sacred grove may be the result of the woods as an effective refuge and/or defense from conflict (Siebert, 2008). In Ghana, the Malshegu sacred grove offers new farmers wood for their first hoe (Chouin, 2002; Decher, 1997). In the Tuareg community, women healers use sacred groves to gather herbs and remedies for their healing practice (Rasmussen, 2006). Wooded shrines throughout the continent are composed of dynamics of social, political, ecological, and religious systems (Sheridan & Nyamweru, 2008). That wooded shrines are dynamic human and nature spaces is opposed to the more typical assumptions of static 'tradition' and sacred groves as relics of 'virgin' forest (Sheridan & Nyamweru, 2008).

Presenting wooded shrines in Benin with systems thinking as a social-ecological system emphasizes these social, political, and religious effects on the ecological system. Remarkably, as the woods surrounding the shrines are reduced due to human pressures, it is also human intervention that halts the reduction and encourages re-growth of the site through a renewed attention to the 'cultural value' of the wooded shrine. That is, the wooded shrine as a site to respect the ancestors and the work of previous generations, to inspire future generations, and to recognize the social-political-religious history of Vodoun in Benin (see chapter 2).

### 4.7.2 Michigan

Finding an appropriate inheritor is a key system component in this system diagrammed as the only link to conservation. Understood broadly, finding an appropriate inheritor included identifying an individual of a future generation to inherit the land, a neighbor or friend to buy the property, or an agency or organization, but necessarily some one or some group approved of by the current owner to care for the land as they determined best. Essentially, this means finding someone who cares, and that requires people who have chosen to live a life more vested in 'nature' than in material acquisitioning. Per the respondents in this research, this type of person most likely came from a background of positive experiences with people in and about nature and the human and natural history of a place.

This study shows that people are eagerly and sometimes actively searching for a means to conserve the nature/places they know and have invested much effort in -places they feel very close to, in a personal relationship with, where they have felt connected (to others, both human and other-than-human, and in the past, present, and future -see chapter 3). While donating the land or creating a conservation easement with a land conservancy may effectively conserve the natural resources, this does not guarantee conservation of the same benefits. In South Africa, place attachment was a high-ranking motivation for creating a conservation easement on a piece of property (Selinske et al., 2015). However, conservation of a space is not conservation of a place; and the *place* is people feeling comfortable and familiar with the space, as if with an old friend, either with knowledge of family and/or human heritage or natural history, or both. Knowledge of human history of a place is not the only means to gain a sense of belonging, but stories are important, especially in noting whose story of whom is told by whom.

The results of this research suggest that adding the goal of creating and sustaining ways in which people develop connectedness to nature and a sense of belonging -CES- have great potential to be very effective strategies for natural resource conservation, as opposed to the single goal of conservation of natural resource spaces. By perpetuating a narrative of nature without people, natural resource conservation is working against itself -a fix that fails. Instead, natural resource conservation should seek to conserve institutions that share and teach, alongside the conservation of spaces.

Donating and placing an easement on the land does not necessarily mean preserving the same benefits. Simply having access to land does not equal the experiences, knowledge, and skills these respondents had. The themes presented in this research from Michigan suggest that the respondents' degree of connectedness came through a lifetime of being in nature, thus developing the capacity to consciously and purposefully seek out nature for their psycho-social-spiritual needs, among others. Conservation efforts should consider how changing the ownership and access to land changes the 'human' story of the land. Thus, along with protecting a physical space, there is a need to conserve/maintain the stories and practices associated with those spaces, although in a flexible and informal enough way so that the social institutions can adapt as society grows and changes.

The results demonstrate that social dynamics and inter-personal activity – culture – drive much of how people identify benefits from nature, which in turn affects human interaction with and activity toward nature, such as cultivation or recreation. The results also demonstrate a non-linear relationship between CES and wooded space. The forest plot data from Benin and the USA in Appendices I and II support this relationship, that people may identify great benefit from the view of a single tree, or from hectares of dense old growth.

Modeling ES is one of the greatest challenges within ES science (Bennett, 2017; Carpenter et al., 2009; Rieb et al., 2017). There have been advances in using models to predict quantitatively specific amounts of ES; however, these models are not robust and fail to fully integrate multiple ES (Bennett, 2017; Rieb et al., 2017). Qualitatively, this research develops causal loop diagrams that demonstrate how multiple ES interact, such as useful medicines from a wooded shrine and the perceived satisfaction of the Vodoun divinities. Or, per the USA, cultivation (which includes timber management) and feeling enriched.

One of the most critical frontiers in modeling of ES science is understanding where changes in nature affect human well-being (Rieb et al., 2017). This point is effectively addressed in this research by demonstrating how, in Benin, people rely on 'traditional' pharmaceuticals for healing, and how changes in the shrines affect people's ability to find relevant and useful medicines. Or, per different types of well-being, the causal loop diagrams emphasize how exotic invasive species may inspire negative emotions, and that observing ecological complexity reflects an individual's sense of spirituality and connectedness.

Ecologists within ES science seek the means to model species and measures of biological diversity that correlate with functional diversity, relating this to the ES an ecosystem provides to human well-being (Bennett, 2017; Rieb et al., 2017), but integrating social dynamics of the social-ecological system from which ES arise remains relatively unanswered (Bennett, 2017; Carpenter et al., 2009; Daniel et al., 2012; Rieb et al., 2017; Ryfield et al., 2019). This research demonstrates that learning, sharing, and acting as role models are integral in the social dynamics that influence the ES of a system.

Researching dynamics of ES in space and time, linking biophysical ES provision with human well-being, the potential for technology to substitute or enhance ES, and including CES

throughout the development of modeling tools are all integral to advancing modeling within ES science (Rieb et al., 2017). By applying systems thinking to this research, the results respond to these challenges.

The points of overlap or parallel between the two cases helps meet the challenge of understanding the system dynamics that affect the provision of ES, as well as the role of and interplay between ecological and sociological components in the provision of ES (Bennett, 2017) and identify where the conceptual goals of a model should begin to match the quantitative goals (Carpenter et al., 2009). These results identify a long delay not only in the growth of wooded spaces that may come to provide ES benefits, but also in the transferring of knowledge from one generation to another, especially when socio-political forces alter or significantly reduce the social institutions that are the vehicles for that knowledge. The results also show knowledge and skills as a component that accumulates, and strongly suggest that the knowledge and skills may serve as a threshold, causing people to switch to active efforts toward conservation, instead of simply passively recreating at a site. Active conservation efforts and cultivation activities cause change to the wooded space in maintaining and/or increasing the size and diversity of the space.

The causal loop diagrams assist in responding to calls for efforts to show dynamics of ES in space and time, as well as links between biophysical ES provision and human well-being (Rieb et al., 2017). The results of this research support the growing understanding of CES as relational values, or values that come from a relationship with nature that is developed over time through social interactions, sharing knowledge, skills, stories, and experiences between people about a particular place. These are values that come from a eudaimonic sense of well-being, of living a life with purpose, in addition to hedonic well-being, which is more feeling well. While people certainly identify feeling relaxed and well in the woods, their responses indicate that even

when their conservation efforts fail, or they see a wooded site destroyed or overcome by exotic invasives and they feel discouraged in a hedonic sense, they may yet feel well in a eudaimonic sense.

The points of overlap between the two cases support the need to create quantitative models that match the conceptual goals (Carpenter et al., 2009). For example, in addition to goals of number of hectares conserved and threatened or endangered species inhabiting a space, models might count the number of role models or teaching groups that interact with the site, as well as incorporate signage and information that includes the human history of the site, attentive to telling more than one story. Emphasizing the many human histories across an ecosystem may facilitate a sense of connection to nature by connecting people through time, relevant to both Benin and USA case studies.

What does this mean for ES science and the flow of benefits to people from nature, especially about CES? This study emphasizes how people need access to nature to be able to gain knowledge, skills, and experiences, as well as make memories, that will encourage a positive relationship with nature. The 'type' of nature, and especially the types of woods the individual needs is variable; however, a consistent aspect of this system is that as people age and/or gain knowledge and skills, people feel more capable and nature has more meaning. There is a strong suggestion that people's needs in and of nature change over time, beginning as a social experience with friends and family and becoming more solitary later. The 'nature' available should be relevant to the individual's needs, knowledge, and skills. Ecological complexity plays a similar role in the system, relative to the depth of knowledge people have about nature. While an initiate may not be able to identify garlic mustard *(Alliaria petiolata),* an exotic invasive plant, but find it a beautiful wildflower, people with specific knowledge about the

plant will be disgusted by its presence. Pursuing the hypothetical graphical function diagrams with empirical research is integral to advancing ES science along the lines identified in this research.

Furthermore, the theme of sharing indicates social institutions that teach skills, create experiences, and improve knowledge that may fuel connectedness to nature and sense of place. There is evidence that connectedness to nature may be taught in traditional classrooms (Lankenau, 2018), and that including cultural values in environmental education predicts pro-environmental behavior (Gould et al., 2018). Thus purposefully teaching and sharing experiences and knowledge about 'nature' may propel connectedness to nature and pro-environmental behavior.

## 4.8 Limitations

These two case studies make an interesting qualitative comparison; however, they lack uniformity in design. Broadening participation in Benin to those who practice religions other than Vodoun would offer very different insight to the system, as well as designing a study including more demographic categories, such as age, gender, and rural/urban gradients. As a white American female with years of study of the wooded shrine system in south west Benin, my point of view is both a benefit and a hindrance. As an outsider, I am capable of noticing patterns that those within the system might not, as well as ignorance that reduces biases. However, this research would be improved with meaningful collaboration with experts from Benin in research design, interpretation, and causal loop diagram development. The same limitations may be claimed in the inverse for the case of the United States. These limitations should be addressed in future work, as well as further integrating this work, and future work like this, into social-ecological systems.

## 4.9 Conclusions

This research addresses the goal of exploring how changes in cultural ecosystem services affect change in forested areas by first structuring the problem of how CES and ecosystem structures and functions are inter-connected. This research highlights key variables and relationships between them to be further explored in future research, especially between knowledge and skills, feeling benefits from nature, and taking action to conserve a space. Future research should continue to explore these relationships. One potential point of departure is studying the United Nations Development Program in Benin that initialized a process of making wooded shrines a distinct category of forested area on the legal landscape for the benefit of the national government and religious authorities. Another would be to develop a study about the ways in which Americans participate in social institutions that share both human and natural history

# APPENDICES

Appendix A. Mono-Kouffo, Benin wooded shrine ordered-distance plots.

For eleven plot samples from three wooded shrines, there was a fixed-radius (1 meter) sub-plot for seedlings. Using the same center of the seedling sub-plot, an ordered-distance sampling method was used to collect data on height and girth of trees (measured dbh, or diameter at breast height). There were three height classes for the ordered-distance method: 2-7 meters, 7-15 meters, and greater than 15 meters.

Some species from the sacred groves were only identifiable in the local language. Of the total species identified from the three sacred groves, three species were found in each grove (*A. africana, A. indica*, and *L. cupanioides*), and seven species were found in two of the groves (*C. auriculoformis, C. petandra, C. zenkeri,* danvé, *E. guinaensis, K. Africana, and T. scleroxylon*). The remaining species were distributed throughout the groves. Data was analyzed with adjustments provided by Cottam and Curtis (1956) and Engeman et al (1994) to calculate stems per hectare, relative abundance, and relative dominance of the groves by species and by height classification. The following charts summarize the results.

A.1 Stems per hectare

Estimates of number of stems per hectare describes the frequency of trees in the grove given a certain area, regardless of tree species or dbh. The charts presented here show the number of stems per hectare within each height classification. ODgC on the y-axis label breaks down to be understood as follows: ‘OD’ is Ordered Distance, the sampling method; ‘g’ is the number of individuals at each sample point; and ‘C’ stand for ‘closest.’ For example, if four trees were included in a height classification in a plot, the stem per hectare label would read OD4C, covering the area based on the distance from the fourth closest individual to the center sample

point. The number of individuals included per height category per plot, or ‘g,’ was variable throughout the data collection.

The stem per hectare estimates allow for cross-grove comparison, as seen in Figure 24, below. Wooded shrine Ad Plot 3 shows an ideal structure of a forest, with fewer taller trees, whose crown dominates the canopy, growing over many shorter trees. This structure was also seen in wooded shrine D in plot 4. Most plots varied in structure, although stems in the 2-7 meter height class were more frequent than stems in any other height class in each grove. Wooded shrine Ad had the least stems/hectare in the 2-7 meter height class than the two other groves. Wooded shrine Ka had the least stems/hectare in greater than fifteen meters height than the other two groves.

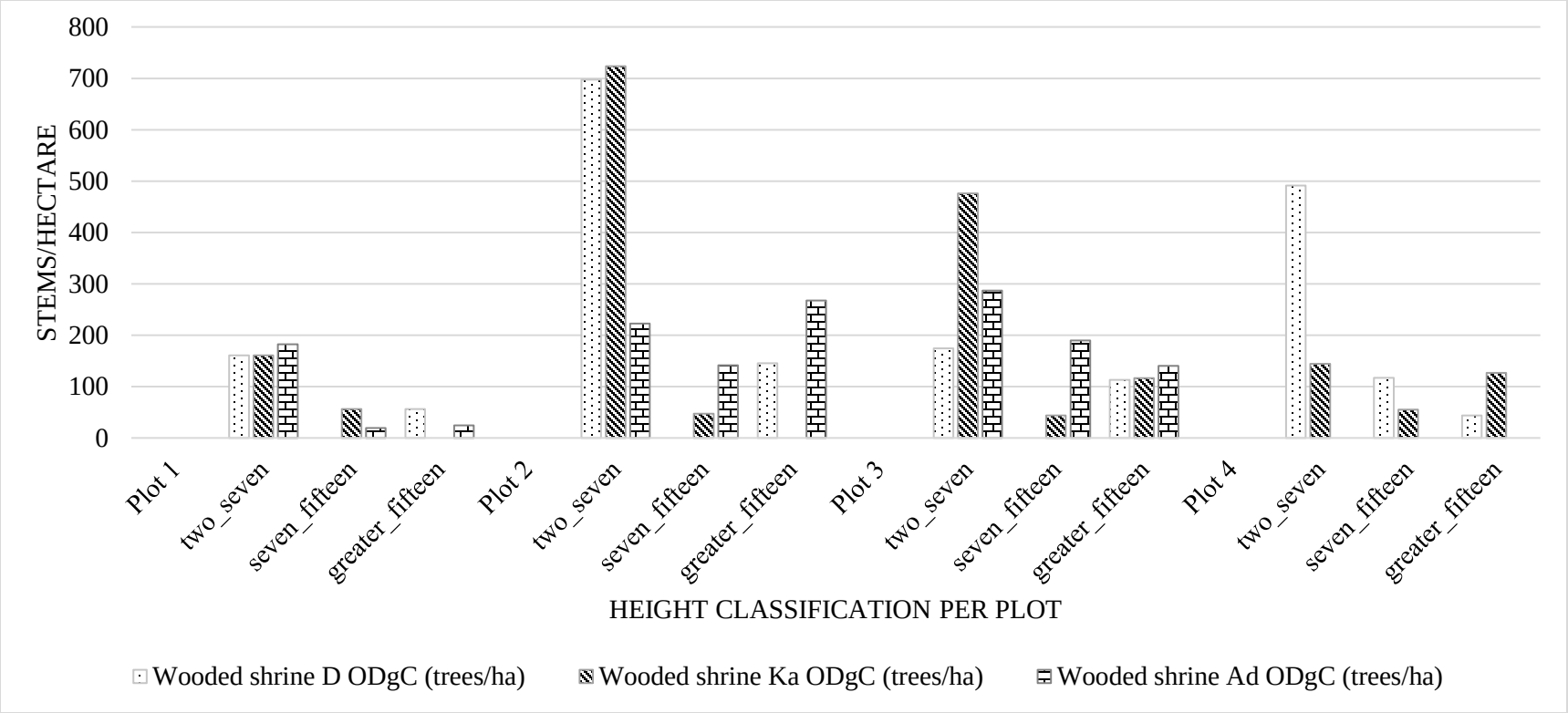


*Figure 24. Stems per hectare estimates per plot in each wooded shrine in Benin.*

In wooded shrine Ad, the highest frequency of tree by height class is two-seven meters in plots one and three. Plot 3 demonstrates an idealized stratification of well-structured forest, with fewer tall trees than shorter trees. This is because a taller tree is capturing more sunlight in the canopy of the grove, while the shorter trees are growing beneath these tall trees. Plot 1 shows height stratification in an area that may have experienced a sudden loss of tall trees, with many shorter trees filling in the gap. This grove only had three plots, and so in not present in Plot 4 on this chart. Wooded shrine D largely lacked mid-sized trees, except for in Plot 4, where trees 7-15 meters high were counted. The other three plots were mainly composed of small trees and very tall trees (see relative abundance charts, below). The difference between Plots 1-3 and Plot 4 was apparent, even while collecting data. Wooded shrine Ka consistently showed new growth, captured in the short and mid-sized height classifications. None of the plots demonstrate the ideal stratification as seen in Plot 3 of wooded shrine Ad, and historical context explains most of this forest's structure. The seedling classification was not included in this analysis.

A. 2 Relative Abundance

Relative abundance measures show the abundance of one species relative to the others, and is seen in Figure 25. This measure is based on the abundance of one species per the abundance of all species; this number was then converted into a percentage value. *Triplochiton scleroxylon* was the most abundant species relative to other species found in wooded shrine D in Figure 3, at 38.3%. The most abundant species in wooded shrine Ka was *L. leucocephala* at 31.1%. For wooded shrine Ad, the most abundant species was *C. zenkeri* at 17.1%. Both *T. scleroxylon* and *C. zenkeri* were found in two groves; *L. leucocephala* was found in one grove, where it was the most abundant. Worth noting here is that *T. scerloxylon* is a popular wood for dug-out canoes used on the Mono River, and is also the namesake of the town and *commune* of Athiémé.

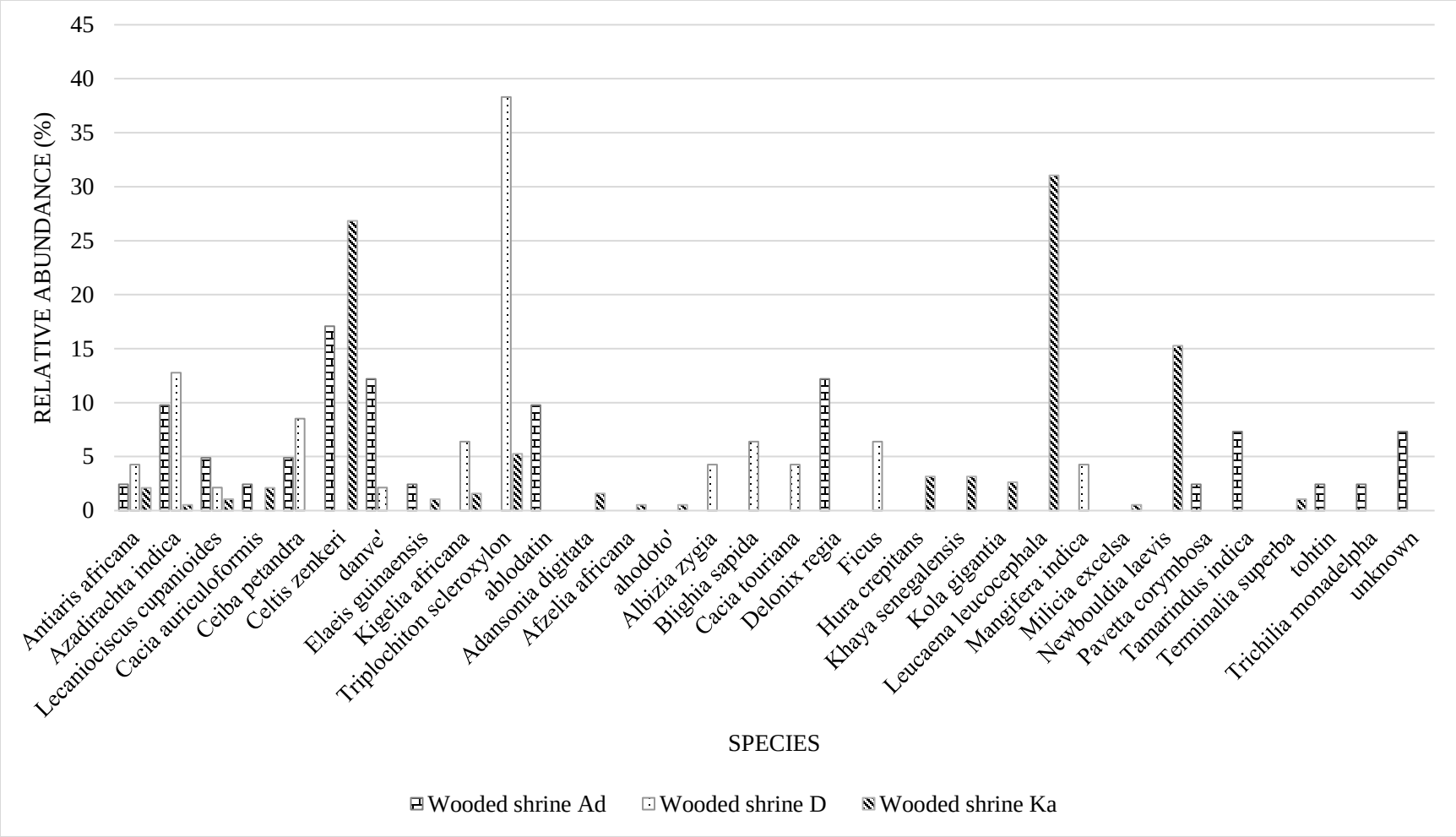


*Figure 25. Cross-wooded shrine comparison of species relative abundance in Benin.*

There are 15 species identified in wooded shrine Ad in Figure 3. The most abundant species in this grove was Celtis zenkeri at 17.1%, followed by danvé at 12.2%, a species not yet identified to scientific name, and Delonix regia also at 12.2%. The least abundant were Antiaris Africana, Cacia auriculoformis, Elaeis guinaensis, Pavetta corymbosa, tohtin, and an unidentified species, all at 2.4%. We identified 12 species in wooded shrine D in Figure 3. The most abundant was T. scleroxylon at 38.3%; the next most abundant species was the neem tree, or A. indica, at 12.8%. The remaining ten species in wooded shrine D were less than 10% abundant relative to all species included. The wooded shrine Ka in Figure 3 was most diverse with 18 species identified. The most abundant of them was L. leucocephala at 31.1%, followed by C. zenkeri at 26.8% and N. laevis at 15.3%. Triplochiton scleroxylon was the next most abundant at 5.3 %, after which the remaining species in this grove were less than 5%.

A.3 Relative Dominance

Relative dominance describes the composition of the grove in terms of the basal area of the tree, and is seen in Figure 26. The basal area of the trees by species was then divided by the area of the plot, giving a measurement in meters$^2$ per hectare. This was then made a percentage per species, relative to the total measured dominance in the grove. Relative dominance is based on trees that have a measured dbh value, which is in contrast to relative abundance that is calculated based on the presence of trees regardless of size.

Wooded shrine D had the fewest species to make the relative dominance list with three species. The most dominant tree relative to the other species measured in the same grove was *A. zygia* at wooded shrine D, with over 45% of the total dominance calculated there. *Triplochiton scleroxylon* was the next most dominant species at wooded shrine D at 35.5%, and *C. petandra* completes the list at 15.1%. Wooded shrine Ka had the most species with 14; the most dominant

was *T. scleroxylon* at 25.4%, and the least abundant was *C. zenkeri* at 0.14%. Wooded shrine Ad's most dominant species was *D. regia* with 35.5%, followed by *C. zenkeri* with 23.7%.

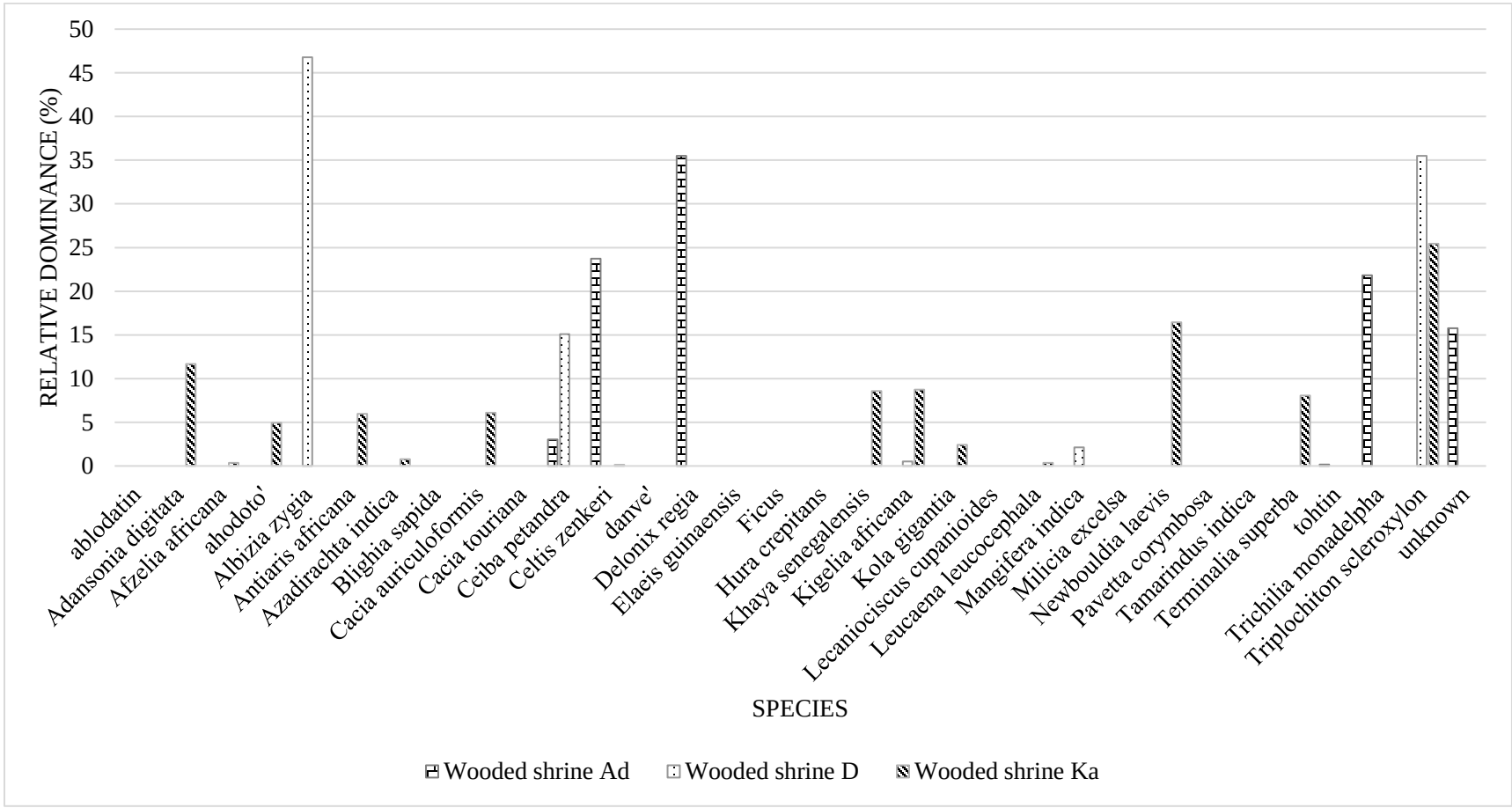


*Figure 26. Cross-wooded shrine comparison of species relative dominance in Benin.*

The most dominant tree species in wooded shrine Ad in Figure 4, was D. regia at 35.5%, followed by C. zenkeri at 23.7%, T. monadelpha at 21.8%, and the unidentified tree at 15.8%. Ceiba petandra is the least dominant, at 3.0%. Only five species of 15 had a measurable dominance in wooded shrine Ad. Albizia zygia is the most dominant tree in wooded shrine D, in Figure 4, at 46.8%, followed by T. scleroxylon at 35.5%. Ceiba petandra is third, at 15.1%, then M. indica at 2.1%, and K. africana at 0.5%. Of the 18 species identified in wooded shrine Ka, in orange in Figure 4, T. scleroxylon was the most abundant at 25.4%, followed by N. laevis with 16.4%. After A. digitata at 11.7%, the remaining species were less than 10% of the total dominance.

*Table 6. List of frequently venerated angiosperm species, from Kokou and Sokpon 2006, p. 18.*

| | *Species Name* | *Family Name* |
|---|---|---|
| 1 | Adansonia digitata | Bombacaceae |
| 2 | Afzelia africana | Caesalpiniaceae |
| 3 | Albizia zygia | Mimosaceae |
| 4 | Antiaris africana | Moraceae |
| 5 | Bombax costatum | Bombacaceae |
| 6 | Borassus aethiopum | Arecaceae |
| 7 | Ceiba pentandra | Bombacaceae |
| 8 | Celtis integrifolia | Ulmaceae |
| 9 | Daniellia oliveri | Caesalpiniaceae |
| 10 | Diospyros mespiliformis | Ebenaceae |
| 11 | Diospyros monbuttensis | Ebenaceae |
| 12 | Dracaena arborea | Agavaceae |
| 13 | Elaeis guineensis | Arecaceae |
| 14 | Ficus capensis | Moraceae |
| 15 | Ficus polita | Moraceae |
| 16 | Grewia carpinifolia | Tiliaceae |
| 17 | Holarrhena floribunda | Apocynaceae |
| 18 | Hymenocardia acida | Euphorbiaceae |
| 19 | Khaya senegalensis | Meliaceae |
| 20 | Lecaniodiscus cupanioides | Sapindaceae |
| 21 | Lophira lanceolata | Ochnaceae |
| 22 | Milicia excelsa | Moraceae |
| 23 | Newbouldia laevis | Bignoniaceae |
| 24 | Parkia biglobosa | Mimosaceae |
| 25 | Tamarindus indica | Caesalpiniaceae |
| 26 | Triplochiton scleroxylon | Sterculiaceae |
| 27 | Vitex doniana | Verbenaceae |
| 28 | Vittelaria paradoxa | Sapotaceae |
| 29 | Zanha golungensis | Sapindaceae |
| 30 | Zanthoxylun zanthosyloides | Rutaceae |

Appendix B. Michigan, USA ‘Preferred Places’ variable radius plots.

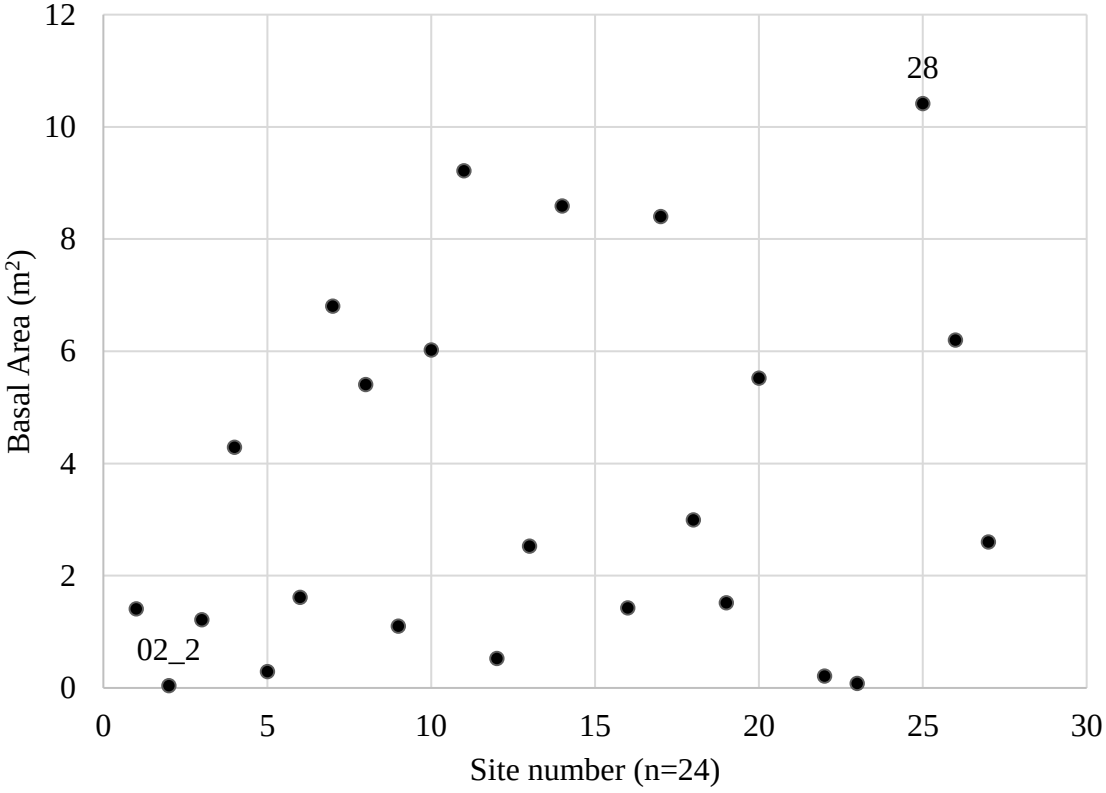


*Figure 27. Total tree basal area in meters squared per site in the USA.*

Figure 27, above, shows the basal area density in meters squared for each site. This gives an idea of how much of the plot was occupied by trees. The densest plot was site number 28, a Lake Michigan dune and swamp site, and the least dense was site number 02_2, a plot with small cottonwoods shading a bench overlooking water where sand had been mined previously.

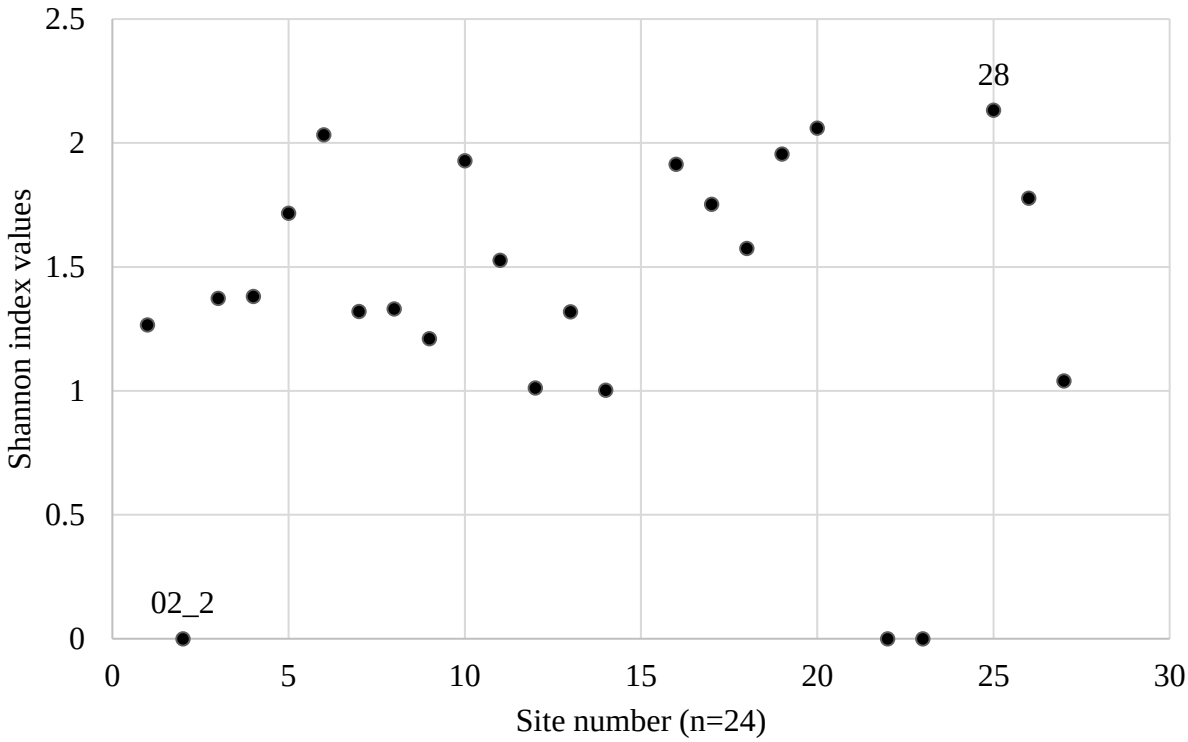


*Figure 28. Species diversity as indicated by the Shannon index for all sites in USA.*

Figure 28, above, shows the Shannon index values for each site. Shannon index values estimate both richness and abundance of species within a site. I calculated these indices based on genus. The non-zero values range from just over 1 (1.003, at site 14), which was almost entirely white pine (*pinus strobus*) to just above 2 (2.13, site 28), which was a Lake Michigan dune and swamp site with many more species identified. The zero values indicate sites where only one species was identified, such as site 02_2.

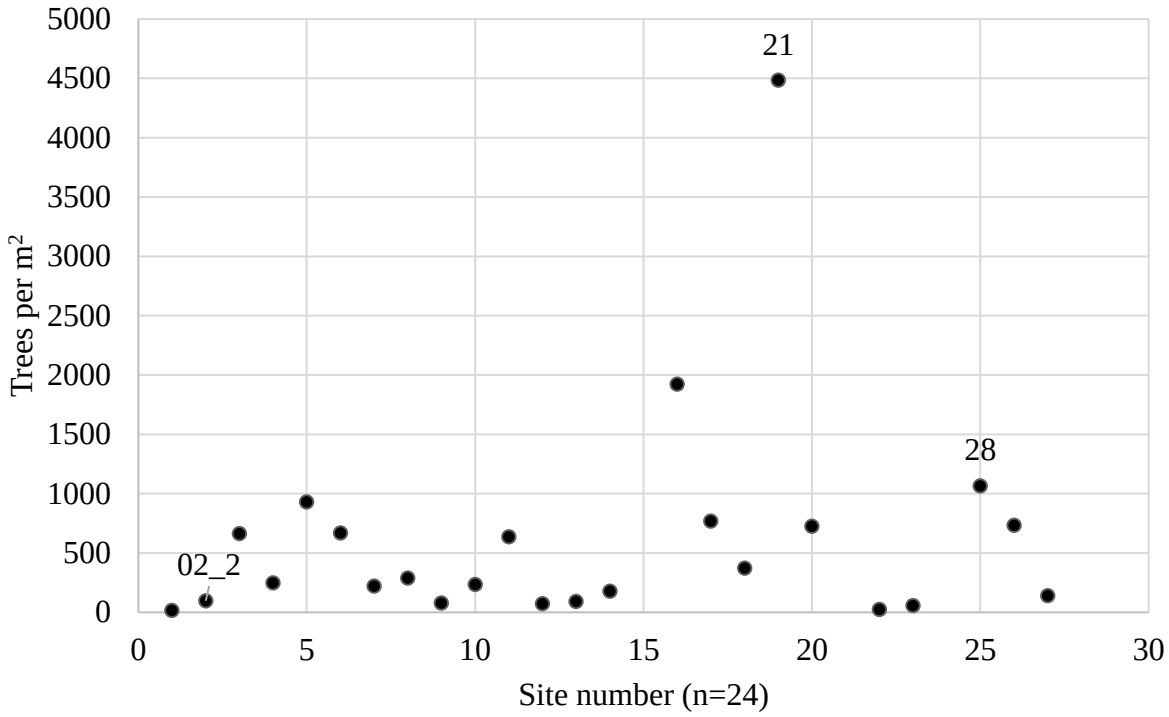


*Figure 29. Trees per meters squared estimated at all sites in the USA.*

Figure 29 shows the density of trees as trees per square meter. Site number 28 had the largest basal area measured; however, the density of the site is lower than site number 21, where many sizeable trees were growing closely together at a lakes' edge. Site number 02_2 had very little basal area, but the density is higher because the cottonwood saplings were tightly spaced shading a bench.

# 5. Discussion

This research advances ES science, and especially CES, by qualitatively modeling with systems thinking how they are part of social-ecological systems. Systems thinking enables the capacity to identify where non-linearities exist in the human-nature systems, as well as sources of delays and accumulations. Other authors have promoted this type of research, especially noting Carpenter and others who envisioned ES science within coupled social-ecological systems (Carpenter et al., 2009), and including Comberti and others who put forward a framework with inverse relationships, termed 'services to ecosystems' (Comberti et al., 2015), and Fish and others with a novel framework for conceptualizing CES as relational processes and entities (Fish et al., 2016). More than a framework, systems thinking depicts change over time, and this research does so with empirical data from two case studies. Place-based research with the capacity for comparison is advocated as an effective means to pursue ES science research as part of a system (Carpenter et al., 2009).

The term 'cultural' as a category of ecosystem services implies meaningful interactions between, and expressions by, people. The humanities and social sciences confirm this in many ways. Within the ES science framework, CES are defined along with other categories of ecosystem services, as benefits to people from ecosystem structures and functions, combined with other forms of capital (Bennett, 2017; Costanza et al., 2017). This research, informed by social-ecological system thinking, presents results that suggest CES come from meaningful interactions between people that have influenced, and laid the foundation for, the capacity to have a positive relationship with nature, thus supporting a transition of the definition of CES to one of relational values (Chan et al., 2016; Fish et al., 2016). Supported with systems thinking, this definition includes change over time, especially with changes in knowledge and skills.

These results are important to the current debate between people in ecosystem services and others advancing a related concept called ‘nature’s contributions to people,’ or NCP (Díaz et al., 2018). These results support ES science in that it is capable of including social sciences and humanities, and outside of an economic perspective, the ‘stock-and-flow’ conceptualization is useful as dynamic systems thinking. However, NCP argues that culture is not a ‘product’ of nature and thus cannot be a category of ecosystem services (Kadykalo et al., 2019), a point this research fully supports, and more so with CES understood as relational values. This work presents evidence that learning and sharing knowledge, skills, and experiences between people - culture- affects all types of categories of ES, such as which plants serve as the best headache remedies, and that having a higher awareness of one’s connectedness to nature may be both spiritual and pragmatic, which supports the argument that ‘categories’ of NCP are overlapping, and that culture permeates all of them (Díaz et al., 2018).

Research on wooded shrines across the continent of Africa are found in anthropology, religion and spirituality, and policy and environmental history (Sheridan & Nyamweru, 2008). While relying heavily on those social and humanistic resources, this research with data generated from south-west Benin offers the point of view that wooded shrines are also a source for important traditional healing practices, with more information needed on the type of healing people seek and practice in the region (but see Lebbie & Guries, 1995; Madge, 1998).

Research in Benin generated data specifically about spirituality, heritage, and identity through the religion of Vodoun. Results demonstrate that this religion operates in many ways as a social institution that shares stories, languages, pharmaceutical and ritual knowledge and skills integral to the practice and perpetuation of the religion. Furthermore, the religion itself is a component of cultural identity and heritage at individual and collective levels (see Tall, 1995).

People spoke of sense of place through both direct and indirect channels. Directly, as residents of a certain community with access to a wooded shrine, and/or as descendants of a certain family with rights to a certain shrine. Indirectly, in recognizing the cultural value of wooded shrines, regardless of one's religious practice.

Research in the United States lacked the focus of a particular religion, but found similar patterns in the sharing of stories, knowledge, experiences, and skills through various social institutions. People spoke of a general enrichment to their lives because of their experiences in nature, and articulated that their memories from youth and the knowledge and skills developed over time contributed to their capacity to identify these benefits, as they felt more comfortable, capable, and familiar with the outdoors in general. Gaining this sense of ease with the outdoor world promoted a stronger sense of spiritual, heritage, and identity benefits that were tightly intertwined with sense of place. Overlap amongst these types of CES is not new, and resonates with research in environmental psychology (Balundė et al., 2019; Poe et al., 2016; Urquhart & Acott, 2014). Cultural heritage and cultural identity were relevant at the individual and collective levels. Recent research has demonstrated that childhood exposure to nature increases the likelihood of continuing such practices in adulthood (Wood & Smyth, 2019).

Causal loop diagrams from both the Benin and USA case studies begin to identify sources of delays and accumulations. First and foremost, one interesting observation based on the CLDs is that knowledge, experiences, and skills in nature are accumulated and contribute to a sense of feeling enriched. This is in contrast to a modified definition of CES as the "benefits, for example the capabilities and experiences, that arise from human-nature ecosystems" (Chan et al., 2012). There is a delay between childhood and adulthood, per this diagram, in taking action toward conservation, cultivation, and recreation efforts about natural resources, especially in

relation to a particular place. While knowledge and skills about non-human nature accumulates, the wooded space, density, canopy height, and species diversity all fluctuate per ecological interactions and human input.

Results from the case studies suggest threshold-like behaviors, where a certain amount of experience, knowledge and skill is necessary to begin to be able to identify benefits from nature, and that a certain threat or external input to either self or place prompts action to participate in conservation efforts, specifically to ensure an appropriate inheritor. Referencing the data generated, there is an important non-linear relationship between knowledge and skills and the ecological structures and functions, where great benefit may come from a very small wooded place, and a large wooded place may provide less, all in relation to a personal sense of one's needs and comfort levels. However, the causal loop diagram, as a qualitative tool, does not yet effectively demonstrate these thresholds, and others that likely exist.

Threats may be understood broadly, such as a decrease in wooded area that creates a sense of shock to people, or a perspective gained that heightens one's awareness of the richness, both human and natural, of a site. External input may be either positive or negative, such as financial or human capital made available to improve the site, or a sudden reduction in financial wealth that requires modification to one's lifestyle. Overall, though there is a correlation between connectedness to nature and sense of place with pro-environmental behaviors, the causal relationship is not well understood (Gosling & Williams, 2010; Otto & Pensini, 2017).

The case studies are very different in terms of 'culture,' but they do both contribute strong themes to CES conceptual development. CES are benefits to people from nature because of a relationship that drives the capacity to feel enriched from the outdoors, and specifically distinguishing eudaimonic and hedonic types of well-being. Spirituality, cultural heritage,

cultural identity, and sense of place are all tightly interconnected, but also distinct in important ways, depending on the individual's interpretation of 'spiritual,' and their social connections and identities in relation to a place. These identities affect the stories, knowledge, and skills one learns, and from whom, that enable different benefits from nature, such as differences between individual- and collective-level benefits to identity and heritage. Furthermore, while ecological structures and functions matter as the wooded space for people to be in, and contribute to the sense of benefit to their well-being, the people's sense of benefit and the overall 'ecological quality' of any given site will vary in some relation to the individual's experience, knowledge, skills, and needs.

# 6. Conclusions

Research that began by processing a three-year experience in the Republic of Benin has produced results that demonstrate how people affect nature in a positive way. This is evidenced in how people who have a strong relationship with some place in nature enrich the site through cultivation and legal efforts, and because of these efforts, develop a strong relationship with nature that benefits their well-being. While an interest in governance as a means to understand ownership and management of particular sites has been a part of this research from the beginning, results from this research suggest that social institutions that are vehicles for stories, knowledge, and skills are equally a tractable point for governance within this kind of work. Further, that human history of a place can play an important role in natural resource conservation, equally if not more than natural history, is also a critical point of this research.

Finally, the most interesting point to pursue at the nexus of human-nature interactions and the mechanisms of ES provision is the relationship between the ‘amount’ of stories, knowledge, and skills of human and natural history, and the ecosystem size and biological diversity. This point may be the most influential in pro-environmental behavior and natural resource conservation efforts by considering how anyone’s backyard or neighborhood park is nature, and making that a starting point for building stories, knowledge, and skills that will drive a desire for more ecological complexity throughout all the outdoors.

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