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Informal Karst Education in the United States and Internationally

Leslie A. North
University of South Florida, north2@mail.usf.edu

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by

Leslie A. North

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Major Professor: Philip E. van Beynen, Ph.D.
Fenda Akiwumi, Ph.D.
Robert Brinkmann, Ph.D.
Bogdan Onac, Ph.D.
Philip Reeder, Ph.D.
Rebecca Zarger, Ph.D.

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DEDICATION

This dissertation is dedicated to all of my friends, family, and colleagues who have consistently supported me throughout my collegiate career. Without shoulders to cry on when I was frustrated, words of encouragement and advice when I was feeling down and lost, unwavering love, hilarious game nights, and must have excursions to Disney where I could just be a big kid, I would have not been able to succeed. I love you all so very much!

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ABSTRACT

Despite the abundance of karst terrains and the important role they play in a wide variety of roles including supplying freshwater drinking supplies, no single, comprehensive study investigates the role of informal education for the improved understanding and protection of the terrains. Commonly overlooked anthropogenic karst disturbances partially occur because of the poor dissemination of scientific information to the general populace and policymakers and budgetary and time constraints of municipalities, thus generating a need to use *informal* education to fill these shortcomings. The purpose of this study was to: 1) establish the status of and quantify the amount of karst-related informal education efforts pursued in the United States and abroad, 2) reveal if any differences in the nature of educational material exist with ownership (i.e. private vs. governmental) at karst attractions, and 3) evaluate the outcomes of increasing the educational karst material presented to show cave visitors through guided tours. The results of this study reveal that karst education is overall lacking in the United States and internationally, the focus of most recent educational endeavors is bats, and educational programs for children far outnumber the quantity of programs available to adult learners. This research also reveals that disconnects between the actuality of current show cave program characteristics and tour guide and manager opinions about informal karst education are abundant. Furthermore, although differences exist in the nature of the educational material presented to visitors during guided tours, the quality and quantity of material at both privately- and publicly-owned facilities is often significantly lacking. Yet, through field-based research this research proves minimal changes to tour content and guide re-training, can result in successfully increasing visitor karst knowledge while simultaneously maintaining the entertainment value of show cave operations.

CHAPTER ONE: INTRODUCTION TO THE STUDY

Karst terrains are landscapes with “distinctive hydrology and landforms that arise from a combination of high rock solubility and well developed secondary (fracture) porosity” (Ford and Williams 2007, p. 1). Karst landscapes possess sensitive water, mineral, and fossil fuel resources, as well as unique features, such as caves and springs, lending these fragile environments to extensive environmental degradation. These terrains are estimated to cover 12 percent of the world’s land surface, provide habitable conditions for over 25 percent of the world’s population, and supply 20-25 percent of the world’s populace with drinking water (Ford and Williams 2007). In the United States alone, karst and its associated features cover 20 percent of the land surface and contribute nearly 40 percent of the freshwater supplies (Veni et al. 2001). Similarly, nearly 50 percent of the freshwater drinking supply in many European countries is derived from karst aquifers, while over 100 million people in southern China live directly on these terrains and rely on them for groundwater (COST Action 65 1995; Ford and Williams 2007).

The rapid transport of percolating water through karst, inability of carbonate bedrocks to effectively filter polluted water, and highly specialized nature of subterranean biota, lends karst to being quite susceptible to human impacts (van Beynen et al. 2006; North et al. 2009) through a myriad of physical, economic, and social activities, including, but not limited to, groundwater pollution and extraction, urban development, cave modification, and deforestation (Gunn et al. 2000; van Beynen et al. 2006; North et al. 2009). These anthropogenic karst disturbances, which are commonly unobserved and ignored, partially occur because of the poor dissemination of scientific information to the general populace and policymakers. Thus, despite the abundance of karst landscapes, their sensitivity to human influence, and the important role they play in supplying fresh drinking water worldwide, overall, there is a severe lack of effective policies at most federal, state, regional, and local levels (Fleury 2009). Furthermore, budgetary and time constraints of municipalities commonly curtail enforcement leading to the rapid degradation of these landscapes even when management tools and policies may be implemented (Hildreth-Werker and Werker 2006). Another tactic, such as education, is therefore needed to fill karst management shortcomings.

When compared to the educational experiences a person has in informal learning environments during their lifetime, the amount of exposure a person has to education in traditional, or formal, classroom settings is minimal and therefore is incapable of providing continuing and wide-ranging educational benefits. Furthermore, informal environmental education is more likely than traditional formal education techniques to increase appreciation for what visitors are experiencing (Wei 2009) and the commitment to natural resources conservation by changing public attitudes and behavior (Grodzinska-Jurczak et al. 2006). Thus, using interpretive services, nature-based tourist attractions such as zoos, aquariums, national parks, and botanical gardens are increasingly becoming centers for informal environmental education (Patrick et al. 2007; Vaughn 2007; Ballantyne et al. 2008). In fact, interpretation is becoming a fundamental component of the visitation experience at these facilities (Wei 2009).

Because the general public is directly exposed to karst and karst-related issues at show caves and springs through interpretative programs, these attractions can serve as potential avenues for disseminating appropriate scientific and educational material about the sensitivity and importance of karst landscapes to visitors. Specifically, I hypothesize that improving educational material at karst attractions will increase the karst knowledge base of the general populace, which, with time, could lead to fewer occurrences of anthropogenic disturbance and increase public demand for the implementation and enforcement of comprehensive policies designed to protect and conserve karst landscapes.

Research Strategy and Framework

In order to research the spatial, qualitative, and quantitative aspects of karst education around the world, one must first choose a theoretical framework within which these concepts can be placed. Developing research questions to study the various aspects of informal education of any topic requires an understanding of the basic theories behind how people learn in these settings and the possible implications of data collection. Bell et al. (2009) argue that when studying informal learning settings, one of three broad approaches can help describe the framework around which the research takes place: research through a people-centered lens (or viewpoint), place-centered lens, or culture-centered lens. Research through a people-centered lens would highlight the development of interests and motives, knowledge, identity, and the influence of prior knowledge on learning in informal learning environments. This type of analysis would likely focus on mental processes and collecting any evidence of acquired knowledge. Through a place-centered lens, in contrast, learning processes and outcomes are viewed as a product of the physical features, available materials, and activities associated with a particular place. This type of research avoids internalized learning outcomes, focusing instead on the role of visualizing material, objects, data, and other educational tools encountered in informal learning settings (Heath et al. 2002). Lastly, the culture-centered lens is one of the most recent shifts in education research theory (Bell et al. 2009). Using this approach, a researcher would put forth that learning is a cultural process, where individuals develop their understandings of the world through cultural practices (Schauble et al. 1997) by identifying with their natural surroundings, experiences in their communities, and activities most familiar to them (Bell et al. 2009).

The choice of an appropriate theoretical framework depends on the nature of the research questions and/or goals and the structure of the study (Anderson et al. 2003). Because the central goal of this research is to determine whether increasing the educational quantity and quality of material presented at show caves can help to effectively increase people's knowledge of karst environments, this research was primarily conducted through place- and people-centered lenses. However, the cultural aspect of education is undoubtedly important when making geographical comparisons of karst education techniques and outcomes.

Research Purpose, Significance, and Rationale

The lack of information on the amount of karst environmental education in the United States and abroad is unfortunate because of the significance and fragility of karst terrains. Furthermore, because of the limited regulatory protection karst environments are offered in most locations as a result of insufficient municipal monetary and time resources and/or an accurate understanding of karst (Fleury 2009), investigating alternative approaches to fill these regulatory and educational gaps and reduce occurrences of anthropogenic impacts to karst is a necessity. Yet, in general, operators of most nature-based tourism facilities "have no idea whether their clients' understanding and appreciation of nature…are enhanced as a result of their guided tour experience" (Weiler and Ham 2001, p. 4). The same can be said for karst-themed tourism facilities such as show caves. In fact, while an extensive and robust body of knowledge exists regarding the ‘science’ of karst, such as karst hydrology, biology, and disturbance, there has been no single, comprehensive study investigating the role of informal education in karst settings. Furthermore, despite being widely used in multiple informal learning settings, such as botanical gardens and zoos, the development of educational environmental interpretation programs for the general public in karst settings is quite recent compared to other informal learning venues. Many heavily visited karst attractions all over the world lack educational tours, brochures, programs, and exhibits. Even where educational programs are offered, these tend to focus on youth learning and are often cave specific, lacking karst science-based interpretation that could be targeted to different age groups and encompass a holistic view of karst systems.

Instances of anthropogenic karst disturbance will likely continue until the general public is adequately educated about the vulnerability and interconnectedness of karst terrains. Thus, the purpose of this study was threefold: 1) analyze current informal karst education efforts being pursued in the United States and abroad, 2) qualitatively and quantitatively establish the characteristics of the educational material currently presented to tourists visiting show caves and springs, and 3) evaluate the outcomes of providing higher quality and quantity educational karst material to visitors through the re-training of show cave guides and updating of existing tour content.

Until now, karst-related educational programs implemented in the United States and abroad, and the tools, techniques, and feasibility of educating the general public at karst attractions remained unstudied. In fact, no single, comprehensive study has ever investigated the role of informal environmental education for the increased protection and conservation of karst despite show caves increasingly facing the demand for establishing scientific environmental interpretation programs and how to evaluate the outcomes of their efforts. Thus, the results of this study hold the potential to add significant new knowledge concerning the status of karst education in the United States and abroad and help significantly improve communication of karst information to the public through informal learning environments.

This research helps managers and interpretation personnel justify the need for improving interpretative material by systematically revealing where shortfalls exist and offers suggestions for improvement based on conclusions drawn from survey data collected during this course of study. Specifically, from this research educators may better understand: 1) the importance of the quality and quantity of educationally-rich material presented at show cave and spring facilities, 2) the current quantity and quality of karst public education, 3) the potential constraints to the development and implementation of educational pursuits at these facilities and 4) the importance of program evaluation since evaluating tour outcomes increases the organizational capacity of facilities to make evidence-based decisions about interpretive program designs and improvement. The exposure of the general public to the importance of karst environments and to karst-related issues through work with both publicly- and privately-owned karst settings is increased through this research, although the ability to educate the general public is limited to visitors these facilities. Lastly, enhanced discourse between scientific researchers, land resource managers, government officials, and the general public about the importance of karst environments and the need for educating the general population regarding this issue will be realized.

Overarching Research Goal

The main focus of this study is to determine whether increasing the exposure of visitors to improved educational material in informal karst learning environments, such as show caves, enhances their knowledge about the importance and vulnerability of karst terrains.

Research Sub-Questions

From the above research question come the following research sub-questions:

1) What is the status and overarching characteristics of karst-related education opportunities in the United States and abroad?

2) What are the characteristics of the educational material currently presented to tourists visiting show caves in the United States and internationally? Do differences exist?

3) How and where do karst attraction operators obtain their karst-related educational materials? Do differences in the nature of educational material exist with ownership (i.e. private vs. governmental) at karst attractions?

4) What barriers/obstacles stand in the way of successfully educating visitors to karst attractions, despite an increased amount of educational material (i.e. funding, cooperation, implementation)?

Research Objectives

From these questions come the following research objectives for this project:

1) establish the characteristics of and quantify the amount of karst-related informal education efforts in the United States and abroad.

2) characterize current karst education opportunities offered at show caves and springs worldwide and reveal any differences in the nature of this material due to ownership (i.e. private vs. governmental) or location at these facilities.

3) identify the constraints that hinder show cave and spring facilities from pursuing karst education and consider strategies that can be used to address these constraints.

4) ascertain if increasing the educational quality and quantity of material presented at attractions improves visitors' understanding of karst terrains.

Conclusions

Education can be a powerful tool for conservation and management in any environment, but particularly for karst terrains where education and management strategies are typically lacking or in their infancy. Ideally, a well informed populace will make well informed decisions. Yet, limited exposure to cave and karst environments perpetuates an inadequate and/or erroneous understanding of the terrains. Increasing this exposure is, therefore, essential to the protection of karst landscapes. Furthermore, because an interpretative program at show caves directly connect the general public to the karst resource intellectually as well as emotionally, educational programs at show caves and springs are especially necessary in karst areas. As such, to answer the aforementioned research questions, achieve their associated research objectives, and ultimately perpetuate informal karst education, extensive review of current informal karst education endeavors directed towards the general public through personal interviews and archival research needs undertaking. Revealing the characteristics of and techniques for developing current show cave material worldwide through similar research techniques, while garnering an understanding of the potential constraints that show caves and springs face when pursuing education with the distribution of electronic surveys are also important. Lastly, guide re-training coupled with the distribution of pre- and post-tour surveys at select show caves throughout the United States is necessary to glean an understanding of whether increasing the educational quality and quantity of material presented at karst attractions improves visitors' understanding of the terrains. Combining the results of each of the inquiries is necessary to not only enhance the understanding of the general publics' knowledge about the importance and vulnerability of karst terrains, but also to discover where shortfalls exist and how to best overcome educational challenges.

CHAPTER TWO: BACKGROUND AND LITERATURE REVIEW

This study attempts to evaluate and improve education of karst terrains for the ultimate purposes of decreasing occurrences of karst degradation and, with time, potentially increasing public demand for karst regulations. Therefore, a thorough appreciation of the unique features of karst landscapes, development of these terrains, extent and importance of karst, and threats karst environments face is necessary. Similarly, a detailed comprehension of the environmental education movement, common informal education venues, and importance and potential role of informal environmental education in environmental protection is also significant to this research and its goals.

The Karst Environment

Karst refers to a landscape with distinctive surface landforms, hydrology, and subsurface features resultant from the solutional removal of carbonate bedrock (White 1988; Ford and Williams 2007; Palmer 2007). The numerous surface and subsurface features, including, but not limited to, sinkholes, sinking streams, aquifers, caves, and springs which dominate karst areas are the result of a combination of high rock solubility and well-developed secondary porosity in these regions (Ford and Williams 2007). Accordingly, these unique, fragile, and non-renewable environments are considered to have significant scientific, cultural, hydrological, recreational, mineralogical, biological, and economic importance (Daoxian and Zaihua 1998; Gunn et al. 2000).

Karst environments derive their name from the Kras plateau region, an area located near the eastern shore of the Adriatic Sea in western Slovenia and eastern Italy (Rosenburg 2006; Ford and Williams 2007). Karst spans roughly 12 to 15 percent of the world's continental land area, provides habitable conditions for over 25 percent of the world's population, and supplies over 20 to 25 percent of the world's population with drinking water in regions such as the Caribbean Islands, southern China, Southeast Asia, the Mediterranean Basin, and Europe (Ford and Williams 2007). In the United States, karst environments comprise 20 percent of the land surface and karst aquifers provide roughly 40 percent of all drinking water supplies to this nation (Veni et al. 2001; Ford and Williams 2007). Similarly, nearly 50 percent of the drinking water in many European countries is derived from karst aquifers, while over 100 million people in southern China live directly on karst terrains and subsequently rely on them for groundwater supplies (COST Action 65 1995).

Evolution of Karst

Although karst exploration dates back to as early as 825BC in the Mediterranean basin, Yugoslavian scientist Jovan Cvijic is credited with the first systematic study of karst hydrology and geomorphology during the late nineteenth and early twentieth centuries (Bahtijarevic 1996; LaMoreaux and LaMoreaux 1998; Ford and Williams 2007). In his work *Das Karstphänomen*, Cvijic not only systematically evaluated a wide variety of karst landforms, but he also laid the foundation for modern ideas of karst evolution (Sweeting 1972; Ford and Williams 1989; LaMoreaux and LaMoreaux 1998; Ford and Williams 2007). From his work and the work of numerous karst scientists who later expanded on his theories, the complex nature and sensitivity of karst, and the geomorphologic aspects of karst terrains are well understood.

Three primary factors are necessary to develop a karst landscape, specifically, and therefore must be considered essential components of these terrains: soluble rock, slightly acidic water, and structural weaknesses in the rock mass. Karst landscape evolution is driven by the hydrologic cycle with the predominant geomorphologic process being chemical weathering, or dissolution (White 1988; White et al. 1995; Palmer 2007; Ford and Williams 2007). Pure water has little impact on the development of karst terrains. However, slightly acidic water is important in the karstification process because it is the agent responsible for the chemical weathering of the soluble bedrock (see below). The high solubility component (chemical composition) of carbonate rocks allows for the rapid dissolution of the rock necessary to form characteristic cavities and sizeable interconnected underground flow systems (Palmer 2007; Ford and Williams 2007). Yet, although the development of karst landscapes is dependent upon the solubility of rocks and acidity of the water solution contacting those rocks (Lane 1986; Ford and Williams 2007), the porosity, permeability, and structural orientation of a rock, as well as the local vegetation, suspended objects within the waters flowing over karst landscapes, thickness of overburden material, and the temperature of the water and atmosphere surrounding karst landscapes all influence the development and evolution of karst (White 1970; Kochel et al. 1995; Palmer 2007).

The combination of high rock solubility and well-developed secondary porosity are equally important in the development of karst (Ford and Williams 2007). Thus, karst formation most commonly, but not exclusively, occurs in carbonate rocks ($CaCO_3$), such as limestone or dolomite, with solubility components greater than 70 percent (Palmer 2007). This process begins with water becoming slightly acidic (forming carbonic acid) as water molecules bind to atmospheric or biologically-generated carbon dioxide molecules while traveling through the atmosphere or overburden material atop soluble rocks (White 1988; Ford and Williams 2007; Palmer 2007). When this acidic water contacts the carbonate bedrock, a $CaCO_3$-CO_2-H_2O chemical reaction is stimulated, breaking the calcium carbonate compound into HCO_3- and Ca^{2+} (White 1988). As the dissolution process continues, the principal ion in the karstification process is removed from the carbonate rock mass enlarging cracks and fissures in the bedrock (Ford and Williams 2007). It is estimated that roughly 0.07 to 0.17 cm^3 of calcite is dissolved per liter of water during this karstification process (Palmer

2007). Over time, the dissolution potential of the water is extended as larger quantities of water are permitted to enter the karst system through enlarging openings (White 1988; Ford and Williams 2007; White et al. 1995). Eventually, the sizeable interconnected underground flow systems and associated landforms that typify karst landscapes are developed.

Threats to Karst Environments

The above description of karst landscapes and their interconnectedness indicates that karst landscapes are considerably susceptible to human impacts and therefore require extensive regulations and/or a knowledgeable populace to ensure their protection. The presence of water, minerals, and fossil fuel deposits results in areas that are highly valuable and, therefore, prone to environmental degradation. Water seeping into underground karst aquifers experiences very little filtration (Ford and Williams 2007), thus increasing the potential for pollution while simultaneously making it difficult to remove pollution once it has entered the karst environment (Veni et al. 2001). Pollution could be a result of contaminants entering the groundwater through a direct input, such as a sinkholes and grikes, or diffusely via bare rock surface. A lack of surface soil cover, which is characteristic of karst landscapes since soil is often easily washed into subsurface cracks and cavities, further reduces filtration of seepage water (Drew 1999). The high interconnectedness of karst terrains also contributes to the vulnerability of these environments. Conduits, whether large or small, connect the major inputs and outputs that comprise a karst environment. Therefore, any pollution which enters into a karst environment has the potential to pollute the entire system depending on the degree to which the karst has developed. Caves often serve as conduits for polluted water to flow through, yet are home to rare and fragile cave biota (Gillieson 1996), and are often where wells are sunk for withdrawal of groundwater for drinking water purposes.

Overall, groundwater pumping, deforestation, improper waste disposal, urban development, cave modification, quarrying, infilling sinkholes, and modifying surficial drainage patterns, amongst many others, each negatively impact karst. As highlighted above, karst aquifers in particular often experience the greatest misuse, with the rapid transport of water through these aquifers intensifying the susceptibility of karst terrains to contamination. Increased water extraction rates in karst lands can lead to sinkhole generation (Metcalf and Hall 1984; Tihansky 1999; van Beynen and Townsend 2005) and salt water intrusion (Tihansky 1999; Afrib et al. 2000). Sinkholes, which are direct connections to aquifers, are commonly used as drainage points for contaminated stormwater (Crawford 1984, White et al. 1984, Trommer 1992; Jones and Upchurch 1993; Keith et al. 1997) and garbage, which not only pollutes groundwater, but also clog sinkholes, disrupting natural drainage patterns and hinders groundwater recharge (Quilan and Ewers 1985; Mitchem et al. 1988; Kacaroglu 1999).

Surface-level contaminants also frequently reach karst aquifers because of the high transmissivity of karst terrains. In Bohol, Philippines, Urich (1993) illustrated the negative impact of heavy pesticide and herbicide used during rice cultivation on karst waters, while Drew (1996) documented contamination to karst aquifers in Ireland from effluent spray and leaking septic tanks. The collapse of a tailings pond in Olkusz, Poland lead to contaminated drinking water supplies in the region (Ford and Williams 1989) and, in 1988 sinkholes formed under an agricultural waste pond, funneling pollution into the aquifer underlying Pinellas County, Florida (Tihansky 1999). Nitrate is a common groundwater contaminant throughout the world, such as in Iowa (Mitchem et al. 1988), the Woodville Karst Plain of Florida (Katz et al. 2004), and Romania (Gatzweiler 2003). Overall, groundwater in multiple locations is no longer safe for consumption because of excessive pollutant concentrations indirectly resulting from a poor understanding of karst systems.

The significant impacts of urban development on karst land surfaces and aquifers are also well-documented. Growing urban centers result in the building of roads, houses, and commercial complexes that not only place unnecessary stress on groundcover, but also limit groundwater recharge (Zhou et al. 2005). A rapid decline in aquifer levels also commonly accompanies urban expansion with demands for water exponentially increasing as communities grow. Sinkholes later develop as water-filled voids in the aquifer are emptied from the over-extraction of groundwater. For instance, failure to account for the presence of karst resulted in damage to buildings, roads, and public water supply infrastructure in the Central Ebro Basin of Spain after sinkholes developed for several years following construction (Soriano and Simon 2002). Decreasing the potential for groundwater recharge by infilling preexisting sinkholes is yet another impact of widespread urbanization. In Pinellas County, Florida, more than 92 percent of sinkholes are infilled (Wilson 2004), and consequently some springs in the area no longer flow (Trommer 1992). A similar trend in sinkhole infilling is noted in the remainder of west-central Florida (Sinclair et al. 1985; North et al. 2009).

Increased flooding, sedimentation rates in caves, and water turbidity can result from unsustainable deforestation in karst areas (Harding and Ford 1993; Sauro 1993; Gunn et al. 2000; Wood et al. 2002; van Beynen and Townsend 2005). In southwest China, deforestation accelerated decomposition rates of the organic soil matter necessary for carbonic acid production and soil buildup that are essential for natural karst evolution (Liu et al 2003), while deforestation for agriculture activities resulted in the complete desertification of a Slovakian karst plateau (Jakal 2000). Unique limestone-dwelling land snail communities in Sabah, Malaysian Borneo collapsed after forest degradation destroyed the areas limestone hills the land snails depended on for survival (Schilthuizen et al. 2005). Near-surface permeability, and subsequently groundwater recharge rates, severely declined in medieval western Ireland and modern-day Guilin, China when occurrences of deforestation promoted the piping of surface soils and other non-permeable material underground (Back 1983). Thus, because the vegetation above karst bedrock prevents soil being washed into underground cavities and aides in the production of carbonic acid, karst areas are particularly susceptible to the damaging effects of widespread tree clearance including, but not limited to, disruptions in karst evolution (James 1993; Harding and Ford 1993), increased flooding, and soil erosion (Harding and Ford 1993; Gams et al. 1993), and increased water turbidity (Sauro 1993; Wood et al. 2002). Yet, despite the fairly widespread knowledge of the potential of karst terrains to be particularly susceptible to deforestation among scientists, policymakers and the general populace seemingly lack this understanding, promoting continually unchecked deforestation practices.

Karst environments also face the potential for considerable destruction by quarrying and mining activities. Such destruction is well noted in Great Britain where mining activities resulted in widespread removal of rock from limestone quarries (Gunn and Bailey 1993; Goldie 1993). In Sorbas, Spain, speleothems, groundwater, soil, and surface water have been impacted by gypsum quarries (Pulido-Bosch et al. 2004), while in Romania, poor disposal of waste material from mining operations polluted the local karst aquifer (Forray 2002). West-Central Florida has experienced the complete destruction of multiple caves due to local limestone quarries (North et al. 2009).

As highlighted above, the fragility and interconnectedness of cave systems in karst environments enhances the occurrence of caves to impairment. In addition, not only does the degradation of caves directly impact the karst system, but it also commonly affects the biota whose survival depends upon the preservation of cave environments. Cave atmospheres can be altered (Huppert et al. 1993), dripwaters are commonly contaminated by surface practices such as improper waste disposal or excessive pesticide use on agricultural fields (Watson et al. 1997), groundwater flow is contaminated or altered (Wood et al. 2002; Gunn et al. 2000; Boulton et al. 2003), and cave sediment is compacted by excessive foot traffic (Gillieson 1996). Artificial cave lighting, clothes lint and skin flakes from tourists, increased evaporation, condensation corrosion, and desiccation resultant from cave tourist body heat and CO_2 respiration (Villar et al. 1986) also negatively impact cave biota and features (Pugsley 1984; Roth 1993). Speleothems are frequently destroyed as cave visitors change the drip water chemistry and atmospheric composition within caves (Donahue 1990; Baker and Genty 1998; Craven 1999; Silverwood 2000; Jeong et al. 2003).

In the United States at least 10 cave dwelling species are extinct because of human activities, while 95 percent of existing species are considered vulnerable or endangered. This fragility in part arises because 69 percent of terrestrial cave species are single county endemics and an additional 20 percent are state endemics. An estimated 44 percent of aquatic cave species are single county endemic, while 30 percent are state endemic species (Karst Waters Institute 2004). In Waitomo, New Zealand, glowworms in Glowworm Cave were impacted by the construction of artificial cave entrances (Pugsley 1984), while bat populations frequently decline when cave entrances or passages are manipulated (Martin et al. 2006) or ambient conditions within caves or bat feeding grounds are altered (Richter et al. 1993; Petit 1996; Mann et al. 2002; Parson et al. 2003).

Despite all of the apparent impacts humans can have on karst, karst can also impact humans. Radon gas, sinkhole development, flooding, and limited groundwater quantity and quality each represent a potential obstacle to living on a karst landscape. Radon gas is a cancer-causing, invisible, odorless, and tasteless radioactive gas often found in karst areas. Exposure to this gas is reported to cause nearly 20,000 deaths annually in the United States alone (EPA 2009). The interconnected porous and permeable rock comprising karst landscapes allows for the easy escape of radon gas from the subsurface into human living spaces on the surface. In certain karst areas this problem is more predominant than others based upon the uranium content in the bedrock. Some of these more predominant areas include the central United States, China, and Slovenia, to name a few (Gammage et al. 1993; Lu et al. 2008; Javonovi 1999).

Although humans can increase the rate at which sinkholes develop, sinkhole development occurs naturally without the influence of human interaction. When this development occurs, either suddenly through the surficial expression of a collapse sinkhole or gradually over time as subsidence sinkholes enlarge, the structures above the sinkhole are subject to varying degrees of damage. To prevent this damage, excess and expensive land surveys are often required before construction is begun. Yet, sinkholes are sometimes not discovered through these surveys or begin to develop after construction is completed, making sinkhole damage to structures unavoidable in karst areas. Depending on the size and type of sinkhole, damage to structures can range from small cracks in a structure to the complete loss of a building and its contents. Because minor sinkhole damage is often hard to distinguish from cracks which occur as building subfloors settle, sinkholes insurance claims are abundant, adding yet another layer of complexity and cost to the impacts karst can have on humans. As these claims continue to occur, insurance rates for homeowners in many karst areas increase, adding to the expense of homeownership. Moreover, in some areas, such as Florida, worries of sinkhole development in areas near where previous sinkhole claims were filed has resulted in home owners being dropped from or not being able to attain affordable home insurance (Beck and Pearson 1995; Veni et al. 2001). The cost for reparation of sinkhole damage, often via grouting and cement pillars, can be significant and cost more than the home is worth (Beck and Pearson 1995).

Flooding is yet another impact karst can have on humans. When groundwater inputs become blocked or overwhelmed, either through natural processes or human influence, delayed recharge can cause flooding during moments of intense precipitation or snowmelt. This is especially true in areas where the groundwater table is close to the land surface. Flooding, much like sinkhole development, can cause minor to severe damage to homes, businesses, and other components of human development, while also influencing building insurance rates at these locations. Flooding also can cause problems with water pollution from sewer backups and stormwater runoff, thereby causing the subsurface to become polluted once this water finally subsides into the groundwater system.

Most importantly, the impact of karst groundwater on humans is manifested in several ways. Groundwater is a limited resource within a karst landscape, wherein a certain carrying capacity for the karst region can easily be exceeded by urban sprawl and overpopulation (Veni et al. 2001). The desire for development and habitation in areas where groundwater supplies are plentiful enough to sustain populations often entails understanding the availability of water in a karst aquifer or discharge from karst springs. Additionally, the quality of this water varies based on several factors, such as the origin of the recharge points, depth of the aquifer from which the water is withdrawn, and the flow rate of the water. The combination of these factors impacts the degree of treatment necessary for consumptive use. Often, if groundwater resources become scarce, alternative methods to obtain water, such as costly desalinization or piping of water from other areas, must be employed. Thus, the quantity and quality of groundwater in karst landscapes, which is influenced by natural drought cycles and changes in or unknown subsurface flow patterns, can be a limiting factor for human development.

In summation, karst resources are rapidly depleting while pollution levels are increasing at an alarming rate. Furthermore, the impact of karst environments on humans is increasing as populations in karst regions continue to grow. Yet, there is a lack of environmentally sound, long term planning and policies in most karst regions. Although policymakers and land managers are becoming more aware of these aforementioned environmental stresses and increased potential for anthropogenic disturbance in karst areas, regulatory gaps in karst protection still exist due to public apathy for policies and municipality budgetary and time constraints. If we hope to reverse this exploitation of karst terrains, we must rely on a central goal of informal environmental education: promoting individual action. Society must understand karst systems and how to live sustainably in them. Hence, education in karst regions is particularly important for the protection of these unique and fragile terrains by promoting a greater understanding and appreciation for karst and its associated resources.

Environmental Education

The Environmental Education Movement

The ultimate goal of environmental education is creating an environmentally literate citizenry (Stapp 1969). Thus, environmental education is "the process that fosters greater understanding of society's environmental problems and the processes of environmental problem-solving and decision-making" (Saveland 1976, p. 12). The foundation of modern environmental education is rooted in the sciences of ecology and conservation biology which, among other interests, raised concerns about environmental degradation and decreasing quality of life during the 1960s (Bakshi and Naveh 1978; Walker

1995; Disinger 2001; Gough 2002). In his work *A Sand County Almanac with Essays on Conservation from Round River*, Aldo Leopold (1949) argued that ecology concerns not only the advancement of science, but it also promotes and interprets human responsibility of the environment through ecological education. The same can be said for conservation biology, which expanded the principals of biological science to promote a "land ethic," or harmony between man and land, through increased conservation education. Combining the principals and philosophies of these two sciences, such as preservation, conservation, land and natural resource management, problem-solving, public action, and sustainability, environmental education is now recognized as its own discipline (Swan and Stapp 1974; Walker 1995; Scott 2007). As stated by Wilke (1993, p. 27) environmental education "refines and redirects the goals of its predecessors as well as fills an educational vacuum not being served: attention to the interactive interrelationship between humans and their environments."

Education policies of the late 1920s *Outdoor Education Movement* put forth that the outdoors were a laboratory capable of aiding in the education of school children by providing experiences with nature. These represent the basis of environmental education in both the United States and Europe. However, this movement became overwhelmed with activities focusing on recreational and physical education, ultimately loosing focus on environmental curriculum. In the 1930s, in response to the emerging *Conservation Movement* which was aimed at educating citizens on the role of natural resources in society, conservation agencies were developed throughout the United States to establish management and educational programs for the country.

Despite the initiation of these previous movements, prior to the 1960s, America and Europe alike only vaguely portrayed a true 'land ethic.' However, as the pursuits of these earlier movements flourished, reports of widespread environmental degradation were released, and travel to wilderness areas increased worldwide throughout the 1960s. William Stapp was encouraged to promote an Environmental Education Movement (Swan and Stapp 1974) which he stated would move away from the heavy focus on the biological components of the environment, and stress the need of learning to problem solve. As stated by Stapp, "Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (1969, p. 30). Thus, more modern day environmental education programs, particularly within formal sectors, are designed to emphasize four levels of environmental education: 1) ecological concepts, 2) conceptual awareness, 3) issues investigation and evaluation, and 4) environmental action skills (Bell et al. 2009).

In 1970, the U.S. Congress passed the National Environmental Education Act which, among other things, authorized the development of an Office of Environmental Education within the federal government. Further building upon Stapp's statements, genuine worldwide interest in environmental education continually flourished throughout the 1970s. The United Nations Education Scientific and Cultural Organization (UNESCO), an agency created to promote international collaboration of education and science, and the United Nations Environment Programme (UNEP), which is a group responsible for coordinating environmental activities and assisting developing countries in the implementation of environmental policies (UNESCO 2009), pioneered international declarations that set goals, objectives, and guiding principles of *formal* environmental education programs (Swan and Stapp 1974; Careda 1999). The first of these declarations was the Declaration of the United Nations Conference on Human Environments made in Stockholm, Sweden on June 15th 1972, where it was proclaimed, "to defend and improve the environment for present and future generations has become an imperative goal for mankind" (UNESCO 1980). The 1975 Belgrade Charter expanded upon the Stockholm Declaration and set three goals for environmental education: 1) foster clear awareness of, and concern about, economic, social, political, and ecological interdependence in urban and rural areas; 2) provide every person with opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment; and 3) create new patterns of behavior of individuals, groups, and society as a whole towards the environment (UNESCO 1975).

In 1977, the Tbilisi Declaration further strengthened the founding goals and principles of environmental education, resulting in a total of twelve goals to be adopted at both national and international levels (UNESCO 1980). These goals were aimed at stimulating a sense of individual responsibility for the physical and aesthetic quality of the environment (Gough 2002). As stated by the former Director-General of UNESCO in his opening address at the Tbilisi conference, "(environmental education should) promote attitudes which will encourage individuals to discipline themselves, first of all in order not to impair the quality of the environment, but also in order to play a positive role in collective action to improve it" (UNESCO 1980).

From each of the aforementioned declarations, it was put forth that environmental education should be provided for all ages, in both formal and informal educational settings (Bakshi and Naveh 1978; UNESCO 1980; Disinger 2001). Laws for the protection and improvement of the environment and environmental education are now implemented at local and national levels in the United States, Australia, New Zealand, the Caribbean, Africa, Asia, and large portions of Europe (Benayas 1991; Eulefeld 1991; Giolitto and Souchon 1991; Harris 1991; Jickling and Sprok 1998; Pellegrini Blanco 2002; Barraza et al. 2003; Wojcik) 2004; Alderman 2005; Bourn 2005; Lang 2005; Shanavis et al. 2005; UNESCO 2009; NAAEE 2009).

Throughout the 1980s, particularly the early 1980s, schools continued to direct attention to introducing environmental subjects into the traditional grade-school material, while post-secondary institutions began developing interdisciplinary environmental education programs. The focus of these formal education efforts was the interconnectedness of people and their environment.

In addition, youth organizations, nature clubs, and nature camps initiated the implementation of programs to encourage out-of-school youth and adults to participate in environmentally centered activities. Meanwhile zoos, gardens, and museums changed mission statements to better position themselves as centers for environmental education (Walker 1995).

Education for *sustainable development* appeared as a subtopic within environmental education in the early 1990s as researchers began to fully understand that education is central to achieving global sustainable development (Barraza et al. 2003). Hence, in 2000, the Earth Charter was drafted to "bring forth a sustainable global society founded from nature, universal human rights, economic justice, and a culture of peace" (Earth Charter 2000, p.1). The Charter did not provide concrete ideas or examples for environmental education teaching, but rather added concepts such as respect and care for the community of life, ecological integrity, and social and economic justice. Later, at the 57th Session of the General Assembly in 2002 (World Summit for Sustainable Development), the United Nations Decade of Education for Sustainable Development was proclaimed.

The Decade, which extends from 2005 to 2014, is a worldwide initiative to reorient education around the economic, social, and environmental pillars of sustainable development. UNESCO, the lead agency responsible for promoting the Decade, recognizes that the success of this program is contingent on the reform of all aspects of education including formal education, the role of media, teacher education, community involvement, and lifelong learning through informal education (Combes 2005). Moreover, the quality or process of education and learning, as opposed to quantity, is emphasized (Education for Sustainable Development 2007). Thus, in conjunction with the Decade's areas of emphasis, this study concentrates on both the education quantity and quality of material presented at karst tourism facilities.

Overall, in 2005 the National American Association for Environmental Education reported on the National Environmental Education Advancement Project which is designed to establish the status of environmental education in each state of the United States. Data related to state comprehensive environmental education plans, state laws requiring K-12 environmental education, environmental education standards, curriculum guides, and statewide environmental education newsletters, amongst others, were gathered from environmental education professionals in each state between 1995 and 2005. The findings of this study revealed that 17 states had environmental education departments developed, 19 states had environmental education legislation implemented, 29 states reported no development of such legislations, and 36 states offered grants related to the improvement of environmental education (NAAEE 2009).

Britain and many other European nations, including, but not limited to, Italy, France, Germany, Denmark, Greece, Spain, Switzerland, Romania, Australia, New Zealand, Venezuela, and South Africa have also developed federal level councils for environmental education at differing times over the past 30 to 35 years (Giolitto and Souchon 1991; Jickling and Sprok 1998; Pellegrini Blanco 2002; UNESCO 2009). For example, in 1988, Britain passed its Education Reform Act to incorporate environmental education in school curriculum (Harris 1991) and developed the United Kingdom Government's Sustainable Development Education Panel in 1998 (Bourn 2005). Poland has developed television, radio, and Internet campaigns, along with the regional Centers for Environmental Education and the National Foundation for Environmental Protection and Water Management that are aimed at informally educating its citizens (Wojcik 2004). By 1987 Spain had developed over 30 nature classrooms, 28 exhibitions and campaigns, and 16 teacher training programs concentrated on environmental education at the federal-level alone (Benayas 1991). Moreover, a 1985 survey of German environmental education efforts at the grade school level revealed environmental materials were incorporated into presentations for nine subjects (such as chemistry, energy, economics, biology, and geography) (Eulefeld 1991). This success is likely attributed to the German federal-level development of textbooks and other educational material concentrated on teaching content and methods of environmental education.

However, the primary focus of the aforementioned environmental education programs is on K-12 school children, as opposed to members of the adult general public who are the focus of this project. For example, Mexico's limited informal environmental education programs only concentrate on elementary-level schooling (Gonzalez-Gaudiano 2005). Similarly, in Peru private foundations are leading successful environmental education endeavors, yet the focus of these ventures are also solely centered on increasing the knowledge-base of school children. For instance, the Peruvian Centre for Cetacean Research established a long-running program to "develop the interest and respect of children for dolphins and other aquatic wildlife" by distributing educational booklets and hosting specialized environmental classes, marine workshops, and pro-conservation demonstrations and exhibits. These endeavors were only pursued at the primary schools of the Country's many dolphin fishing villages (Van Bressem et al. 2006, p. 185). One could argue, however, about a need to also increase the knowledge-base of the adults in the fishing communities to maximize the effects of enhancing respect for aquatic wildlife.

Environmental Education: Formal, Informal, Nonformal

Environmental education programs are intended to increase people's knowledge and awareness of the environment, causing attitude changes and fostering personal motivations to alter behavior patterns and take environmentally sound actions to solve environmental problems (National Environmental Education Advisory Council 1996). The two fundamental components to potentially increasing environmentally responsible behavior are learning inside the classroom as a youth and continued learning beyond the classroom as an adult (Ballantyne and Packer 2005). Hence, research in environmental education can be divided into three fields: formal, informal, and nonformal education. Formal education refers to education which takes place in schools and institutions by licensed instructors, while informal education commonly refers to cumulative learning outside of traditional educational institutions or by institutions whose first function is not to educate (Swan and Stapp 1974; Dierking et al. 2003; Rennie 2007). Informal education includes activities that are not developed primarily for school use and/or are not developed to be part of an ongoing school curriculum (Robertson 2003). Informal education is also frequently used to describe experimental learning, or learning through experiences, such as the experience of seeing and encountering a show cave. Lastly, youth learning through organized educational activities, such as fieldtrips to museums or nature centers, that are conducted by either licensed or non-licensed instructors outside of the traditional classroom setting are typically considered nonformal education (Coombes 1973; La Belle 1982). Because the crux of this project is concerned with adult learning in informal settings, nonformal learning, as broadly defined above, is not evaluated during this research project.

As previously discussed, the initial guiding principles of environmental education were overall designed to encourage people to be active participants in the fight for environmental protection through learning standardized environmental curriculum (Weilbacher 1993). Therefore, the greatest majority of research in environmental education science is focused on formal education. This research primarily concentrates on instructional techniques, curriculum development and integration (Hodson 2003), the relationships between scientific literacy and environmental education in schools, evaluation of scientific literacy, and student attitudes and motivations towards learning in formal institutions (Walker 1995; Tsai and Wen 2005; Joseph 2008). Yet, because the average person only spends approximately three percent of his or her lifetime in school, merely a small percent of a person's knowledge is actually obtained in formal educational settings (Falk 2001), necessitating the need for continued lifelong learning through informal learning environments. These informal learning environments are locations where "opportunities for learning are structured by educators, but the choice of participation is entirely on the part of the individual" (Heimlich 1993, p. 4).

In a formal learning environment, a predefined curriculum is followed so students mandatorily leave a classroom with a minimum level of knowledge on a subject. In contrast, informal learning settings, such as parks, museums, zoos, the Internet, and science centers, provide learning opportunities, but participation in learning is up to the individual (Heimlich 1993) and stimulated by the interests of the learner (Kola-Olusanya 2005; Anderson 1995; Falk and Dierking 2001; Packer and Ballantyne 2002). As such, learning which occurs through informal institutions is commonly referred to as free-choice learning, "learning experiences where the learner exercises a large degree of choice and control over the what, when, and why of learning" (Falk 2005, p. 265).

Informal science education is often a one-time learning experience and material is presented using a single medium such as an exhibit or interactive display (Field and Powell 2001; Bitgood 1988). The concepts presented in informal educational settings are commonly broader than concepts emphasized in formal settings and are intended to "encourage change in learning about the environment, to improve levels of interest, and to increase the learner's knowledge through contextual cues from the outside world" (Kola-Olusanya 2005, p. 298). Informal institutions convey this broad information to non-technical, non-captive public audiences (Joseph 2008) by translating the technical material of a science into terms and concepts that non-scientists can readily understand, a technique known as interpretation. The goal of environmental interpretation in informal settings is to communicate material concerning environmental sustainability issues in a way that is entertaining, meaningful, and interesting, so a visitor is personally motivated to take new knowledge and integrate it into their lifestyles (Heimlich 1993). Thus, informal learning is intended to be a passive and internally motivated experience, compared with formal learning where the audience is captive and externally motivated by grades, money, or employment (Heimlich 1993). Informal educators often only interact with an audience one time and are consequently not concerned with a progression of knowledge, while formal education is structured to gradually increase knowledge over time through repeated contact with an audience and systematically evaluate progress in increasing knowledge

(Payne 2006). Table 2.1 summarizes each of the aforementioned differences between formal and informal learning.

Table 2.1: Formal versus Informal Learning.

Formal (In-School) Learning	**Informal (Out-of-School) Learning**
Captive audience	Non-captive audience
Mandatory Participation	Voluntary Participation
Instructional material both verbal (lecture format) and visual (textbook)	Instructional material primarily visual (exhibit and labels), except where guided tours provided
Sustained exposure to the learning material (ex: an entire semester)	Short exposure to learning material (typically 1-4 hours)
Time commitment is fixed	Time commitment is not fixed
Learning is externally motivated (grades, diplomas, licenses, money, jobs, advancement)	Learning is internally motivated (interest, fun, entertainment, self-improvement, passing time)
Learning assessed – external motivation	Learning not assessed
Learning explicitly controlled by a teacher	Learning explicitly controlled by the learner, exploratory in nature
De-contextualized	Contextualized (place-based)
Linear learning (learning occurs in a progressive manner that is controlled by a teacher)	Non-linear (audience can come and go and can review the educational materials at the site in any order)
Learning is a nonsocial event	Learning is more of a social event (motivated by social contribution)
Consequences of learning are often coercive (grades, punishment)	Consequences of learning are non-coercive (visitor selects experiences, no consequences if visitor fails to learn)
Audience is restricted by age and academic achievement	Audience is unrestricted
Wide focus of material	Narrow focus regarding a specific place, object, or subject
Typically federally evaluated and regulated	Typically not evaluated or regulated by federal-level agencies

Benefits and Opportunities of Informal Education

Unfortunately, formal environmental education efforts often fail because of disagreement on what to teach, how to teach, and how to evaluate learning. Effective environmental education must therefore encompass both formal and informal learning (Barney et al. 2005; Scott 2007). Research into the benefits of curriculum-based formal environmental education began in the 1960s and 1970s and is therefore better documented than that of informal education. However, criticism against formal education in the 1970s and 1980s spurred enthusiasm and research in the field of informal education. For instance, in his work *Deschooling Society,* Illich (1971) wrote:

> "…criticism leads many people to ask whether it is possible to conceive of a different style of learning. The same people, paradoxically, when pressed to specify how they acquire what they know and value, will readily admit that they have learned more often outside than inside school. Their knowledge of facts, their understanding of life and work came to them from friendship or love, while viewing TV, or while reading, from examples of peers or the challenge of a street encounter. Or they may have learned what they know through the apprenticeship ritual for admission to a street gang or the initiation to a hospital, newspaper city room, plumber's shop, or insurance office. The alternative to dependence on schools is not the use of public resources for some new device which "makes" people learn; rather than it is the creation of a new style of educational relationship between man and his environment. To foster this style, attitudes toward growing up, the tools available for learning, and the quality and

> structure of daily life will have to change currently. Attitudes are already changing. The proud dependence on school is gone." (Illich 1971, p. 109-110).

Consequently, although the initial principles of environmental education solely focused on standardized formal curriculum, as a result of writings such as Illich (1971) and increased research into the potential benefits for informal learning, the principles of environmental education have continually expanded over time to recognize the importance of informal education.

Though the significance of informal education in environmental problem-solving is not fully understood, researchers do understand that environmental education through informal venues can have a positive impact on the development of environmentally sustainable attitudes and behavior in some instances (Ballantyne and Packer 2005). Common venues that facilitate informal learning include, but are not limited to, parks (local, state, and national), zoos, museums, aquariums, science and nature centers, and ecotourism adventure trips. Educational opportunities provided at these facilities may include a tour, workshop, exhibit, interactive display, interpretative video or other media, interaction with staff and volunteers, and/or brochure, amongst many others.

Mass media venues reach considerably more people than in traditional educational settings (Saveland 1974) and science centers and museums generate more enthusiasm for learning than traditional classroom education (Hooper-Greenhill 2007, Tal and Morag 2007, Rennie and Williams 2006, Medved and Oatley 2000, Rix and McSorley 1999). Moreover, people who learn in informal settings are more likely to retain information presented to them while visiting such facilities than information presented within formal classroom settings (Gillet et al. 1991; Tunnicliffe 1996; Bogner 1998; Falk and Dierking 2000; Medved and Oatley 2000). Informal learning experiences more effectively spur attitudinal changes and bring about people's willingness to engage in sociopolitical action than formal schooling (Rennie and McClafferty 1996; Jeffrey-Clay 1999; Pedretti 2002). Educating adults through informal learning settings can help to develop understanding and judgment on environmental policy issues, encourage discourse on these issues, and ultimately promote informed participation in decision-making (Lauber et al. 2002). Research also indicates encounters with nature at zoos and aquariums have strong emotional affects on participants (Ballantyne et al. 2001; Ballantyne and Packer 2002).

Swan and Stapp (1974) argue the long-term goal of environmental education should be to develop a populace knowledgeable about the biophysical environment and its associated problems. Because the average person only spends three percent of his or her lifetime in formal learning settings (Falk and Dierking 2002), informal education is needed to update knowledge and understanding of environmental issues and challenges. Thus, regardless of how successful formal education efforts are, to even have a chance at effectively developing an environmentally and scientifically knowledgeable citizenry, society must make better use of non-traditional learning opportunities to ensure all generations and walks of life have opportunities to be educated (Hopkins and McKeown 2002; Hodson 2003).

Saveland (1974) confirmed that a part of the job of public environmental education is done by informal mass media venues all over the world, whether they are governmental or privately managed. Although the education function at these venues sometimes becomes a secondary priority when entertainment is also a function of the facility, he states the acceptance of an obligation to educate at these informal learning institutions symbolizes the public's general acceptance of learning about environmental issues outside of traditional classroom settings. Yet, barriers to environmental education are documented and are worthy of noting. In particular, Darkenwalk (1982) found that a lack of time and money are the two greatest barriers to learning in informal environments, indicating a large number of environmental education opportunities are disproportionally available to certain members of society. Similarly, Caffarella (1999) cite a sheer lack of interest in learning as a major pitfall to environmental education efforts. Merriam and Brockett (1997) indicate that geographic, demographic, education, socioeconomic, and/or other cultural determinants can limit willingness or access to informal environmental education even when environmental education programs are abundant.

Despite the aforementioned constraints and barriers, multiple case studies highlight the ability of non-traditional education settings to reach the masses far surpasses traditional settings (Saveland 1974; Brodie 2001; Tribe 2001;

Ballantyne and Packer 2005). Museums and science centers are particularly successful in educating masses of local, national, and international visitors while also meeting visitors' recreational needs (Brodie 2001). Hooper-Greenhill (2007), Tal and Morag (2007), Rennie and Williams (2006), Medved and Oatley (2000), and Rix and McSorley (1999), amongst others, specifically emphasize the power and benefit of museum and science center based learning for environmental education. For instance, to investigate the value of museum education to both teachers and pupils, Hooper-Greenhill (2007) had 3,113 teachers and 56,810 students complete questionnaires in Britain museums. The results from the questionnaires indicated that both teachers and pupils become more enthusiastic and actively engaged in learning in non-traditional environments than in classrooms. This was attributed to both groups often becoming bored with educational material in traditional settings. The questionnaires also indicated that 76 percent of participating teachers felt their student's knowledge and understanding of material was significantly increased by museum visits. Ansbacher (1998) further highlighted that entertainment and education are not mutually exclusive; thus, it may be possible for visitors to show cave exhibits to have an enjoyable time while receiving an educational experience and becoming more environmentally aware members of society.

Medved and Oatley (2000) researched the connectedness between scientific literacy and remembering educational material obtained in informal environments. Adult visitors to a Canadian science center were questioned about exhibits they found interesting at the time of and one month following their tour. From these interviews, the researchers reported that participants retained 92 percent of the information presented at the exhibits, 72 percent of the participants talked about the center's material to others, and 15 percent of the participants markedly changed their behavior as a result of what they learned. This study also helps illustrate the potential for karst knowledge to spread far beyond the visitors whom physically visit karst attractions.

The benefit of informal education to change public attitudes and behavior is discussed in Grodzinska-Jurczak et al. (2006). In this study, educational campaigns related to municipal solid waste management were conducted in Jaslo City, Poland to investigate the effects of informal environmental education on public behavior and attitudes. To help increase recycling efforts in the city, a public education campaign was adopted which encouraged waste management advisors to visit households and provide material on their local waste system and the importance of recycling. Over the months following the visits, a nearly 12 ton increase in the monthly amount of material recycled was noted, indicating that informal education likely plays a significant role in shaping public behavior.

Tran (2006) revealed the positive effects of increasing public awareness and involvement in the planning and implementation of development activities through community-wide informal education efforts in Holbox Island, Quintana Roo State, Mexico. Surveys revealed these efforts increased awareness of the causes and consequences of coastal water pollution, coastal erosion, and garbage dumping, as well as improved understanding of the interrelationship between the communities' behavior and the area's environmental concerns. Likewise, research by Tisdell and Wilson (2005) on the role of turtle-based ecotourism in promoting environmental learning and nature conservation revealed that increased environmental education while on tours had statistically significant impacts on visitors' desires and intentions to protect sea turtles.

Theory and Research in Informal Education

As late as the 1990s, theory on learning in informal settings was in its infancy compared to that of formal settings (Ramey-Gassert et al. 1994, Anderson et al. 2003). In fact, it was not until the late 1990s that a clear, widespread distinction began to be made between theoretical perspectives in formal and informal settings (Anderson et al. 2003). As such, most environmental education theories are grounded in formal education and therefore are not particularly applicable to any study of its informal alternative because of the aforementioned differences between the two forms of learning.

As a result of this infancy, up until the late-1990s and early-2000s much of the research on informal learning environments, particularly museums and science centers, lacked a theoretical underpinning. However, a wide range of varying theories related to the subject of informal education now exist to help guide current research in the field. Nonetheless, the focus of this research has consistently remained concentrated in understanding the ways in which visitors make sense of information presented to them in informal settings as opposed to whether visitors actually leave these settings understanding the message educators intended to convey (Ballantyne and Packer 2005).

The Contextual Model of Free-Choice Learning developed by Falk and Dierking (2000) is a theoretical construct of learning in informal or free-choice learning environments. The authors put forth that learning is a cumulative process, where prior experiences and motivations for learning, in addition to the learning environment, influence the way a learner experiences the educational environment. In particular, the contextual model of free-choice learning identifies three distinct influences on learning in informal environments: the Personal Context, the Sociocultural Context, and the Physical Context. The personal context, which is arguably the most important when attempting to promote environmentally-responsible behavior, is comprised of the personal characteristics a visitor brings to the learning environment such as previous knowledge and experiences, interests and motivations, and learning-style preferences. The sociocultural context involves the social, cultural, and historical components of learning, implying that learning encompasses the effects of a group dynamic in informal education settings. Thus, the degree to which visitors interact and talk about their experiences to other visitors, particularly what they saw, heard, and felt, helps tie prior experiences to the new knowledge gained in the informal setting. Lastly, the physical context suggests that learning is dependent on the qualities of the physical environment such as sights and sounds (Falk and Dierking 2000). Thus, based on this model, a combination of a minimum of twelve factors contributes to informal learning experiences (Falk and Storksdieck 2005). This learning model holds that learning in informal settings is a highly personalized process, dependent on prior knowledge and is subject to the experiences of a specific physical context (Falk and Dierking 2000).

Conceptual Change Theories, highlighted by Posner et al. (1982) and Magnusson et al. (1997), put forth that material must be presented in such a way that meaningful linkages of new and difficult concepts to existing knowledge are made in order to enhance people's cognitive structures and future understanding of the subject matter. Thus, conceptual change theories emphasize the importance of visitors' prior knowledge, alternative perceptions to that knowledge, and how people construct meaning from their learning experiences. An important part of conceptual change theories is the learners' dissatisfaction with his or her initial conceptions related to the presented material. Hence, educators must aim to create a *cognitive conflict*, thereby encouraging the learner to become dissatisfied with his or her existing conceptions and ultimately abandon these initial beliefs and replace them with the new scientific conceptions the learner was just presented. In addition, as put forth by Posner et al. (1982), the material being presented must also be intelligible (clear for learner to understand), plausibly true, and fruitful (the concept must appear to be potentially useful for solving problems) for conceptual change to occur.

Family learning theory is also commonly employed to help frame the construction of learning experiences and improve learning outcomes in informal settings, particularly museums (Astor-Jack et al. 2007; Ellenbogen et al. 2004; Ellenbogen 2003; Borun et al. 1997; Bell et al. 2009). Family learning is concentrated on an entire group, or a family, learning simultaneously. Learning in such instances is considered to be a joint collaborative effort, particularly between an intergenerational group of children and adults. Family learning theories, when applied to informal museum exhibits, put forth that six characteristics of an exhibit should be achieved in order to create a successful family or group learning-oriented exhibit and increase active family learning. These characteristics include developing an exhibit which is multi-sided, multi-user, accessible, multi-outcome, relevant, and readable (Borun et al. 1997).

Ajzen's (1991) Theory of Planned Behavior describes the influential factors in promoting attitude and behavior change in environmental education. This theory describes behavior as a function of three belief categories: 1) behavioral beliefs or beliefs about the outcome and consequence of a particular behavior, 2) normative beliefs or beliefs of social pressure to perform or not perform a behavior, and 3) control beliefs or beliefs about one's ability, knowledge, skills, resources, and opportunities to perform a behavior. Researchers working with this theoretical framework would concentrate on developing material that specifically identifies common beliefs about an issue and visitor misconceptions related to this subject before presenting information that challenges those beliefs

(Ballantyne and Packer 2005). This theory is applicable in nearly all informal learning settings, yet it is most frequently applied in the development of signage and brochures that encourage visitors to adopt sustainable behaviors that lessen the environmental impacts of their current behaviors (McArthur and Hall 1996; Ham and Krumpe 1996; Orams 1996).

Compared to research on visitor learning in museums, research on natural park visitor learning is relatively non-existent. However, in an attempt to expand the current informal learning theories from a focus on museum learning to learning in a natural park, Brody et al. (2002) conducted research at Yellowstone National Park with the goal of discovering how park visitors' understandings, values, and beliefs are affected by visiting the park. They revealed that learning in parks most closely follows the aforementioned Contextual Model of Free-Choice Learning, wherein park visitors' understanding of prior conceptions of geology (personal context), discussions of interpretive signs and their park experiences (sociocultural context), and increased and unexpected desires to learn because of the foreign nature of the landscape (physical context), all influenced learning. However, the researchers also discovered additional learning variables not encompassed in the model, including background knowledge on a subject and visitors' existing internal beliefs. These were the most important factors influencing the degree of knowledge the visitors attained during their visit, and the authors therefore argue these factors should be more closely accounted for in informal learning settings and their subsequent theories. In fact, in nearly all of the research conducted on learning in free-choice environments, the role of prior knowledge in learning is emphasized (Csikszentmihalyi 1987; Minstrell 1993; Ramsey-Gassert 1997; diSessa and Sherin 1998; Carr 1999; Anderson et al. 2003).

Overall, although the aforementioned theories are primarily concerned with the ways in which people learn, they provide a theoretical framework into establishing instructional methods and materials for the development of exhibits and tours. Thus, each of the aforementioned theories help shape the theoretical framework for this study in that they provide the guidelines for developing educational material, such as a tour material, based on the ways in which people acquire and employ new knowledge in their behaviors. For instance, the underlying consensus in each of these learning theories is that effectively increasing learning outcomes requires combining facts with meaningful messages that facilitate connections between previous experiences and the interpreted issues. One could also assume from these theories that tour guides at karst facilities should be instructed to attempt to make an intellectual and emotional connection with visitors to increase the positive outcomes of learning the interpreted material. Moreover, following these theories leads to developing interpretative messages that are persuasive and tap into visitor beliefs to convince him or her that adopting conservation behaviors can help halt or reverse environmental degradation.

The Conceptual Change Theory and Contextual Model of Free-Choice Learning Theory are the two most applicable theories for this study. Based on the objectives of this research, the Conceptual Change Theory guides how the presented material is formulated. For instance, common misconceptions about caves were presented towards the beginning of the tour, followed by how these misconceptions lead to environmental problems and then by more accurate karst information to replace these prior misconceptions. However, as emphasized by Brody et al. (2002), the Contextual Model of Free-Choice Learning also strongly informs this research in that the physical context of being in a cave, as well as the motivations for visiting the karst attraction, visitor expectations of their tour, and previous experiences with karst must be gleaned as important factors influencing learning at these facilities. These theories are also applicable to this study in that they clarify the complex issues of how people learn and change their motivations, previous knowledge about a subject, and past experiences, and, subsequently, guide the development of this study's survey to ensure the inclusion of appropriate questions.

Environmental Interpretation

One would be amiss to discuss environmental education in informal settings without also highlighting environmental interpretation. While environmental education refers to learning within formal education settings (grade school, universities, etc.), interpretation is often considered the vehicle for learning in informal settings (Cardea 1999). As defined by Freeman Tilden (1977, p. 8), interpretation is "an educational activity which aims to reveal meaning and relationships through the use of original objects, by first hand experiences, and by illustrative media, rather than simply to communicate factual information." Interpretation is also commonly defined as "the art of educating visitors of all ages by telling stories about the places they are visiting in an engaging, interesting, and enjoyable way which, if successfully planned, leads to personal changes in environmental knowledge/concepts, skills, attitudes/values and behavior," (Ballantyne and Uzzell 1994, p. 112).

Tilden (1977) defined the principles of interpretation that form the core of interpretive philosophy still guiding interpreters today as:

> 1) Interpretation that does not relate what is being displayed/described to something within the personal experience of the visitor will be sterile.
> 2) Information, as such, in not interpretation. Interpretation is relevant based on information, but they are entirely different things. However, all interpretation includes information.
> 3) Interpretation is an art, which combines many arts, whether the materials presented are scientific, historical, or architectural. Any art is in some degree teachable.
> 4) The chief aim of interpretation is not instruction, but provocation.
> 5) Interpretation should aim to present a whole rather than a part, and must address the whole man rather than any phase.
> 6) Interpretation for children should not be a dilution of the presentation to adults, but should follow a fundamentally different approach. To be at its best requires a separate program (Tilden 1977, p.9)

Since 1977, Tilden's definition and guiding principles have continually been modified and reshaped by numerous practitioners and theorists in the fields of environmental education and interpretation. Descriptions of interpretation now include words such as "interpretation is an approach to communication… interpretation is translating" (Ham 1992), "interpretation is a management tool" (Sharpe 1982), and "interpretation is a communication process that forges emotional and intellectual connections between the interests of the audience and the meanings inherent in a resource" (National Association of Interpretation 2010). Yet, regardless of the specific terminology used to describe environmental interpretation, many experts agree interpretation overall aims to help visitors at informal learning environments find meaning in and understanding of a resource by translating the technical language of a science into terms and ideas that a layperson can understand yet find interesting and entertaining (Ham 1992; Peake et al. 2009). Furthermore, all interpretation attempts to describe a resource to a general audience in an effort to provoke feelings of stewardship. Thus, environmental education is uniquely tied to the concept of environmental interpretation in that "education provides a framework and goals (the what), while interpretation provides a methodology and approach (the how and why)" (Cardea 1999, p. 9). Table 2.2 further highlights the primary differences between environmental education and environmental interpretation.

Table 2.2: Differences between Education and Interpretation. Adapted from Ballantyne and Uzzell (1994, p. 114).

	Environmental Education	**Environmental Interpretation**
Who?	School teachers, education officers, teacher educators	Interpreters; exhibition designers, rangers, interpretive trainers
What?	Understanding of environmental concepts and acquisition of environmental skills	Information about people, places and objects, interpretation of meanings
To Whom?	School children, adult continuing education	Tourists, residents, wide age range
Why?	Develop environmental literacy, fulfill curriculum objectives	Recreation, entertainment, site conservation, profit
Where?	Schools, field study	Interpretive centers, parks, museums
When?	School trips, in-class lessons for preparation or follow-up to trips	Whenever people engage in recreational or tourism activity with limited time involvement

Agencies such as the United States National Park Service use environmental interpretation as a tool for not only increasing knowledge, but also managing visitor behaviors in order to minimize negative impacts to the parks (Tilden 1977; Sharpe 1982; Ham and Krumpe 1996). In fact, the most commonly cited use of interpretation is in park settings (Oliver et al. 1985; Manfredo 1992; Kohl 2005), primarily because people seek out new experiences at these locations, concern for the nature can be increased simply through contact with natural environments, and they offer the few remaining natural environments that are not extensively degraded from human activity (Negra and Manning 1997).

Overall, the interpretive approach to communication has four distinguishing qualities: 1) pleasurable, 2) relevant, 3) organized, 4) thematic (Ham 1992). Furthermore, interpretation draws on the sense of wonder at inherently interesting places such as museums, national parks, and zoos. Interpretative technique is now widely accepted as one of the most effective methods to communicate environmental messages in leisure settings (Orams 1994; Uzzell and Ballantyne 1998; Weiler and Ham 2001; Madin and Fenton 2004; Powell and Ham 2008; Peake et al. 2009). As such it will be the primary technique used in investigating learning at show cave environments during this research project.

Nature-based Tourism

Nature-based tourism can be broadly described as tourism that emphasizes visitation to natural areas and/or wildlife (World Tourism Organization 2001). Nature-based tourism facilities, such as national parks and botanical gardens, are progressively being incorporated in vacations as growing urban populations increasingly seek to engage the natural world (Sellars 1997). At the turn of the century, the World Tourism Organization estimated annual worldwide nature-based tourism revenue at approximately $38 billion (World Tourism Organization 2001). In 2007 more than 134 million people visited zoos

(Patrick et al. 2007) and over 250 million people visited botanical gardens (Ballantyne et al. 2008). As visitation increases, these tourism attractions are increasingly becoming centers for environmental education and conservation, allowing for large masses of people to be educated about environmental issues (Orams 1997; Ballantyne et al. 2008, Ballantyne et al. 2007, Patrick et al. 2007). For instance, zoos, natural wildlife encounter experiences, and aquariums have shifted their focus over recent years to promote more conservation learning at their facilities by allowing visitors to observe animals in more 'natural' environments and incorporating more opportunities for close encounters with the wildlife (Dierking et al. 2002; Catibog-Sinha 2008). Similarly, national parks have expanded education programs from an exclusive focus on the protection of parks to a more holistic approach of harmonizing society with nature (Blanco 2002). Yet, the potential impacts of these efforts on changing visitor environmental knowledge, attitudes, and behaviors are still not fully understood.

Ballantyne et al. (2008) designed a study to evaluate if and how botanical garden visitors could be adequately educated on the ideals of conservation by investigating visitor interests and motives for visiting gardens. After questioning visitors to the Mt. Coot-tha Botanic Gardens in Queensland, Australia, the researchers found that enjoyment was the primary purpose for traveling to gardens while learning was the least important reason. Nonetheless, the authors suggest that gardens can successfully introduce educational material to visitors if consideration is paid to the design and promotion of the material as to not contradict with desires for relaxation. In particular, the authors believe visitors should be prepared for a learning experience at facility entrances with signs and leaflets that suggest how to get the most out of visits.

After investigating the national park system of Venezuela, Blanco (2002, p. 463) found that environmental education in "protected areas can be a basic tool for conservation management and the promotion of attitude changes in the citizenry that will lead to a better quality of life for all community members." The author argues that environmental education pertaining to tourism of national parks and natural monuments is equivalent to "an open and permanent educational process through which individuals and communities become aware of their natural environment and acquire a critical and reflective attitude towards it and the use of its resources" (p. 464).

Overall, each of the aforementioned efforts resulted in tourists, who were once solely concerned with purely entertainment endeavors, becoming more receptive to conservation messages. Prior tourism education research indicated that tourists generally expressed little interest in being educated on environmental issues. Luck (2003), however, conducted a study to assist in answering the question, "Do tourists want to be educated" and found surprising results. From questionnaires distributed at swim-with-dolphin tours in New Zealand, the author concluded that a shift in the receptiveness of tourists to being educated while on vacation is occurring, opening the door for informal environmental education. Thus, the aforementioned studies illustrate the benefits and importance of informal education, and help justify the need to continue investigations into this field. Although the effects of learning in a wide array of informal settings are well documented, the potential for show caves and springs in karst environments to become locales for active informal education has largely not been investigated. Analyses of educational efforts at public karst facilities are needed to establish the current status of informal karst education efforts, and to evaluate the potential effectiveness of increasing education standards at karst tourism facilities.

Karst and the Environmental Education Interface

Cave publicity is ever increasing through cave accounts and stories, national and regional news, movies, television programs, and print media (Ganter 1992). The danger of this publicity arises in that the delivered material can be vastly different in content and tone and can be objective or sensational. This can, in effect, lead to a misinformed public and increase the number of people going into caves and exploring karst environments, which in turn may increase the instances of karst degradation by inexperienced karst explorers. At the same time, if carried out responsibility, publicity can lead to positive outcomes of increased awareness of karst environments awareness. For example, the publics' positive changing views of bats were in part attributed to public campaigns by Bat Conservation International of the late 1980s and early 1990s (Ganter 1992). Table 2.3 further highlights the costs and benefits of publicity for caves and karst, cave owners and cavers, and the general public, ultimately demonstrating the need for ensuring the delivery of relatively un-sensationalized, scientifically well-informed cave and karst science to the general public, an activity this research attempts to pursue through work on show cave tour content.

Table 2.3: Benefits and Costs of Objective and Sensational Karst Publicity. Adapted from Ganter (1992).

Potential Benefits of Objective Cave/Karst Publicity			**Potential Costs of Sensational Cave/Karst Publicity**		
Caves/Karst	*The Public*	*Cavers and Societies*	*Caves/Karst*	*The Public*	*Cavers and Societies*
1) Visitors become more karst considerate	1) Exposure to proper cave safety and values	1) More grants and support for agendas	1) Increase in interest, careless visitation	1) Data Exaggerated, Misinformed	1) Distrust in cavers and cave societies
2) Visitors realize caving risks, discouraged from caving	2) Greater knowledge of the natural karst world	2) Better image as explorers/ researchers rather than adventurer	2) Increase in anxiety, insurance, liability for cave owner, caves closed	2) Increased cost of management	2) Increase in needed rescues and accidents
3) Increase informed policy reduces instances of pollution	3) Increased leisure opportunities	3) Increase in political power and respect	3) Increase in accident potential		3) Uneasy land owners 4) Negative image as daredevils

Overall, being better informed about karst environments will not guarantee more favorable attitudes towards karst, but as argued by Pettus (1976), some basic level of knowledge is needed to promote the enhancement of environmentally conscious attitudes and sound decision making. Kastning and Kastning (1999) argue public education efforts can easily rectify the nine common misconceptions about karst terrains of: 1) karst bedrock is solid; 2) water enters, not creates, sinkholes; 3) pollutants placed into the ground remain there; 4) karst spring water is pure; 5) sinkholes only form catastrophically; 6) karst is always exposed at the land surface; 7) erosion forms caves; 8) caves and the rocks they are formed in are the same age; and 9) karst groundwater flow is simple. The authors contend these misconceptions develop because policymakers and many people living in karst regions are misinformed about the processes which occur in karst terrains. Scientific data and knowledge regarding karst is abundant, yet is not properly disseminated to the public at large and policymakers charged with protecting these terrains through outreach projects. Kastning and Kastning (1999) believe these educational endeavors should incorporate clear and concise information through maps, photographs, drawings, and/or other visual devices so people learning about karst for the first time can easily comprehend the material they are shown.

Successful examples of informal education projects exemplifying these characteristic are documented. For example, James Goodbar of the Bureau of Land Management produced a portable cave exhibit for display at the National

Boy Scouts of America Jamboree in Fort Hill, Virginia. The display, which incorporated interpretive video and an interactive cave, was designed to educate boy scouts about cave resource conservation and spur the development of a cave ethic by allowing exhibit visitors to experience the sights, sounds, and feel of real caves (Goodbar 1999). Similar interactive cave displays were created at Whiteman Park in Australia (Anderson 2000).

Davis (2002) proposed that less traditional settings offer more opportunities to reach larger audiences. Using his own 33 years of experience in teaching about geology in non-traditional settings, the author concluded that direct learning through field investigations can result in people as young as eight learning how to conduct science. As students share their knowledge with friends and family members, more people become educated about geology. Transforming interpretive signs at nature-based facilities to discuss not only the ecology of a region, but also the connections between ecological communities and the underlying geology has also shown to be an effective way to put geology and environmental science in the public eye (Davis 2002).

Show caves, which are located throughout the world, are commonly described as caves made accessible to the public by guided tours (Davey 1982). Research conducted in 2001 indicated over 43 percent of all United States National Park Service sites alone contained karst features open to the public for viewing. A minimum level of infrastructure is built within these facilities to ensure visitor safety while touring. The focus of show caves tours has historically been entertainment, leaving increasing public knowledge of karst environments to fall to the wayside (Foster 1999). This is often true for both privately- and publicly-owned facilities. Yet, in recent years, a push for show caves to educate and promote land stewardship has occurred as show cave operators, particularly federal, are slowly beginning to incorporate interpretive exhibits at their facilities and offer additional education and science-centered tours. This push has been primarily fueled by increasing public awareness through high profile news events, volunteerism, private sector partnerships with governmental agencies, increased acquisition of karst land by nonprofit organizations and land trusts, and the development of cave protection regulations. School children are also beginning to visit these facilities more frequently during class fieldtrips. However, even where show cave operators are recognizing the monetary value of combining education with entertainment, the education material most frequently fails to relate the concepts of a holistic karst system, instead focusing solely on cave interiors (Foster 1999). Moreover, even when tour content focuses on entire karst ecosystems, such as at Hidden River Cave in Kentucky, the target group for this information is largely visiting school groups, not the general public.

Conclusions

In summation, the aforementioned scientific literature has reviewed the importance of informal environmental education in relation to environmental awareness, while pointing out the insufficiency of traditional formal classroom settings for promoting environmental conservation and karst protection. Using interpretation techniques, informal education can help extend environmental ideals to a substantial amount of people with relatively little effort, particularly at zoos, museums, and science centers. However, this review of academic literature has also highlighted the widespread nature of karst misconceptions and the lack of research related to informal karst education. The few studies which have investigated efforts to educate visitors about karst science at show caves or springs reveal educational projects are primarily geared towards the development of karst education within formal, not informal learning settings. Furthermore, presented education material most frequently fails to relate the concepts of a holistic karst system, instead focusing solely on caves. Overall, the need for informal environmental education is understood, yet the adaptation and adoption of informal education techniques from other science and nature based facilities for use at show caves and the outcomes of implementing these techniques has, until now, largely been ignored.

CHAPTER THREE: METHODS

The overarching goal of this research is to increase our knowledge of informal karst education as described in Chapter 2. Consequently, this dissertation will take a bilateral approach: 1) document the availability of informal karst-related educational opportunities for the general public in the United States and internationally; and 2) determine whether increasing the exposure of visitors to improved educational material in informal karst learning environments, such as show caves, enhances their knowledge about the importance and vulnerability of karst terrains. These two approaches have different methods sets. The first requires a detailed and thorough search of institutional efforts which promote karst education through archival- and internet-based research and personal communications. Such institutions cover the spectrum from national- and state-level government to non-profit agencies and local caving groups.

To achieve the second goal, a mixed methods research approach was employed which involved collection and analysis of both qualitative and quantitative data. Specifically, facilitating this effort required: 1) interviews with select show cave and spring operators, owners, and guides; 2) soliciting data related to the opinions of tour guides and show cave owners about the educational characteristics of materials presented at karst attractions throughout the United States and abroad via a SurveyMonkey® survey; 3) reviewing cave management strategies as they relate to education at participating facilities; 4) making personal observations whenever possible, and 5) developing and applying a structured outcomes assessment survey pertaining to the quantity and quality of karst education provided at participating show cave facilities. Thus, this study employed the following data collection techniques: archival research, structured surveys, semi-structured interviews, and participant observations. Each of these methods utilized for data collection and analysis is discussed in detail below.

Archival Research and Expert Consultation

Archival research and expert consultation were utilized to achieve both goals of this research, but particularly for investigating informal karst education (goal 1). Specifically, communication technologies (internet and telephone) were utilized to collect information on show cave legislation, the characteristics of educational material presented at show caves across the globe, and current karst-specific informal educational efforts for the general public in the United States and internationally. For assessing documented informal karst education worldwide, qualitative data were gathered through the review of records and reports as well as the completion of semi-structured interviews. Sources of these data included: 1) political and scientific documents, 2) United States and international policy related to karst education, 3) recent trends in informal environmental education presented in published manuscripts, 4) centers for learning such as museums and science centers, and 5) show caves and springs, grottos, government agency/ministries, regional and international organizations, and show cave association webpages.

Key informant interviews with experts in karst education, such as education coordinators of the National Cave and Karst Research Institute and Virginia Natural Heritage Karst Program, and program leaders at karst tourist facilities helped to guide this grey literature search by providing information related to educational endeavors not advertised via the internet or published literature. The familiarity of the researcher with the United States allowed for a state-level review of educational endeavors in the nation. International archival research was primarily conducted at the country-level unless expert consultation directed the researcher's inquires to the regional-level.

Overall, the collection of archival data was important for this study in order to concisely document the availability of informal karst-related educational opportunities for the general public across countries. However, the significance of archival research can be diminished if the context with which reviewed items were developed is not understood, the appropriateness of data not reviewed, and the dissemination strategies of developed materials not investigated. Thus, whenever possible, archival data were validated through qualitative interviews with appropriate karst outreach and education experts and personal observations (Johnson and Christensen 2008, Creswell 2009).

Participant Interviews

Archival Data Collection and Validation: Establishing Current Karst Education

Semi-structured interviews were conducted to gather and validate archival data (see above) as well as to extract opinions about the educational characteristics of tour materials currently presented to visitors and utilized at cave and karst attractions (Fink 2006, Creswell 2009). In addition, these interviews allowed for the review of cave management strategies as they relate to education at participating facilities (see below). During archival, personal communication, and internet-based research, names of persons with potential knowledge of educational pursuits were collected for each country. Positions held by these persons included, but were not limited to:

- museum and nature center staff
- officers of cave grottos and likewise organizations and businesses
- personnel from government agencies and ministries (including those related to geology, environment, water, education, and/or tourism)
- directors of karst programs and cave associations
- environmental education coordinators

After potential interview sources were gathered, both international and domestic participants were initially contacted via email and requested to provide any information he or she were aware of that related to informal karst education. The content for initial email contact is shown below. Modifications were consistently made to personalize the message as needed. Translation services were utilized to convert the message content from English to more appropriate languages when needed. Emails with translated messages contained both the English and translated text.

> My name is Leslie North and I am working on my dissertation at the University of South Florida, Florida, USA, focusing on cave and karst education across the globe. The focus of my research is gaining an understanding of informal karst education, which is any education that occurs outside of formal school settings. Thus, my purpose for emailing is to ask for your assistance in understanding all of the cave and karst education opportunities geared towards the general public (exhibits, programs, signs, talks, brochures and publication, media outreach, festivals, scout activities, etc.) that are being pursued or offered in your region and/or by your organization. Any specific information you could provide would be so greatly appreciated. I am very interested to learn about all of the educational opportunities offered through your organization. If you know of somebody else I should contact please forward this email and pass along his or her email address to me; I would like to gather as much information as possible.
>
> In addition, I would prefer to speak with you via telephone to learn about karst education in your area. If you are willing to participate in a brief telephone conversation with me, please let me know of the best means with which to contact you. I am happy to utilize internet calling technology to reduce the cost of calls.

In compliance with Institutional Review Board (IRB) requirements, willing participants were offered a consent form and then contacted via telephone and asked to further describe the initial information provided in his or her email response. On multiple occasions, telephone communication was not possible, particularly for international participants, but consent forms were electronically sent to informants and data were further collected through a series of email correspondences. Whenever possible, multiple contacts were made within the same region to help substantiate reported educational pursuits not found through other means of archival research. All educational pursuits uncovered during these communications were included in the results of this study (please see Chapter 4). In total, 12 telephone interviews were conducted internationally with personnel from environmental centers, caving organizations, government agencies, and NGOs, and over 83 email communications were received. Data were collected through 11 face-to-face interviews (see below), 26 telephone correspondences, and 86 email communications in the United States.

Gathering Cave Management Strategy and Karst Education Opinions

Qualitative interviews were also conducted through a semi-structured face-to-face meeting with a small sample of show cave and spring operators, owners, site directors, education program coordinators, and tour guides in the United States to gather information such as if visitor learning outcomes of tours are evaluated, tour guide training procedures, and tour guide evaluation strategies, amongst other topics (see Chapter 5). International show cave and spring operators, owners, and guides were contacted via telephone and email. A purposeful selection of interviewees was based on the interviewee being willing to participate and if they held a position which allowed him or her to have intimate knowledge of the status of educational efforts pursued at a particular show cave or spring. Information on the same topics was also solicited from show cave operators, owners, and guides throughout the United States and aboard via a SurveyMonkey® survey to increase the breadth of opinions and data related to karst education at show caves (please see the following section for further details on the construction and distribution of the SurveyMonkey® survey). The goal of these interviews was to overall gather opinions of the educational quantity and quality of information presented during cave tours and the feasibility of increasing said education.

Through the use of SurveyMonkey® and 16 semi-structured face-to-face meetings, willing tour guides were further questioned on the material they present during his or her tours, where they received presented materials, and how and why they have chosen to present particular materials. Information was also collected on the demographics of tour guides, how long they have lead tours, their background expertise in karst and caves, and their experiences with the cave, cave visitors, and their reasons for becoming tour guides.

The semi-structured format of these manger, owner, and guide interviewees ensured that essential topics were covered and only appropriate data was gathered (Fink 2006, Creswell 2009). Each interview was scheduled ahead of time. During interviews participants were asked to provide their thoughts on the status of karst education at their location, the role of show caves and springs in educating the general public, and where karst education-related materials (if used) were obtained. In addition, participants were asked about educational efforts undertaken at their facilities, and if provided with more educational material, would they be willing to incorporate this material into their tour. Lastly, participants were asked to discuss their thoughts on standardizing educational material at show caves and their willingness to provide educationally-rich tours. The specific question set for these interviews is:

1) What educational opportunities do you provide at your facilities?

2) Do you believe karst show caves should be mandated to have a greater focus of karst education? Why or why not?

3) Do you feel you provide visitors with adequate information related to karst environments? Why or why not?

4) Should show caves should present standardized karst material?

5) From where, does your facility receive its educational material?

6) If provided with more educational material, would you be willing to incorporate this material into your tours?

At locations indicating the presence of educational programs, additional questions were asked to determine whether measures are taken to assess and evaluate these programs and if the goals of the program are clearly identified. These interviews differed from interviews conducted during the archival data review process in that the latter did not have the same depth as the interviews concerning the educational activities of studied karst tourism facilities.

In accordance IRB regulations, after participants had verbally given their consent to be interviewed they were then asked to read, sign, and date an Informed Consent for Participation in Research form. This indicated they understood the purpose, procedures, and benefits of the study; that their participation was voluntary and confidential; and that they had the right to ask questions throughout the interview.

Upon obtaining permission, all responses were tape-recorded using a micro-cassette recorder. To ensure the privacy and confidentiality of the participant, all interviews took place in a closed-door office. Any necessary follow-up conversations with participants were completed within two weeks of the initial point of contact, typically via telephone. Following completion of each interview, participant responses were transcribed and coded. Coded data was sorted and analyzed for emerging patterns in participant responses using standard statistical techniques (Peterson and Ross 1997, Zimmerman 2001, Creswell 2003, Fink 2006, Johnson and Christensen 2008). In writing the results of these interviews, the researcher did not suppress, falsify, or invent any findings to meet any outside objectives or research goals.

In total, 24 face-to-face interviews and 21 telephone interviews were conducted in the United States to gather information on show cave management strategies. Additionally, 117 show cave managers/owners/operators from around the world participated in the SurveyMonkey®, 16 show cave managers/owners/operators at different international facilities were contacted via telephone, and 185 tour guides from around the world participated in the SurveyMonkey® during the data collection period.

SurveyMonkey® Survey Data Collection Technique

In addition to semi-structured interviews, information was solicited from show cave operators, owners, and tour guides throughout the United States and aboard via the SurveyMonkey® web-based tool with the intention of increasing the breadth of opinions and data related to karst education at show caves worldwide (please see Appendices D and E). Contact was initially made with show cave facilities via email. A sample of the content of these emails is shown below. Modifications were consistently made to personalize the message as needed. As with emails sent for the purposes of validating archival data, translation services were utilized to convert the message content from English to the appropriate language when needed. Emails with translated messages contained both the English and translated text.

> My name is Leslie North and I am working on my dissertation at the University of South Florida, Florida, USA focusing on karst education in the United States and abroad. The focus of my research in gaining an understanding of informal karst education, which is karst knowledge gained outside of formal school settings.
>
> I am particularly interested in learning about cave tour content and its development, and I need your help in reaching this goal. I am asking for show caves throughout the country to participate in a brief electronic survey about karst education at show cave facilities. There are two surveys, one for tour guides and rangers at facilities with karst features and one for persons involved in management and interpretation development. The survey should not take participants anymore than 10 minutes to complete and all participants will remain completely anonymous in the reporting of any results from this study.
>
> I was hoping you may be able to distribute the survey to the guides and other appropriate personnel, including yourself, at your facility. I have provided all of the links below.

1) Tour Guide Survey -
http://www.surveymonkey.com/s/X5YTVQX

2) Management, Education, Interpretation Staff Survey -
http://www.surveymonkey.com/s/T7BX97Y

To get to the survey, please click on the appropriate link above and follow the instructions on the screen to the appropriate survey for you. I am asking for you to participate by _________________. Please do not hesitate to contact me with any questions or concerns. You are welcome to the results of my study once completed. Thank you in advance for your time and consideration.

As suggested by statistical and survey research literature, an extended period of time was allowed for survey participation (Fink 2006, Johnson and Christensen 2008, Creswell 2009). In fact, a period of one month was allowed to pass between attempts to solicit participation in the survey. After the allotted time period, facilities which participated in the study were noted and the remaining show caves were sent additional correspondence reminding them of the survey and the need for their participation. A total of three emails were sent to any facility that had not previously responded to inquires.

In total, the survey was successfully sent to 326 show caves worldwide. Contact with an additional 107 facilities was attempted but unsuccessful due to inaccurate contact information. Show caves were found using internet searches, tourism websites, and the Show Caves of the World database. Although multiple interpretations of what constitutes a show cave exist worldwide, for the purposes of this study, a show cave needed to have facilities that were continually managed and employ official tour guides. Furthermore, only show caves in karst environments were allowed to participate in this study, due to the focus of this research being karst-specific education. A complete list of contacted facilities can be found in Appendix C.

Establishing Learning through Show Cave Tours

Collecting Baseline Data

In seeking factual and conceptual knowledge about privately- verses publicly-owned show caves in the United States, an open (short answer) and close-ended (true-false, multiple choice) survey in the form of a karst quiz was distributed at two caves of each category. This data collection technique was utilized in an effort to examine whether increasing the exposure of visitors to improved educational material in these environments enhances their knowledge about the importance and vulnerability of karst terrains. The quiz instrument consisted of 12 knowledge questions and an additional 17 items for measuring personal socio-demographics, opinions, and motivations for visiting. Knowledge questions were designed to measure familiarity and awareness of karst science concepts in a true-false, multiple choice, and short-answer format. The complete survey instrument can be found in Appendix F.

Facilities where surveys were administered were selected based on willingness to participate, annual number of visitors to ensure significant quantities of respondents, and ownership. Due to finance and time constraints, only two respective publicly-and privately-owned facilities (one national-level and one state-level) were visited: Mammoth Cave National Park (Public-national), Lost River Cave and Valley (Private), Florida Caverns State Park (Public-state), and Cumberland Caverns (Private).

The combined karst quiz/survey questionnaire was distributed to adult (age 18 or older) cave visitors to help discern the extent of learning from their tour and determine each visitors preexisting knowledge of karst. In order to gather a large sample set as suggested by survey research guidelines (Fink 2006), surveys were distributed to a minimum of 115 participants at each of the four study sites. To diversify the survey sample and thereby ensure the sample set reflected the characteristics of the facility's tours on the whole and not merely one or two guides, no more than 10 surveys were distributed per tour and surveys were distributed during tours from multiple guides. Comparable numbers of male and female and varying-aged participants were collected. These voluntary surveys were distributed prior to and immediately after tours were completed. Space was provided for additional comments to allow visitors to further illustrate their general karst knowledge, attitudes, and perceptions of karst and karst education at the conclusion of the survey. Informal interviews with willing participants were also solicited to allow visitors to expand upon the information provided in their survey/quizzes. All participants were asked to read, sign, and date an Informed Consent for Participation in Research form.

This set of quizzes and interviews helped to establish what cave and karst science knowledge visitors came and left tours with prior to attempting to increase the educational quality and quantity offered at the four study sites.

Gathering all of this relevant information helped to better analyze and interpret the general results of these surveys (see below section), to discover what knowledge, if any, was gleaned, and what may be the most influential factors affecting learning in commercialized karst environments.

Changing Cave Tour Content and Deliver

To increase the educational quality and quantity of material presented at participating facilities, tour guides were supplied with karst-science rich material and trained in karst science and interpretation techniques. Each participating facility provides tour content to guides, although the degree to which the content is delivered as a verbatim tour script varies from guide to guide. Thus, the tour "script" for each facility was reviewed for the presence and accuracy of karst science and changes were made to incorporate more karst-specific material. Altered scripts were distributed to all of the guides at each facility along with a PowerPoint explaining basic karst science, why and how karst is vulnerable to human impact, and basic concepts of the interconnectedness of karst terrains (see Appendix G). Guides were instructed by cave managers and interpretation staff to study the material and make changes to their individual tours.

After meeting with managers at each of the four participating facilities, three guides were selected from each facility to participate in more in-depth guide training. Guide selection was primarily based on full-time employment during data collection to ensure the minimum number of survey responses could be achieved. Preference was also given to guides who lead tours during the initial stage of data collection. Additional information on selected guides is discussed in Chapter 6.

A minimum of three weeks after the implementation of altered scripts, each selected tour guide was observed while leading a series of tours. Extensive notes were taken during each tour to establish where changes to the content and its delivery could be made without jeopardizing the tour experience for visitors. The Conceptual Change Theory and Contextual Model of Free-Choice Learning (Posner et al. 1982, Magnusson et al. 1997, Falk and Dierking 2000, Falk and Storksdieck 2005), both discussed in detail in Chapter 2, were closely considered while making these recommendations. For instance, each guide was instructed to discuss common misconceptions about caves in the beginning of the tour, followed by more accurate karst information to replace these prior misconceptions. Whenever possible, visible environmental concerns were pointed out to visitors, making use of the physical environment as is suggested in the Contextual Model of Free-Choice Learning. Guides were also instructed to learn about visitors, such as where they were from and their motivations for visiting the cave, in an effort to make personal connections between tour content and individual visitors. Lastly, the interconnectedness of the individual caves to the entire karst landscape was discussed throughout tours, but especially while visitors were led across the landscape to cave entrances.

After each tour, guides were provided with feedback on where changes could be made and suggestions for how to best implement those changes. On occasion, offering feedback required guides to revisit the cave without visitors and deliver a mock tour to the researcher. The discourse between guide and researcher continued until the content and delivery of each guides' tour incorporated the suggested changes, incorporated ample karst science, described the interconnectedness between the surface and subsurface environment, and the guides were fully comfortable with the newly developed tour strategies.

Determining Learning from Incorporated Changes

The same combined karst quiz and survey instrument initially distributed to show cave visitors prior to the pursuit of guide re-training and tour content changes were redistributed to visitors a minimum of three weeks after the full implementation of the more educationally-rich tours. This three week time lapse was designed to offer guides ample time to grow and remain comfortable and familiar with his or her newly developed tours even in the absence of the researcher. The survey was distributed to adult (age 18 or older) cave visitors only. These surveys were intended to determine if visitors, provided with more holistic karst educational material, gain any or more sophisticated karst knowledge while touring facilities. Post-change surveys were distributed to a minimum of 115 participates at each of the four study sites. As with pre-change surveys, no more than 10 surveys were distributed per tour to diversify the survey sample. Surveys were distributed prior to and immediately after the completion of tours. Informal interviews with willing participants were once again solicited. All participants were asked to read, sign, and date an Informed Consent for Participation in Research form to comply with IRB permit requirements.

Data Analysis

Data collected through archival research, surveys, and semi-structured interviews were analyzed using a variety of techniques. The nature of most of this study's archival data (particularly that which was collected to investigate karst education efforts) restricted data analysis to descriptive statistics. The qualitative data in this study, such as interview responses and open-ended survey questions were rigorously analyzed through a process of content analysis (Johnson and Christensen 2008). Content analysis involves coding and classifying transcribed data into categories so it can be more easily evaluated through classification, summarization, and tabulation (Peterson and Ross 1997, Zimmerman 2001). The programs ATLAS and Excel were used during this process. For the purposes of this study, content analysis allowed for emerging themes and other informative data to be extracted from the participant interviews, open-ended survey results, and published literature.

Survey data were coded and the data entered in Excel. The data were then transferred into and analyzed using standard descriptive statistical techniques with the use of SPSS and Excel software. When participants did not complete the post-tour survey or failed to complete at least 50 percent of the total questions, the surveys were deemed invalid and removed from the data set. When respondents failed to answer a survey question, the question data was coded as "no opinion." All data were checked for normal distribution before statistical tests were run.

In addition to descriptive statistical analysis, which was used to simply describe the subjects or groups being studied, inferential statistical methods were used to discover whether inferences made from the data were real differences among the subjects/groups, or the result of error or chance (Fink 2006). Thus, ANOVA tests, which are used for comparing sample means to detect significant differences, were used to ascertain suitability of comparisons between test groups (Moore and McCabe 2000; George and Mallery 2003; Fink 2006). These included estimating the relationship between quiz scores and sex, level of education, residence, and age. When normality failed, meaning samples were drawn from non-normal populations or did not have equal variances and when three or more different experimental groups were affected by a single factor a Kruskal-Wallis ANOVA test or Mann-Whitney Rank Sum ANOVA test (for comparing two treatments) was performed. All tests were run with a 95-percent confidence interval.

In closing, this study utilized a wide variety of data analysis and collection strategies to evaluate informal karst education in the United States and abroad. These methods included archival research, the use of SurveyMonkey®, semi-structured interviews, and outcomes assessments and surveys. The following Chapter utilizes the first of these methods to establish the current karst education endeavors pursued worldwide and the characteristics of these efforts.

CHAPTER FOUR: STATUS OF KARST EDUCATION

Genuine worldwide interest in formal environmental education has continually flourished since the 1970s in response to international declarations for environmental education programs, such as the Belgrade Charter and Tbilisi Declaration, which promoted by UNESCO and UNEP (Careda 1999; Disinger 2001; UNESCO 2009). Yet, despite these accomplishments, informal education efforts and research have lagged behind those of formal education. In karst regions, both formal and informal karst-specific environmental education programs are minimal, and are less established than other comparable environmental education curricula. For instance, American museum directors reported a 70 percent increase in the educational opportunities provided at their facilities in the 1990s compared to previous years. By the end of 1999, the museums were offering more than four million hours of educational programming annually (IMLS 1999), while a minimal number of comparable opportunities occurred at karst facilities during the same period. Despite this fact, what education efforts did occur produced some successful, documented karst environmental education projects in the United States and abroad.

The chapter highlights discusses these efforts and analyzes their characteristics and major trends that may exist (Please see Appendixes A and B for a complete review of the efforts uncovered). United States programs are investigated at both the national-level and state-level, while international programs are limited to the national-level. As discussed in Chapter 3, material related to the karst educational efforts was gathered by conducting face-to-face and telephone interviews, archival research, and email. Surprisingly, a 69 percent return rate was attained for all email and personal communication requests.

Karst Education in the United States

National-Level

For the purpose of this research the informal karst education efforts described below included any educational opportunity offered to the adult general public or children aside from those offered at show cave facilities (the latter are investigated in Chapter 5 of this document). Examples of informal learning opportunities meeting these criteria included: media (radio, film, television, and/or newspaper) reports, cave and karst outreach events, educational information provided on websites, coloring and other related activities for children, interpretative signs or other educational boards positioned at locations other than show caves, educational caving opportunities typically offered by caving groups, karst training programs and instructional materials for teachers, and brochures and pamphlets, amongst others. This research found a minimum of 100 Cave and Karst Environmental Education programs located in the United States. While it is not possible to cover all 100 programs, some of the more significant efforts are discussed below. Those examples which did not have a great deal of information or were similar in nature to others described below are summarized in Appendices A and B.

Project Underground, created by the Richmond Area Speleological Society, is a national interdisciplinary educational program designed by speleology educators and experts to promote cave awareness (Project Underground 2010). Its purpose is "to create and build awareness of and responsible attitudes toward karst and cave resources and their management needs." The program provides activity guides and 6-hour workshops to teachers of kindergarten to high school students on a variety of topics including. These include, but are not limited to: 1) cave biota through the *Troglo…What?* and *Bat Echoes* activities; and 2) cave geology and hydrology via the *Rocks and Water* program which incorporates a *Lost River Village* activity where participates plan a town on karst land (Project Underground 2010). Overall, Project Underground is the overwhelmingly predominate karst education program in the United States; it has been adopted or used as a guide to develop new programs by multiple state agencies, private organizations, show cave facilities, and caving grottos in both the United States and internationally.

Two federal government agencies provide karst education, the United States Geological Survey (USGS) and Bureau of Land Management (BLM). The USGS provides lesson plans, maps, and online resources to educators of K-12 and university-level students. Two such resources include *Caverns and Caves* and *Groundwater* designed for use in K-6 grades. The *Caverns and Caves* teaching packet provide teachers with multiple teaching resources including stories, discussion questions, and writing assignments. The step-by-step instructions provided to teachers promote building upon previous knowledge to maximize student learning. This packet also includes 3-D tours of Mammoth Cave National Park and Carlsbad Caverns. The USGS *Groundwater* resources aid teaching about how groundwater interacts with the land surface, sources of pollution, landscapes containing groundwater (karst included), and groundwater usage (USGS Education Webpage 2010). Unlike the *Caverns and Caves* packet, these resources are more technical written and are not presented to teachers in a systematic mattier, thereby potentially hindering student understanding of karst groundwater.

In addition, the USGS created a teacher's guide for karst topography and a karst paper model that can be downloaded without cost via the National Park Service and USGS websites (Alpha et al. 1997). The guide and model describes common karst landform features and why karst is important for people. An abbreviated and simplified version of *Geology of Caves* ,created by Davies and Morgan (1989), is also available for free through the USGS website.

The second federal agency, the BLM produces and maintains a cave- and karst-related set of resources called *Welcome to the Underground*. This resource describes the types of caves found in the United States and their distribution, how caves and karst landscapes form, cave decorations, and cave biota and their adaptations. Additionally, the historic use of caves by humans and the resulting impacts are covered as well as the challenges of managing and conserving karst. Five classroom activities were adapted from Project Underground by the bureau and incorporated into their cave and karst education resource packets: *Karst and Nonkarst* W*atershed*, *Cave Creations*, *Bat Babies*, and *Life in the Dark*. *Life in the Dark* challenges students to determine what specially adapted food chains exist within caves and explores human-induced changes to these adaptations, while bat adaptations are explored in the *Bat Babies* activity. Cave formations are created in the classroom with the guidance of the *Cave Creations* activity. Lastly, the most pertinent activity, *Karst and Nonkarst Watershed*, enhances the understanding of the negative impacts of human activities on groundwater quality by constructing a porous, well-drained karst watershed, and other less porous watersheds using sand, gravel, and varying rocks. A colored powdered drink mix poured onto the karst watershed demonstrates the rapid flow of water throughout the entire karst aquifer (Booth et al. 2009).

Watersheds.org, a website for the Bryant Watershed Education Project in south-central Arkansas, hosts multiple karst education resources. *Karst: the Movie* is an online, interactive karst model designed to educate participants about karst features and non-point source pollution through karst word search puzzles, word matching exercises, vocabulary worksheets, an experiment for simulating the flow of water and contaminants through karst topography, and an evaluation tool in the form of a karst quiz (Watersheds.org, undated website).

Teacher and student guides instruct students on how to navigate "the movie." In one month this website can receive 200,000 hits from around the world which highlights its importance for karst education in both the United States and internationally (Carden-Jessen, personal communication, 2010).

The 11-part *Planet Earth* series includes a segment on caves. Although the term 'karst' is not used in the video, the episode introduces viewers to cave formations, limestone erosion, the importance of water in limestone environments, and the uniqueness and sensitivity of cave biota. Limestone landscape and cave pollution from leaking sewage tanks, agricultural runoff, industrial sites, and the significance of pollution on drinking water supplies are also discussed in the video (Fothergill et al. 2007). In fact, a participant at Florida Caverns State Park (please see Chapter 6) attributed her high score on the distributed karst survey to the *Planet Earth* series, which further illustrates the importance of encouraging accurate and complete content of popular media.

One usual and non-traditional karst education example is *Circle of Blue*, which is a Michigan-based international network of journalists, scientists, and communication design experts that report on the global freshwater crisis and therefore cover many issues related directly to karst (Circle of Blue.org 2010). Consequently, Circle of Blue commonly reports on karst environments in an effort to increase knowledge of their importance, sensitivity, and uniqueness. In addition to developing and distributing a karst world map, in 2010 karst reports and videos titled *Exploring Underground Water Systems in Mammoth Cave*

(Ganter 2010), *Following the Hidden Water of Southwest China's Karst Region* (Robertshaw and Jaffe 2010), *Tracing Kunming, China's Freshwater Hazards* (Ganter 2010), *Karst Landscapes Across the Continents* (Groves 2010a), and *Connecting Caves, Karst Landscapes and Climate Around the World* (Groves 2010b) were produced by the group.

More modern and technologically advanced forms of information dispersal have not been ignored in karst education efforts. UTube videos are an excellent case in point as they are increasingly becoming a source of information on an array of topics regarding karst. For instance, Dr. Penny Boston, Director of the Caves and Karst Studies Program at New Mexico Tech, offers viewers a brief (1 minute, 19 seconds) explanation of what is meant by the term *karst* (New Mexico Tech Earth and Environmental Science 2008). Similarly, the University of South Florida Libraries (2008) created an 11-minute documentary on the importance of karst terrains for the health of environments and humans. A number of videos produced by students for class assignments also accurately depict and describe karst landscapes and their sensitivity and importance (for example, please see Rylincoln 2008).

State-Level

Many of the states in the USA do not have significant karst landscapes and were therefore not included in this study. Other states do have significant karst, but offer little in the way of education efforts for either schools or the general public. This information can easily be summarized and is done so in Appendix A. Those states that have invested in important education efforts pertaining to karst are covered in more detail in the below sections.

Florida

The University of South Florida and Southwest Florida Water Management District (SWFWMD) produced *Linked Resources for Community Education in Hydrogeology* to teach Florida residents about sinkholes, the hydrologic system, and stormwater runoff (SWFWMD, undated). SWFWMD also sponsored the creation of *Water's Journey: the Hidden Rivers of Florida,* which depicts cave divers traveling through karst conduit as they are followed on the surface by the use of radio devices. This program repeatedly airs on WUSF-TV and the local PBS channel (Karst Productions Inc. 2004). In 2000, SWFWMD also produced a watershed excursion guide and teacher's accompaniment as part of Water Resources Education Week. The guide educates about water resource issues through descriptions of watersheds and their protection. Although minimal, karst terrains and features are described within this text (Yarbrough 2000). The guide is still available on the SWFWMD website.

In collaboration with Hands on the Land, Florida's Department of Environmental Protection (FDEP), and local water management and school districts provide support for the State's LIFE (Learning in Florida's Environment) Program. This program, which is "an initiative to establish a series of field-based, environmental-science, education programs" (Florida Department of Environmental Protection LIFE Program 2009), involves SWFWMD partnering with school districts to create environmental-based education experiences and material pertinent to the school districts' local area. The program content for LIFE networks, Wakulla Springs, Florida Caverns State Park, Ichetucknee Springs, and Leon Sinks Geological Area, are devoted to karst-related material. For example, the *Karst Features Field Lab*, whose objectives include identifying karst features and determining the origin of sedimentary rock, is incorporated into the programs of both the Wakulla Springs and Florida Caverns State Park LIFE networks. Additionally, an *Upland Karst Features Field Lab* is incorporated into the Ichetucknee Springs LIFE program, and *Water on the Move*, a field-base lab activity concentrating on the interconnectedness of surface and subsurface groundwater and human influences on water quality is offered at Florida Caverns State Park.

Floridasprings.org, a division of FDEP, provides teachers with a *Water's Journey Expedition* activity guide for grades 6-8 consisting of two activities: *Reporting on Water's Journey Expedition* and *Examining Human Impact on the Aquifer and Springs*. Although the term 'karst' is not mentioned in the document, students are expected to understand the principles of two karst features, aquifers and springs, and how sinkhole pollution can negatively impact these features (Floridasprings.org, undated). In addition, the Hydrogeology section of the FDEP produces an interactive video aimed at educating viewers on human-induced threats to Florida's springs and aquifer (FDEP 2005). The FDEP also supports a *Water and You* public education campaign geared at educating Florida's citizens about the sensitivity and importance of the State's karst springs. Several spring working groups such as those at Wakulla Spring, and Ichetucknee Springs also educate about karst springs through varying outreach strategies.

Multiple city-level government departments in the state offer educational material related to water resources and protection, yet increased danger of pollution in karst terrains is seldom discussed in this material. For instance, the Hernando County Department of Public Works website contains brochures on the importance of preventing stormwater pollution, and how to become a part of the "pollution solution." However, none of these documents clearly describe the term karst or how the uniqueness of Florida's karst escalades these hazards (Hernando County Public Works Department, undated). The County's Citizens for Water Committee does, however, offer some karst education through brochures, questionnaires in customer water bills, public talks, and broadcasted programming on local cable channels (Citizens for Water, undated).

The Florida Museum of Natural History contains the *Northwest Florida: Waterways and Wildlife* exhibit which takes visitors on a tour of northwest Florida's differing habitats, including caves. While exploring the cave portion of the exhibit, visitors experience what it is like to be inside a cave and learn about cave minerals, hydrology, biota, and fossils. Multiple natural areas in Florida also periodically offer seminars related to karst, caves, and springs. Any member of the public is welcome to attend these activities.

For nine consecutive years, a 'Springs Festival' has been hosted in Marion County, Florida and is usually sponsored by state agencies and parks. The goal of this month-long event is "educating Marion County residents and visitors about Florida's freshwater springs" (springfest.org 2010). Activities include guided snorkeling and canoeing tours in Rainbow Springs State Park. Discussion on proper watering and fertilizer use and how to utilize the river without damaging the spring are part of the tour. This festival has received a number of local, state and nation awards. Examples include the 2008 Outstanding Special Event of the Year Award presented by Friends of Florida State Parks Citizen's Service Organization of the Department of Environmental Protection Division of Recreation and Parks, 2006 Walt Drigger's Environmentalist of the Year awarded by the Ocala/Marion County Chamber of Commerce, and the Spirit Award for Working Together for Rural American by the United States Department of Agriculture Forest Service in 2004 (Aiken, personal communication, 2010; Springsfest.org 2010). Similar activities to the festival include those hosted at Silver River State Park and Indian Lake State Forest. Another is the *Juniper Springs Recreation Area – Ocala National Forest Symposium* which concentrates on the history of the areas springs, local flora and fauna, the connections between surface and groundwater supplies, and environmental carrying capacities. All activities are offered to participants for free or reduced prices.

Kentucky

While other states rely on governmental agencies for karst education materials, Kentucky does not. Yet, common educational materials in Kentucky are similar to other states in their content and include hands-on activities, geology fieldtrips, special cave tours, and educational workshops for the general public and schools. For instance, the Rockcastle Karst Conservancy offers three educational resources that educators or the general public may borrow. These include a *Kids Discover Bats* video and a 28-page activity book, *Bats: A Creativity Book for Young Conservationists* (Otten, personal communication, 2010). The Conservancy, along with the Kentucky Speleological Survey, also provides a karst resource on their website (Rockcastle Karst Conservancy 2010).

Other organizations offering educational resources include Kentucky's Geological Survey, Kentucky Education Television, American Cave Association, Carter Caves State Park, and Eastern States Speleological Organization. Distinctive features of karst that are commonly included in the educational efforts of these organizations are rather varied and inconsistent. For instance, Kentucky's Geological Survey offers a series of educational papers describing karst and its location, frequent karst misconceptions, building risks, flood hazards, and the vulnerability of karst to human degradation (Kentucky Geological Survey 2010). James Currens of the Survey produced *Kentucky is Karst Country: What You Should Know About Sinkholes and Springs*, which contains relevant educational diagrams and pictures. Information is provided on karst hydrology, the importance of protecting karst resources by individual behaviors and practices, and the geologic hazards commonly associated with karst (Currens 2002). In contrast, Kentucky Educational Television has no televised series on karst, specifically, although three cave-specific programs have aired. This organization also offers the educational karst writing, *The Lay of the Land: Effects of Kentucky Geology on Culture* and *Karst Topography in Kentucky*, and a free watershed field guide, video, activity collection, and lesson plans which describe karst watersheds and nonpoint source pollution on their website. Finally, the one-hour Kentucky-centered program, *If it's on the Ground, it's in your Water*, focuses on water degradation from agricultural, recreational, and household activities (Kentucky Educational Television 2010).

For a fee of $75, staff from the American Cave Association, which is housed in Horse Cave, Kentucky, will visit any facility (such as a school, library, or church) within a 35-mile radius to present and lead hands-on activities on a variety of karst-centered topics. Specifically, three outreach programs directly related to karst include: *Caves and Karst*, *Farming in Cave Country*, and *On the Karst Farm*. As their titles suggest, these programs are designed to teach participants about the development of caves, how farming practices impact caves and karst groundwater quality and best management practices to minimize agriculture-induced degradation of karst (American Cave Association 2010). Cave and karst workshops, exclusively for school educators, are also available through the association (Nims, personal communication, 2010).

Tennessee, Alabama, and Georgia

Although nearly half of Georgia's landmass is underlain by karst limited karst educational resources and efforts for formal or informal learning environments directly associated with the state were uncovered during this research. Similarly, only two karst education efforts were uncovered in Alabama, with only one of these efforts, *Down Under in North Alabam*a, offering hands-on experiences. In September 2010, the Legacy organization hosted free mini-workshops through their Down Under project to introduce participants to karst topography, cave formations, and karst biodiversity. The workshops included trips to wild and show caves, as well as classroom sessions designed to provide participants with karst knowledge and teachers with classroom activities and successful techniques for teaching about karst environments (Legacy 2010).

Tennessee, like other southern states such as Georgia and Alabama, lacks karst education programs and efforts despite its extensive karst terrain. However, the city of Cookeville has authorized the placement of several signs about karst groundwater in key locations. For instance, at Ensor Sink, the Upper Cumberland Grotto and Earth Science Department of Tennessee at Technological University have placed a large pavilion with karst related information around the large sinkhole (Sutherland, personal communication, 2011). The Tennessee Department of Environment and Conservation website offers links to multiple, short videos (approximately fifteen minutes in length) on sources of water pollution, where water resources in Tennessee come from, how to prevent water contamination, and the concerns of karst (TN Department of Environment and Conservation, undated website). Uniquely, a selection of these videos is also offered in Spanish.

Nonetheless, the Tennessee Department of Environment and Conservation Division of Geology does not conduct, oversee, or provide any type of karst education program (Clendening, personal communication, 2010). Instead, the Division focuses on creating geologic resources, such as maps and scientific publications, which they feel others can then use for the development of educational activities. With approximately 75 percent of public inquires to the Department being sinkhole related, the bulk of what the Division considers outreach on karst matters consists of meeting with property owners or offering material on sinkholes via email and phone discussions (Clendening, personal communication, 2010). Furthermore, residents of the state are encouraged to post any specific geologic question they may have on the Division's website feature *Ask Geology* (TN Department of Environment and Conservation). However, for a person to ask a question about their regional karst geology, they must first know they are residents of a karst state (which is often not the case). Overall, the only outreach pursued by the Division consists of Division members occasionally presenting at schools or other state agencies; karst is always reviewed during these discussions (Clendening, personal communication, 2010).

Illinois and Indiana

Through external funding and donations, primarily from the National Speleological Society, the Indiana Karst Conservancy's Education and Outreach Committee offers educational experiences that include workshops developed from the aforementioned national-level karst education program *Project Underground*. These workshops allow participants to utilize a karst groundwater model, explore a 37.5 inflatable cave, and view *Caves: Life Beneath the Forest*, which illustrates the dynamics of caves and karst hydrogeology (Ingle, personal communication, 2010). PowerPoint presentations and karst handouts and booklets are provided. The Committee also maintains a unique Facebook page which provides links, articles, and updates related to their education efforts and the latest cave and karst news throughout Indiana and the remainder of the United States (Indiana Karst Conservancy Website 2010).

The Conservancy educates youth groups on the importance of karst landscapes and minimizing human impact during cave tours (Ingle, personal communication, 2010). In addition, karst presentations are commonly shown at public libraries and Indiana state parks (Indiana Karst Conservancy Website 2010; Lindberg 2008). Overall, Don Ingle best summarized the Conservancy's motivation when stating, "There were a lot of things that happened in the past that were just from ignorance and people not really knowing that what they were doing was really impacting their own drinking water...we are kind of trying to recruit and educate people to become responsible cavers so those resources can be protected" (form Lindberg 2008, p 13).

Two other efforts at educating the public should be mentioned. Through the *Gone Caving* event, Spring Mill State Park takes the public on wild cave tours, demonstrates cave rescues, and teaches about cave biota and karst geology (Spring Mill State Park Website 2010). Project Underground material is commonly utilized, however, the central focus of this event is exploring caves and cave science rather than karst environments as a whole (Ingle, personal communication, 2010). The second endeavor is the annual Indiana Bat Festival undertaken by the Center for North American Bat Research and Conservation of Indiana State University. While previous years have concentrated on educating the public about cave biology and hydrology (Ingle, personal communication, 2010), the dominate focus of the 2010 Festival was White Nose Syndrome because of the rising threat of the deadly disease to bat populations in the United States (ISU Indiana Bat Festival 2010). Additionally, as more adults begin to attend the event, aspects of entire karst landscapes, are increasingly being incorporated into the Festivals' activities. Members of the Indiana Karst Conservancy also participate in the event (Ingle, personal communication, 2010).

Michigan

The distribution of karst landscapes in the state of Michigan is minimal when compared to the southeastern United States, and sinkholes are the primary karst feature in the region (Acerboni, personal communication, 2010). However, the Michigan Karst Conservancy is contributing to karst education through two managed properties: Fiborn Karst Preserve and Stevens Twin Sinks Preserve (Luckins 2008). At these facilities free interpretative trails with kiosks featuring multiple karst features are open to the public. Cave tours for the public are also lead by the Conservancy, and free talks are offered at a variety of public venues (Golden, personal communication, 2010). The group also produces the bi-annual publication, *Michigan Karst*, which describes pertinent information related to the State's karst. Approximately 200 copies of each issue are distributed to Conservancy members and other interested persons (Luckins 2008).

For three consecutive years the Monroe Conservation District has lead the Monroe-Lenawee Groundwater Stewardship Program, which boasted a karst education initiative centered on dye trace demonstrations, well water testing and education, and the production of karst posters. The District also utilizes a unique, interactive *EnviroScape* model complete with a farm, construction site, factory, sewage treatment plant, logging site, golf course, and roads to educate about karst aquifer pollution (Harper, personal communication, 2010).

Minnesota

Minnesota's Sharing Environmental Education Knowledge program (SEEK), directed by the state's Pollution Control Agency, offers a "learning trunk" for karst education. Educational materials included in the trunk are very similar to those in the Missouri Department of Conservation's *Discovery Trunk*s but with added items such as a 3-D karst model, geological maps, and slideshows for middle school students (SEEK, undated website). The Agency was also recently awarded $22,000 for a Karst Education Project centered on four two-day workshops designed to enhance the understanding of local officials, educators, and citizens with regards to the vulnerability of karst groundwater resources. Half-day fieldtrips to karst features as well as sites where karst problems exist were included at each workshop (US Environmental Protection Agency 2010). A printable karst poster titled, *Karst: A Complex Landscape Sculpted by Water,* is available on their website (Minnesota Pollution Control Agency 2010).

Eagle Bluff Learning Center uses karst features on its property to help students evaluate real-life karst environmental issues and understand how humans impact these fragile landscapes (Eagle Bluff Environmental Learning Center 2008a). Moreover, teachers are provided with pre-visit activities, which allow students to become familiar with the karst terminology they hear during the course, and two post-visit activities ("seepy sandwich" which illustrates pollutant movement through karst and a karst mountain where students witness karst formation over time) to solidify karst concepts (Eagle Bluff Environmental Learning Center 2008b; Eagle Bluff Environmental Learning Center 2008c). As the learning theories described in Chapter 2 suggest, these pre- and post-activities are important for maximizing learning at the center.

Twin Cities Public Television aired a program titled *Spelunking* on their *Newton's Apple* series to highlight the physical features of caves and archaeological artifacts found within them. The station's website offers an accompanying guide to the program which characterizes cave and karst environments through hands-on activities and thought questions about limestone dissolution (Twin Cities Public Television, undated website).

Missouri

Both state and federal agencies are instrumental in providing karst educational materials in Missouri. In 2003, the Missouri Department of Conservation funded the production of *A Guide to Missouri's Cave Life*, in which Missouri cave species are individually described and illustrated (Elliot 2003). An electronic version of this document is available for free download on the Department's website, increasing the longevity with which this document can serve as an educational karst tool. The Department also offers a free subscription to the monthly publication, *Missouri Conservationist*, which features reports on a wide variety of environmental topics including karst and caves. In fact, a search of this publication's archives reveals 23 reports on karst related stories, while a search for "cave" uncovers approximately 100 different articles, yet many of these reports are specifically related to cave biology, cave cleanups, historical use of Missouri's caves, or parks and educational centers where caves are located. These "cave" articles fail to focus on karst science and provide readers with a holistic understanding of the sensitivity of karst. Examples of these archived articles include, *Karst Groundwater, Below Missouri Karst, Missouri the "Spring State," Conserving an Ozark Cave, Missouri Cave Life,* and *Conservation goes Underground* (Missouri Conservationist 2010).

The US Environmental Protection Agency helped the Missouri Department of Conservation to develop *Discovery Trunk*s for schools. These trunks are available for loan at no cost (Carden-Jessen, personal communication, 2010). Two of the twelve trunks offered are directly related to karst environments: *Bat Mini-Trunk* and *Caves and Karst Trunk*. These trunks may come equipped with puppets, audio tapes containing bat sounds, books, lesson plans, hands-on activities, videos, rock samples, and pictorial resources designed to introduce students to cave life and the increased sensitivity of groundwater in karst environments (Missouri Department of Conservation 2010). A variety of multiday educational workshops have also been hosted by the Department with topics including cave ecology, cave management, and karst watersheds (Missouri Conservationist 2010; Carden-Jessen, personal communication, 2010).

The final state agency involved in karst education is the Department of Natural Resources who provide pamphlets on karst and its associated features (particularly caves, springs, and sinkholes), the quantification of each of the karst features located in the State, and PDFs of scientific publications (Missouri Department of Natural Resources 2010a). This department produces the *Missouri Resources Magazine,* which reports on karst matters, and makes it available free of charge to subscribing Missouri households three times a year. Out of state persons can receive a copy of this magazine for a minimal $4.50 annually, further increasing the potential for this magazine to have positive impacts on karst understanding (Missouri Department of Natural Resources 2010b).

Caving groups such as the Springfield Plateau Grotto and the Kansas City Area Grotto of the NSS offer web-based information on cave formation, the importance of cave management and restoration, and methods for reversing cave degradation. The former group produced a free 20-page electronic guide, *Caring for Your Karst: A Guide for Landowners in the Ozarks,* to explain karst and its associated features, how to minimize karst aquifer pollution, and cave biota. The document concludes with a glossary of scientific karst terminology (Springfield Plateau Grotto, undated).

Texas

Organizations in Texas who aim to improve the public's knowledge of karst include the Texas Cave Management Association (TCMA), the Texas Speleological Society (TSS), and the Texas Parks and Wildlife Department. For instance, theTCMA restore and improve the educational value of local karst parks, such as Robber Baron Preserve (Mitchell 2008; Jenkins and Russell 2005, 2009), and offer educational presentations and cave tours to 6^{th}, 7^{th}, and 8^{th} graders throughout the year and to the general public during their annual cave festival (Jenkins 2008). The Texas Parks and Wildlife Department promote education, yet efforts are mainly concentrated on cave science and biology, not karst as a holistic system. For instance, their webcast *Deep in the Karst of Texas* primarily concerns the development cave formations, human use and biota of caves, with only a short segment featuring the connections of subsurface and surface 'karst systems.' The activities which accompany this webcast are also largely concerned with caves, not whole karst systems (Texas Parks and Wildlife 2010). Nonetheless, this webcast is an entertaining program that serves as a useful guide for the United States. The Department's outdoor magazine also frequently publishes papers on Texan karst, with examples including *When the Earth Opens* (Graves 2008), *Saving Land, Saving Water* (Holtcamp 2010), *Aquatic Islands in a Sea of Land* (Holtcamp 2005) which brings to light the importance of karst springs, and *Karst, Caves and Cavers* (Nadler-Olenick 2009).

Wisconsin

In collaboration with the University of Wisconsin, the Rock River Coalition Inc. produced an educational pamphlet on limestone, sinkholes, and groundwater contamination entitled "Karst: Avoid the Sinking Feeling," (Rock River Coalition, 2010). The pamphlet, which is primarily aimed at educating homeowners, also includes best management practices for preventing karst groundwater pollution (Santry, personal communication, 2010). An electronic copy of the document is available on various Wisconsin government websites and is distributed by the Wisconsin Department of Agriculture, Department of

Natural Resources Conservation, and county-level Land and Water Conservation Departments. Administrative offices in three Wisconsin counties are working on improving the groundwater booklet and getting hard copies published for dissemination (Santry, personal communication, 2010).

Overall, groundwater contamination levels between karst and non-karst areas are starkly different in Wisconsin (Santry, personal communication, 2010). As a result, the Wisconsin Water Conservation Department regularly hosts workshops and individually visits farmers and manure hauler operators in the State's karst areas. These efforts are to educate these groups on manure and fertilizer application that consider the health of the environment, how to identify karst features, and the regulatory and voluntary setback policies for these features. Similarly, homeowners with septic systems and/or groundwater wells in these areas are visited to provide information about homeowner options if contaminated water is discovered in wells. State officials explain to these individuals why the karst areas are vulnerable to contamination, the importance of testing for bacteria and nitrates in well water, and maintaining septic systems (Santry, personal communication, 2010).

Virginia

Virginia's Department of Conservation and Recreation (VDOCR) established the program, *Virginia Natural Heritage Karst Program for Cave and Karst Protection,* which is sponsored by EPA Section 319, Clean Water Act

Program. The aim is to sponsor, develop, and distribute programs and materials encouraging the protection and conservation of Virginia's karst, particularly groundwater and cave habitats. As part of the program an informative and educationally-rich website was developed and includes various materials such as two detailed PowerPoint presentations, *The World Beneath Our Feet* and *Introduction to Virginia's Karst.* Karst watershed factsheets are also provided for various catchments within the state. In an effort to raise awareness of the deadly White-Nose Syndrome, a fungal disease affecting bat species throughout the United States, extensive material related to Virginia bat species and populations, as well as links to additional bat resources and a downloadable brochure on Virginia's bats are provided (VDOCR Karst Program Website 2010).

The Virginia Cave Board is a twelve member collegial body of the Virginia Department of Conservation and Recreation established to "conserve and protect caves and karstlands of the Commonwealth and advocate the wise use of these resources" (Virginia Cave Board 2010). Board members advise private individuals, organizations, and agencies on cave and karst matters, prepare and present educational materials, identify "significant" caves, and make recommendations on cave resource conservation and preservation. Since its conception in 1979, members of the Virginia Cave Board have undertaken several educational projects on karst matters. These include: a speleological museum exhibit *Buried Treasurers: Caves of the Virginias*; *Living with Sinkholes* brochure on sinkhole function and sinkhole drainage protection; cave conservation poster *In Karstlands…What Goes Down Must Come Up* for nearly 1,000 9th grade earth science teachers; and *Virginia Cave Owner's Newsletter* which is distributed to over 1,500 Virginia cave owners. Virginia Cave Board members have also provided interpretation guidance to show cave owners, managers, and tour guides (Kastning, undated). Finally, the Board sponsors the annual *Virginia Cave Week* celebration to promote an understanding of Virginia's karst and caves (The Recorder 2010a) and encourages educators to use in-class activities and visit a commercial cave (Virginia Cave Week 2010). During the function, Virginia show caves commonly offer discounts to visitors to help spur visitation (The Recorder 2010). Educational resources are provided on the Virginia Cave Week website year round.

The Cave Conservancy of the Virginias developed *Living on Karst: A Reference Guide for Landowners in Limestone Regions* with the editorial help of Virginia Department of Conservation Natural Heritage Program Karst Education Coordinator Carol Zokaites (Cave Conservancy of the Virginias Website 2010). This free guidebook outlines sinkhole management, erosion control, reducing runoff pollution in karst areas, septic system use in karst regions, and tips for cave landowners (Zokaites 1999).

Virginia Naturally, a partnership of businesses, organizations, natural resource agencies, and environmental education programs, is the official environmental education program of the State (Zokaites 2007; Virginia Naturally 2010). This program facilitates training in environmental education, funds the production of teaching resources such as the web based V*irginia's Natural Resources Education Guide: Information, Activities, and Resources for Elementary Teachers* which has an average of 1,200 copies downloaded and printed monthly (Virginia Naturally Website 2010), and offered over $500,000 in funding for promoting outdoor experiences for students.

Virginia Chesapeake Bay Education grants and Virginia Naturally provide week-long workshops for teachers complete with fieldtrips to karst spring, sinkholes, and caves. These are designed to facilitate educational experiences on interactions between the surface and groundwater in karst regions and the importance of protecting karst aquifers (Zokaites 2007, Virginia Department of Environmental Quality Website 2010).

Combining the efforts of VDOCR karst and Virginia Naturally programs, karst science is introduced into the statewide educational system of Virginia (Zokaites 2007). Rather than introducing completely new educational standards to the established curriculum, VDOCR integrated karst science into already existing standards by using karst topics such as cave habitats and karst hydrology to teach students more generalized science concepts. For example, karst topography is integrated into the pre-existing earth science standard, while lectures on cave biota are used to introduce students to rare and endangered species. Table 4.1 illustrates an example of how the Virginia earth science standard incorporates karst into its curriculum. These standards on karst topography and groundwater are largely taught with the help of *Project Underground* activities (Zokaites 2007).

Table 4.1: Virginia Karst Education Standard Example. Table recreated from Zokaites (2007).

The student will investigate and understand how freshwater resources are influenced by geologic processes and the activities of humans.	
(a)	Processes of soil development
(b)	Development of karst topography
(c)	Identification of groundwater zones
(d)	Identification of other sources of fresh water including rivers, spring, and aquifers
(e)	Dependence on freshwater resources and the effects of human usage on water quality
(f)	Identification of the major watershed systems in Virginia including the Chesapeake Bay and its tributaries[1]

[1]The Chesapeake Bay is commonly identified as a topic to introduce students to karst concepts since the headwaters of many rivers running into the Bay are in karst regions.

National Karst Education Efforts Abroad

European Core

The countries that make up the European Core include the United Kingdom (England, Scotland, and Wales), Republic of Ireland, France, Germany, Belgium, Netherlands, Switzerland, and Austria. Appendix B provides information on the countries from this region which are not discussed below.

England

England alone provides the most karst-related educational endeavors in the United Kingdom. *Natural England* is a grant-funded independent government advisory agency striving to protect and improve England's natural environment and encourage environmental involvement. Karst is continually included on various web-based educational materials, signs in natural areas, public talks and guided tours, and in published brochures. Contributors to their website provide educational resources to the Country's farmers, land managers, researchers, teachers, and students. Threats to karst landscapes are also covered throughout these materials (Natural England 2010). The organization's 8-volume set *Countryside Character* educates the public on the major geologic areas/features of England and Wales. Karst landscapes are included in these volumes and reviews human influences to karst, modern-day changes, and future considerations for minimizing harmful impacts and changes (Natural England Countryside Commission 2003).

The British Geological Survey offers multiple educational resources for teachers and students on their website, but as of yet there are no resources related to karst (Cooper, personal communication, 2010), highlighting a lack of concern for education about karst. In fact, karst is only discussed through the Survey's 'interactive guides to landscapes.' For instance, in addition to describing the biodiversity, minerals, and human impacts, a set of webpage guides on the karst of the Mendip Hills describes solution cave formation, sinkhole formation and importance, and karst hydrogeology (British Geological Survey Foundations of the Mendips). Guidebooks for managing karst subsidence and understanding pollution prevention are also available (Cooper 2006; Cooper, personal communication, 2010). Overall, the United Kingdom karst educational efforts for the general public can be described as minimal compared to other international locations such as Australia despite vast amounts of karst terrain. Furthermore, while school geography classes teach a small section on karst, the material is limited to basic cave geology. Only students who choose to study geology or physical geography as a specialty typically learn about karst, and educational signs are only present at sites such as Cheddar Gorge that have high rates of foreign tourists (Wilton-Jones, personal communication, 2010).

Austria

Most karst education activities uncovered in Austria are pursued by the VÖH (Austrian Speleological Association), which is comparable to the National Speleological Society of the United States (Austrian Speleological Association 2010), and the Natural History Museum of Vienna, which boasts the only Cave and Karst Museum Department found during this research. For example, as well as offering extensive training for cavers and expedition leaders through one-week courses and publications, the Society also hosts multi-day seminars concerning cave and karst science topics each year. Monthly talks are commonly given to the general public and fellow cavers by the caving clubs of the Society. Lastly, the VÖH typically publishes two reports each year on karst that are occasionally directed toward the general public (Austrian Speleological Association 2010; Plan, personal communication, 2010).

The result of the efforts of the Natural History Museum of Vienna Karst Department is a recently opened cave and karst exhibition, *Caves: Landscapes without Light*. The 3-room exhibit will remain in the Museum for two years and includes guided tours for interested parties. It is designed to educate people on all aspects of cave and karst science, including but not limited to groundwater sensitivity, cave biota, and cave and karst formation. The exhibit also features a speleological trail with hundreds of items related to cave and karst environments such as cave biota and rock samples. Talks on various caves and karst topics will be hosted each month for the duration of the exhibit. A series of short videos also allows visitors to explore 28 different caves in Austria (Plan, personal communication, 2010; Pavuza, personal communication, 2010). Overall, this exhibit appears to be unique among karst education products around the world.

European Community

In 2009 the European Landscape Convention commissioned Education on Landscape for Children to "Consider landscape as heritage, the spreading of a wider knowledge on landscapes and on landscape change processes, as well as improving landscape reading abilities," (Castiglioni 2009, p 3). An assumption of the program is that children will become better stewards of the environment and spread the learned information to adults until material for adults is developed (Castiglioni 2009). As illustrated by the inclusion of the *3KL – Karstic Cultural Landscape* project led by the Montebelluna Museum of National History and

Archaeology and research centers and schools in France and Slovenia, karst terrains are considered an important landscape children should be exposed to. This project, which aims to "provide innovative contents, both from the scientific and the educational profile, in the study and interpretation of the evolution of fragile karst eco-system and of their relationship with human settlements," (Castiglioni 2009, p 34)," is deemed a successful example of landscape learning in the reports of the Convention.

Western Mediterranean Nations

Spain, Portugal, Italy, Malta, Greece, Macedonia, and Cyprus comprise the countries in this grouping. Again, karst educational efforts of those countries not included in the below discussion are presented in Appendix B.

Spain

Karst-specific educational material is available from the Geological and Mineral Institute of Spain and the Ministry of Environment and Marine Affairs. The most noteworthy karst education pursuits came from the latter via the National Center for Environmental Education (CENEAM). This Center prepares free newsletters, develops environmental interpretation material, offers educational courses, hosts seminars, and develops exhibitions for use throughout the Country (CENEAM 2008). A search of their database does reveal that holistic reviews of basic cave and karst science are central topics to multiple endeavors.

The Balkans

In Greece, many of the Country's fourteen caving clubs organize cave tours for schools and the general public in an effort to make the people appreciate the "underground beauty and learn some basic things about the formation of caves, cave biology, and cave and karst protection and sensitivity" (Despiniadis, personal communication, 2010). Some of these groups host public cave photography exhibitions, while others publish cave comics and activity books for children.

In contrast, many Macedonian caving clubs are new and because of their budgets, provide limited karst education materials. Generally, only public lectures and debates have been prepared as part of their larger education projects. Some information on caving activities is disseminated into local and national media, yet Macedonians first receive information about caves and karst in primary school geography classes and cave excursions organized by geography teachers with cavers (Temovski, personal communication, 2010).

Italy

Caving clubs are the primary source of karst-specific educational material in Italy. For instance, Gruppo Speleo-Alpinistico Cinghiali and Gruppo Speleologico Piemontese both pursue a *Caving in School* project, which aims to raise awareness about the vulnerability of caves and underground water. Activities associated with the on-going project include classroom lectures and hikes through caves and across karst landscapes. Topics covered during lectures and while touring cave and karst environments include the science of karst systems, biospeleology, speleothem formation, and geographical distribution of karst features (Gruppo Speleologico Piemontese 2010). Both groups offer karst educational materials on their websites.

Eastern Europe

Eastern Europe consisted of Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Slovenia, Croatia, Bosnia and Herzegovina, and Albania. See Appendix B for any educational information not included below.

<u>Albania and Slovenia</u>

Karst covers approximately 25 percent of Albania, while an estimated 43 percent of Slovenia is considered karst. In fact, the word 'karst' originated in Slovenia, yet no education efforts could be uncovered in either of these countries outside of efforts pursued at federally-owned parks and show caves. However, investigations into karst education in these regions during this study are considered to be *inconclusive*. For both Albania and Slovenia, the inability to investigate the speleological clubs of the two countries due to inactive websites and inaccurate contact information for group members significantly hindered the accurate assessment of karst education endeavors by these organizations.

In Albania, contact with the Bulgarian-Albanian Speleological Society or Albanian Speleological Society, which would likely be sources of karst-specific educational materials was unsuccessful. The websites for both the Albania Geological Survey and Slovenia Geological Survey were under construction at the time of data collection, so educational material offered through these agencies could not be reviewed and repeated attempts to contact the facilities via telephone or email were unsuccessful.

The Slovenia Ministry of the Environment and Spatial Planning stated educational bulletins and publications are regularly made available to the general public, yet the content of most of these documents could not be reviewed, and those that could be reviewed were not related to karst or cave environments. Overall, the Ministry of Environment and Spatial Planning report an "insufficient capacity" to promote cave and karst education through their agency, although periodic newsletters produced by the agency do attempt to educate of caves and karst (Bajraktari, personal communication, 2010).

Slovakia

The Slovak Caves Administration is the primary source of educational karst material for the general public in Slovakia, while the Slovak Speleological Society (Slovenska Speleologicka Spolocnost) is the predominant source of educational material for avid cavers and karst scientists. The Slovak Caves Administration, an organization that is part of the Ministry of the Environment of the Slovak

Republic, works to protect, operate, and develop caves and karst landscapes for public use. The Administration is also responsible for the "preparation of expositions, permanent exhibitions, and education boards in cave visitor centers, preparation of educational trails…and the publishing of Aragonit magazine and publications of show caves" (Slovak Caves Administration 2010) and is therefore discussed in more detail in Chapter 5. Aside from promoting education through show caves, the Slovak Caves Administration (SCA) regularly host lectures on caves and karst and "Speleological Evenings" at the Slovak Museum of Nature Protection and Caving. Additionally, *Let's Protect Our Underground Gems* is a 15-minute film co-produced by the SCA, illustrating the function, types, and natural and cultural values of caves. The SCA are also co-producers of the half-hour long documentaries *Bats – Mysterious Dwellers of Caves* and *Hidden Life in the Slovak Caves*. Lastly, in 1997 the SCA created a free karst coloring book for youth. The document is still available for use (Slovak Caves Administration 2010).

Romania

No educational opportunities that are directed towards the general public through the Romania Speleology Karstology Society or Romanian Federation of Speleology were available at the time of data collection. However, several alternate organizations in the Country reported karst-specific educational endeavors for the general public including the Grupul de Explorari Subacvatice si Speologice (GESS), local caving grottos, and the Arad Regional Environmental

Center (CZEA). For instance, GESS is a non-governmental organization (NGO) which educates about karst landscapes and aquatic systems through the production of a wide variety of films, books, photo exhibitions, and presentations (GESS 2010), while a caving club near Scarisoara Ice Cave has organized multiple presentations about karst and caving for local citizens in cooperation with the Alba County`s Department for Youth (Ciubotarescu, personal communication, 2010). The CZEA lists speleology as a subcategory of their environmental education initiatives and offer presentations at schools and area attractions such as museums. The focus of these presentations is to introduce viewers to karst environments and how human impacts to these environments can be minimized (Arad Regional Environmental Center 2010).

Lastly, the Center for Protected Areas and Sustainable Development developed the project *Nature for People* to help raise awareness and acceptance of some of Romania's natural areas. Karst is one of two "thematic tracks" pursued under this project. As a result, interpretive panels and interactive exhibits concentrating on karst environments are placed along hiking routes throughout Romania's karst plateaus and gorges. More recently cave biodiversity education was also incorporated into the Project's goals (Center for Protected Areas and Sustainable Development 2010; Lucaciu, personal communication, 2010). Educational components to the cave biodiversity initiative include hosting seminars and workshops for local citizens, developing related lesson plans, and training area teachers about karst, cave biota, and conservation strategies.

Africa

Comparatively, the African region has minimal highly karstified areas. Thus, no karst education efforts are pursued by most African nations. Additionally, all educational efforts uncovered in Morocco, Nigeria, Madagascar, and Algeria which relate to karst specifically dealt with cave archaeology, rather than geologic systems or the diversity of karst environments.

South Africa

The South African Speleological Association and Cape Peninsula Speleological Society of South Africa did not respond to requests for data about their karst education efforts. Nonetheless, Mike Buchanan of the Cave Research Organization of South Africa (CROSA) and International Union of Conservation Nations, South Africa Country Office, maintains an informative blog which consistently discusses recent scientific studies of karst, human-induced threats to karst, ways for preventing and correcting karst pollution, and the importance of these terrains. The Karst Working Group, which is a collaboration of personnel from the CROSA and International Union of Conservation Nations - South Africa Country Office, developed and promoted school-based education programs concerning cave biota, cave and karst resource management strategies, and a code of conduct booklet for farmers and landowners which concentrates on karst and the inherent value of caves (Buchanan, personal communication, 2010).

Tunisia

In Tunisia the primary source of karst knowledge is Zaghouan-Tunisia Caving Club. Access to caves is primarily a privilege of a small number of people in this region, thus, the Club organizes tourist trips to raise awareness and educate the public about the importance of the region's karst. Specifically, during tours trip leaders discuss the local geology and its impact on the formation of caves, various modes of cave formation, equipment and techniques used by cavers, the need to protect cave fauna, the socio-economic importance of the underground environment (history, archeology, water resources and tourism), importance of karst environments, and means to promote preservation. These activities are aimed at people of all ages and all levels of cultural or scientific backgrounds. A great deal of this information is made available on posters distributed to local schools (Meher, personal communication, 2010). This organization regularly presents information about caves and karst to the general public at environmental events and is currently working on the production of a documentary film shot designed to explain the formation of caves, building of cave formations, and techniques for preventing cave and karst environments contamination (Meher, personal communication, 2010).

Asia (East/Southeast)

On the whole, research into the karst-specific informal education pursuits in the Asia region is inconclusive. Uncovering these opportunities through internet search engines were hindered due to language barriers which could not be overcome by the use of translational services. In addition, email addresses could not be found for many of the organizations located in the region, and when email addresses were tracked down, attempts to contact the groups proved unsuccessful due to erroneous email addresses or a simple lack of response. A shortage of functional telephone numbers and/or language barriers further prevented successful telephone communication.

Oceania

This region covers most of the South Pacific where many coral atolls are either entirely karst or bordered by uplifted coral reefs (for example Fiji and Vanuatu). Yet, the only nations in this region that have any karst educational efforts are Australia and New Zealand.

<u>Australia</u>

The New South Wales Department of Environment, Climate Change and Water is responsible for managing over 40 distinct karst areas, including four karst conservation reserves and fifteen sites on World Heritage sites. This department offers many interesting educational products, some of which are described in Appendix B. The Karst and Geodiversity Unit of this agency maintains interpretative karst materials, such as educational boards and brochures at four regional parks: Abercrombie, Wombeyan, Jenolan, and

Borenore Karst Conservation Reserves. The NSW Department of Environment, Climate Change, and Water also produces *geoLogic* resources, which are short, interpretive reviews of each of the region's diverse environments (karst landscapes included). The karst *geoLogic* contains chapters titled "Karst Environments: More than caves and pretty rocks," "Karst forming and development processes," and "Living on Karst," amongst others. Through these documents readers are introduced to the distribution and importance of karst terrains, specialized nature of karst rocks, importance of the unique plants and animals in karst areas, micro-organisms living in caves, and how to be a good steward of karst (NSW 2008).

The Newcastle and Hunter Valley Speleological Society scouting groups in New South Wales take youth members, their parents, and group leaders through a wide variety of caving courses. These must be taken in sequence with each building on the previous course as the participant gains knowledge and expertise. Although the central theme of these courses is caving and rock climbing technique, participants are introduced to basic cave and karst science and the importance of cave conservation during courses. For instance, a badly degraded karst area in Timor is regularly used to not only teach about skills of safely navigating small spaces within the region's caves, but also to teach about limestone caves and speleothems, and allow participants to see damaged areas firsthand to enhance their understanding of the need for protection (Smith, personal communication, 2010).

Both the Western Australia Speleological Group and Australian Cave and Karst Management Association maintain informative websites rich with cave biota material. However, the bulk of their information concentrates on working with local regulatory agencies to establish cave conservation areas rather than trying to educate the general public. In contrast, the primary objectives of the Mole Creek Caving Club of Tasmania are fostering good relations with landowners, promoting safe and ethical caving, and nurturing knowledge exchange between caving clubs, management agencies, and, most importantly, the general public. The latter of these objectives is achieved through school presentations, educational wild cave tours, an educational website, participating at local environmental activities, and writing karst articles in local newspapers and tourism publications (Lichon, personal communication, 2010). The group also conducts several cave and karst education activities during the biennial Jackeys Marsh Forest Festival (Hunter, personal communication, 2010).

CaveWorks Eco Center and Research Laboratory is a unique interpretative visitor center in the Margaret River region of Australia. The center specializes in introducing visitors to caves, karst and ecology of the area. The facility features educational displays and poster boards, interactive models of caves, life-like cave models, and replicas of cave formations. Children can also experience crawling through a cave. All aspects of caves and karst, including the importance and sensitivity of these environments, karst hydrology, cave biology, distribution of karst, and cave and karst exploration and research are presented at the Center (CaveWorks Eco Center and Research Laboratory 2010).

New Zealand

In New Zealand, the Department of Conservation hosts a *Karst, Conservation, and Catchment* event, which allows participants to be lead on a countryside tour of secluded land areas near the headwaters of Waitomo Stream. Participants are provided with educational handouts to follow during the excursion across the karst landscape (New Zealand Department of Conservation 2010). The Department has also established free trail excursion areas through the Country's highly karstified environments, such as Waipu Caves Walk and Waro Limestone Scenic Reserve Walk. Interpretative signs are available along the trail paths. The Canterbury Caving Club works closely with the Department to ensure appropriate usage of cave and karst terminology and provide photographs for use on signs at local caves (Alice Shanks, personal communication, 2010).

The Waitomo Caves Discovery Centre has several educational opportunities available for the general public and an educational facility designed for school children: 1) exhibits on caves, karst, and Waitomo; 2) collections of items and fossils found in the area's caves and karst; 3) educational postcards and brochures; and 4) collections of theses and cave related scientific journal articles that can be reviewed by the general public who join the Centre's library

(Yapp, personal communication, 2010). Caves and cave biota are the primary focuses of this material, yet the sensitivity and interconnectedness of karst terrains are also reviewed.

Canada

The Geological Survey of Canada maintains a wide array of educational resources including virtual fieldtrips to popular Canadian sites, downloadable activities for children, lectures, maps, videos, and classroom posters. Although many of these resources focus on geological processes and formations instead of karst, karst is discussed in a select number of these outreach opportunities. In addition, through the *Innovators in the Schools, Rent a Scientist, and Calgary Science Hotline* programs, a geology expert can be scheduled to come and speak about geology topics (including karst) in Nova Scotia, British Columbia, Ottawa, and Ontario (Viau, personal communication, 2010; Geological Survey of Canada 2010). Please see Appendix B for additional karst education conducted by the Geological Survey of Canada.

The Canadian Cave and Karst Information Server offers an easy-to-access collection of resources and weblinks to Canada's agencies, conservancies, and grottos focused on cave and karst management, conservation, and exploration. For instance, a complete list of terms associated with karst terrains, descriptions and graphics about karst and how karst systems function, files containing appropriate laws and codes, human influence on these terrains, and karst-specific scientific articles and reports are all accessible for free on the server. A wide variety of karst photos are also on the site (Canadian Cave and Karst Information Server 2009). A karst management handbook, which was originally produced by the British Columbia Ministry of Forests and Range, is also accessible free of charge through the group. This unique server is the only one of its kind uncovered during this research.

Another organization promoting education is the Friends of the Eramosa Karst which is citizen-based group working to promote the preservation of Emamosa karst lands near Hamilton, Ontario. Their goal is to educate the provincial government, the City of Hamilton, developers, and the general public about the importance of karst terrains in an effort to convince them of the necessity to protect the region's karst lands from further development. The group has developed a UTube video about Eramosa karst, created and mapped Ontario karst regions, and written scientific reports in a variety of journals and newspapers. They have also published Eramosa karst factsheets and short statements on the importance of karst and its vulnerability to degradation (Friends of the Eramosa Karst 2010).

Central and South America

Archival research and personal communications revealed informal karst education is only available in one South American country: Brazil. The Brazilian Society of Speleology produces a free electronic bulletin, which is aimed at the general public and beginning cavers to provide the latest news and other educational blurbs related to speleology and the karst environment. The group also leads educational caving trips (Brazilian Society of Speleology 2010).

In Central America applicable educational efforts were not found in any country despite this region's abundant karst. However, attempts to contact eight Mexico-based speleology organizations were unsuccessful. As such, multiple potential sources for informal karst education could not be investigated.

The Caribbean

Despite the increased sensitivity of Caribbean karst to degradation, a search for karst-specific informal education in the Caribbean region only uncovered three countries involved in this endeavor: the Dominican Republic, Puerto Rico, and Jamaica. Although a relatively new organization, the Dominican Republic Speleological Society routinely leads educational cave tours discussing the local karst environment and why it is important to preserve this landscape. The group also attempts to participate in every environmental conservation event to spread conservation messages (Dominican Republic Speleological Society 2010), and pays for space in a local newspaper to publish articles on cave formation and care, the importance of protecting karst groundwater supplies, and ways to prevent groundwater pollution, among many other topics. They were also recently approved for participation in a local television program which will have an exclusive section on caves and their protection (Pittaro, personal communication, 2010).

In Puerto Rico the North Study Speleological Society gives talks about caves, karst, and underground habitats to interested elementary and intermediate schools. Karst informational brochures are distributed to any public institutions who desire such materials. Members of the organization also lead karst fieldtrips to discuss the importance of the terrain for Puerto Rico, cave development, and cave care (Carrión, personal communication, 2010).

The Federación Espeleológica de Puerto Rico is highly active in educating cavers and local government officials, while also promoting karst research in the area, through presentations at local venues and participation in government meetings. However, education geared towards the general public is lacking by the group (Federación Espeleológica de Puerto Rico 2010).

The Jamaican Caves Organization regularly conducts what they call "outreach sessions." After a day caving the group travels to the nearest friendly shop or bar for relaxation and encourages locals to watch cave videos and discuss the importance of caves to the environment and water supplies. They review how caves and springs are used as dumps and use videos and photos of trash in cave entrances and sinkholes to illustrate discussion points. They also talk about the role bats play in seed dispersal, pest control, and pollination. This typically continues for over an hour, but sometimes much longer. The group is adamant about staying until all participants' curiosity and questions are addressed. As stated by the chair of the organization, "This might sound a little frivolous, but it's actually a technique that works quite well in Jamaica. We've done this many, many times, and educated literally thousands of people in the course of it. What makes it so effective is that we're not lecturing people, we're hanging out with them as equals, using language they understand, and as a result, they listen very closely," (Stefan, personal communication, 2010).

Middle East and Central Asia

Most countries of the Middle East do not attempt to educate the public on karst. For instance, although two caving organizations exist in Pakistan, the Chiltan Adventures Association and the Pakistan Cave Research Federation, neither reported any education efforts for the general public at the time of data collection (Durrani, personal communication, 2010). Attempts to contact the Turkey Cave Research Association were unsuccessful, while the Turkish Cavers Union reported no educational efforts (Yamac, personal communication, 2010). Contact with the Geological Agency of Turkey was unsuccessful, but no karst educational material was revealed on their website. Of the ten caving clubs found in Turkey, none revealed any support of karst education for the general public. This is likely attributable to the infancy of most of these organizations.

The only significant educational effort in the region is pursued by the Lebanese Association of Speleological Studies. This group frequently works with local media venues (newspapers, television, radio) to produce and release documentaries and other publications in order to popularize karst and cave knowledge, participates in local exhibitions, frequently trains public authorities on karst preservation and conservation, and offers cave expeditions for tourists. Lastly, in 2006, the group launched the “Say, What’s a Cave” Initiative to introduce children aged 5 to 13 to the importance and wonder of cave environments (Stephan, personal communication, 2010).

Russia and the former Soviet States

Karst-specific education efforts uncovered in Russia and nearby countries for the general public were minimal. Twelve countries were classified under this sub-heading for the purposes of this research: Kazakhstan, Uzbekistan, Turkmenistan, Kyrgyzstan, Tajikistan, Georgia, Armenia, Russia, Belarus, and Ukraine. Similar to the conclusions reached regarding current karst education pursuits in Slovenia and Albania, no education efforts could be uncovered in Ukraine. However, for the purposes of this research, investigations into the karst efforts in the region are considered inconclusive. The inability to investigate the speleological clubs of this Country due to a lack of active websites for many of local organizations significantly hindered the accurate assessment of karst education endeavors in the Country. Furthermore, inaccurate contact information for members of the many of the aforementioned organizations prevented the pursuit of data via email or telephone communication. Thus, the presence of karst education endeavors for the general public could not be accurately determined, although it is clear that no karst education efforts are currently being pursued through the Association of Ukrainian Geologists.

Status of Karst Education: A Closer Look

Differences in the quality of data collected via the varying techniques utilized during this research (email, phone, and face-to-face interview) were not noted and therefore, the educational efforts discussed within this Chapter were analyzed collectively, regardless of the data collected used to gather information about the effort. Furthermore, multiple techniques were frequently used to gather information about the same educational resource.

There is a wide variety of categories of karst educational pursuits uncovered during this research (see Figures 4.1 and 4.2), yet no significant differences between these educational categories exist and therefore they were not analyzed in-depth. For adult learners internationally and in the United States publications such as brochures and pamphlets were the most frequently uncovered educational technique utilized to promote the significance and importance of karst terrains (Figure 4.1). After brochures, websites, public educational talks, and exhibits/signs are the next most common educational techniques worldwide. In the United States, videos are a favored tool while cave tours focus more heavily on concepts of karst, not simply cave environments as is the case in the United States. Regardless of locate, karst education for children are abundant and focus on activities and tool for teachers such as teacher workshops about karst and caves and in-class teaching resources such as lesson plans and activity guides. Web-based educational activities for children occur only in the United States, while specialized educational cave tours for children are in abundance in both the United States and internationally.

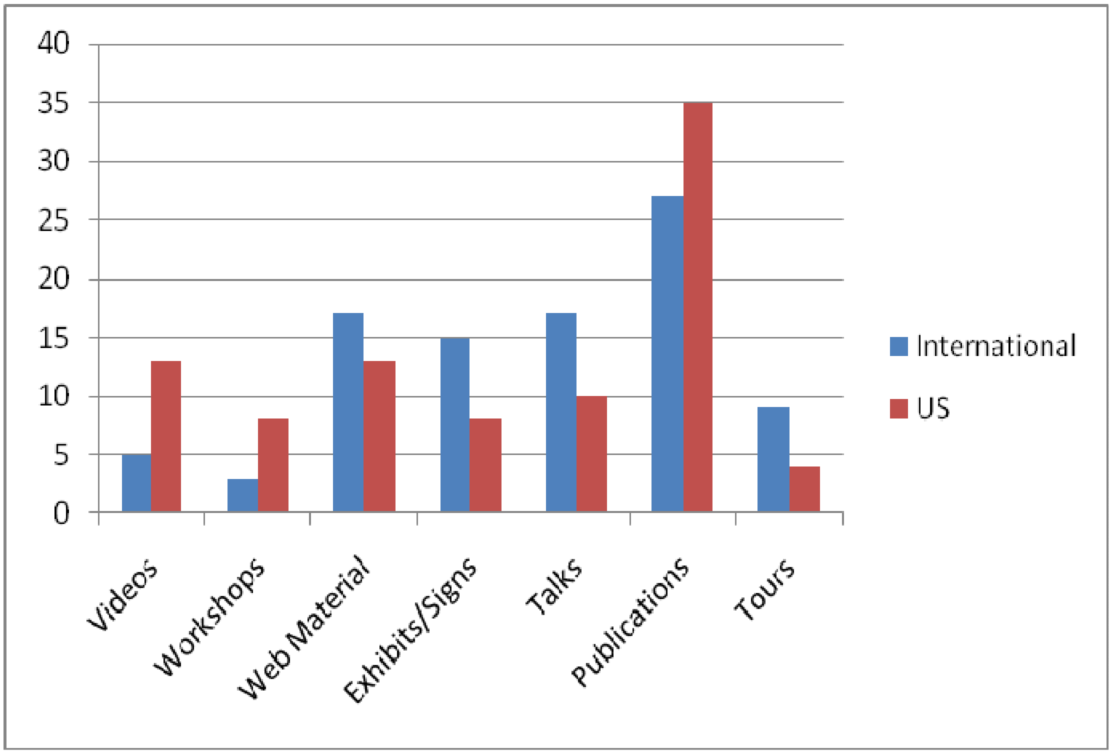

Figure 4.1: Categories and Quantity of Karst Education for Adult Learners.

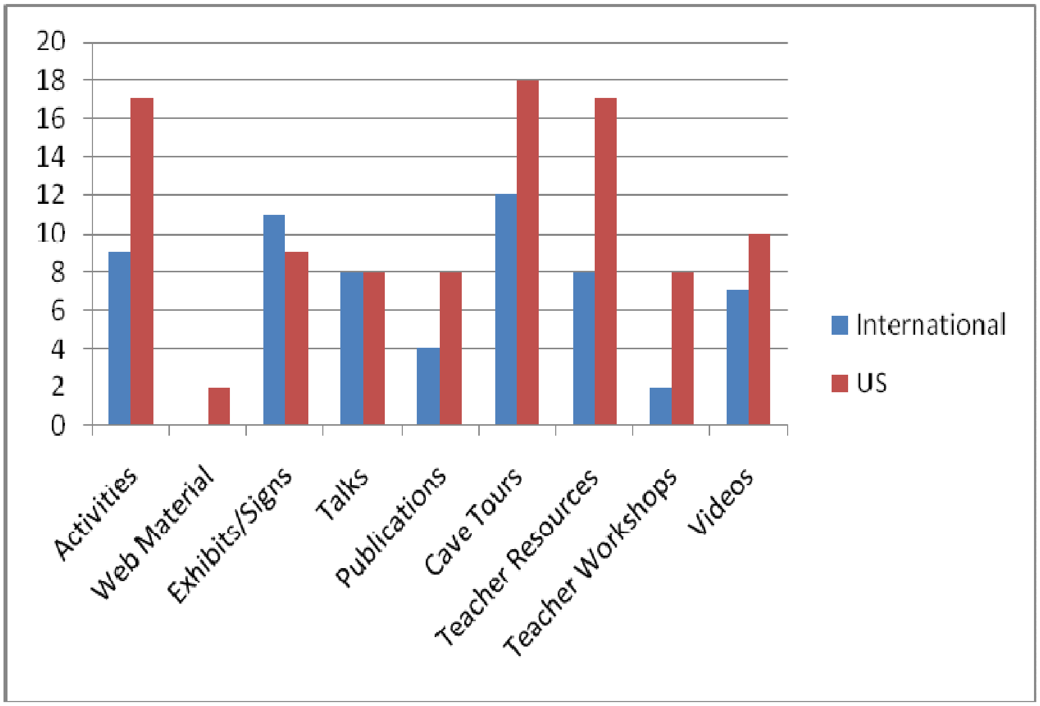

Figure 4.2: Categories and Quantity of Karst Education for Youth Learners.

The above summaries of worldwide karst-related educational endeavors seemingly reveal that these efforts are abundant in both the United States and abroad. However, a closer examination of these findings shows that 54 percent of educational opportunities in the United States only focus on cave environments or they are only narrowly concerned with karst terrains as interconnected, unique and fragile environments. In contrast, of the international education efforts, only 12 percent of these pursuits narrowly focused on a single karst feature, specifically caves. Thus, although there are fewer educational efforts internationally compared to the United States, the focus of abroad efforts is primarily on karst terrains as interconnected and vulnerable environments and not simply caves, thereby achieving more comprehensive karst education.

No single definitive explanation can be given for the above situation as revealed through personal observations or participant inquires. However, one possible cause for this trend is that in the United States many educational efforts are pursued by caving organizations which typically tend to exclusively focus on caves. Conversations with members of these organizations revealed that they do not fully understand the complexities of karst terrains or that caves are merely a single component of a much larger and complex system. Additionally, owners and managers of multiple educational centers and show caves in both the United States and abroad felt that by providing both karst and cave science information to their clientele may be overwhelming and therefore should not be undertaken. This issue will be discussed in more detail in Chapter 5.

Interviews with multiple personnel at US government agencies, which are commonly the source of cave and karst knowledge in the United States, revealed they also do not fully appreciate or comprehend karst environments, thereby limiting the development of or gathering support for educational tools for the general public. Nonetheless, as Chapter 2 of this dissertation illustrated, karst terrains are highly interconnected and particularly vulnerable to human influence due in part to the ease with which pollution can rapidly travel through an entire karst landscape. Thus, educational efforts which solely focus on caves fail to accurately increase the public knowledge of karst environments. By not providing the public with knowledge that caves are simply one small component of a complex, interconnected and geologic karst environment results in the most important and unique features of this landscape being overlooked.

Chapter 2 noted that educating adults has multiple benefits over educating children alone. Adult actions, not those of children, are the primary source of degradation in natural environments. Thus, even though educational programs for children are important, these endeavors will likely not result in an immediate decrease in the occurrence of significant karst degradation. Instead, the benefits of these educational pursuits will only be primarily valuable for reducing karst degradation once these educated children reach adulthood. In addition, when compared to children, adults have a greater potential to influence policy development and their enforcement in the communities where they live. If properly informed about the sensitivity of karst terrains, the opportunity is provided them to use this newfound knowledge to attempt to reduce future instance of anthropogenic karst degradation.

With the need to educate adults, it is somewhat disappointing that 41 percent of the aforementioned education endeavors in the United States (especially true at national-level) are for children (teacher lesson plans, youth fieldtrips, classroom activities, etc.), while only 8 percent of efforts (such as homeowner guides, information in water bills, and advanced public presentations) are specifically directed towards adults. The remaining 51 percent of efforts (museum exhibits, television programming, interpretative trails, etc.) can be considered useful for increasing karst knowledge for both audiences.

In contrast to the United States, this study found that in foreign countries educational efforts directly exclusively at children constituted only 11 percent of karst education efforts, while the adult audience received 17 percent and the remaining 72 percent were for both adults and children. For instance, with the exception of two uncovered efforts in both New Zealand and Canada, all other educational opportunities found pursued in these countries can be utilized by adult learners. This difference between the target audiences in the United States and internationally illustrates that the efforts undertaken abroad may have a better potential to immediately decrease instances of karst degradation since adults are the source of many disturbances. Moreover, because adults are solely responsible for voting and influencing policy, there is an increased potential for karst policy to be positively influenced by an informed adult public abroad.

When making broad-scale comparisons between the United States and abroad, international environmental agencies are not the primary source of educational material and instead are strictly regulatory bodies (Stefanie Foster, Customer Service Advisor, UK Environmental Agency). In the United States these agencies commonly attempt both tasks when budgets allow. For instance, nearly 71 percent of all international educational opportunities reviewed were pioneered by cave and karst groups and associations, private environmental centers, non-governmental organizations, or museums. Additionally, even when international regulatory bodies are pursing karst education, they consistently do so with significant help from local cavers, museums, and non-governmental organizations. In contrast, in the United States a comparable number of investigated opportunities for increasing karst knowledge are pursued by government (nearly 46 percent) and non-government entities (54 percent). Yet, this trend is not universal in the entire country, since no government-level efforts were uncovered in Alabama, Arkansas, California, Colorado, Georgia, Michigan, Pennsylvania, or West Virginia, amongst others. This difference in source of education material between the United States and abroad is likely attributable to the strict separation of regulation and education in many foreign countries, particularly Europe, which results in less time and resources being dedicated to education by government agencies. In fact, five interviewees from Britain, Germany, Italy, and Lebanon confirmed this finding during interviews, stating their agency serves only as a regulatory body.

In regards to pursuits by non-governmental organizations and groups, an overwhelming number of their efforts concentrate mainly on website content due to the minimal time and monetary investment required: this trend is true for organizations/groups in both the United States and abroad. Participant interviews revealed that all cave trips, educational presentations, or participation at local events is strictly voluntary with monetary compensation rarely being offered. Thus, members of these groups tend to limit their voluntary endeavors, relying instead on the minimal investment (time and monetary) of maintaining cave- and karst-science rich website.

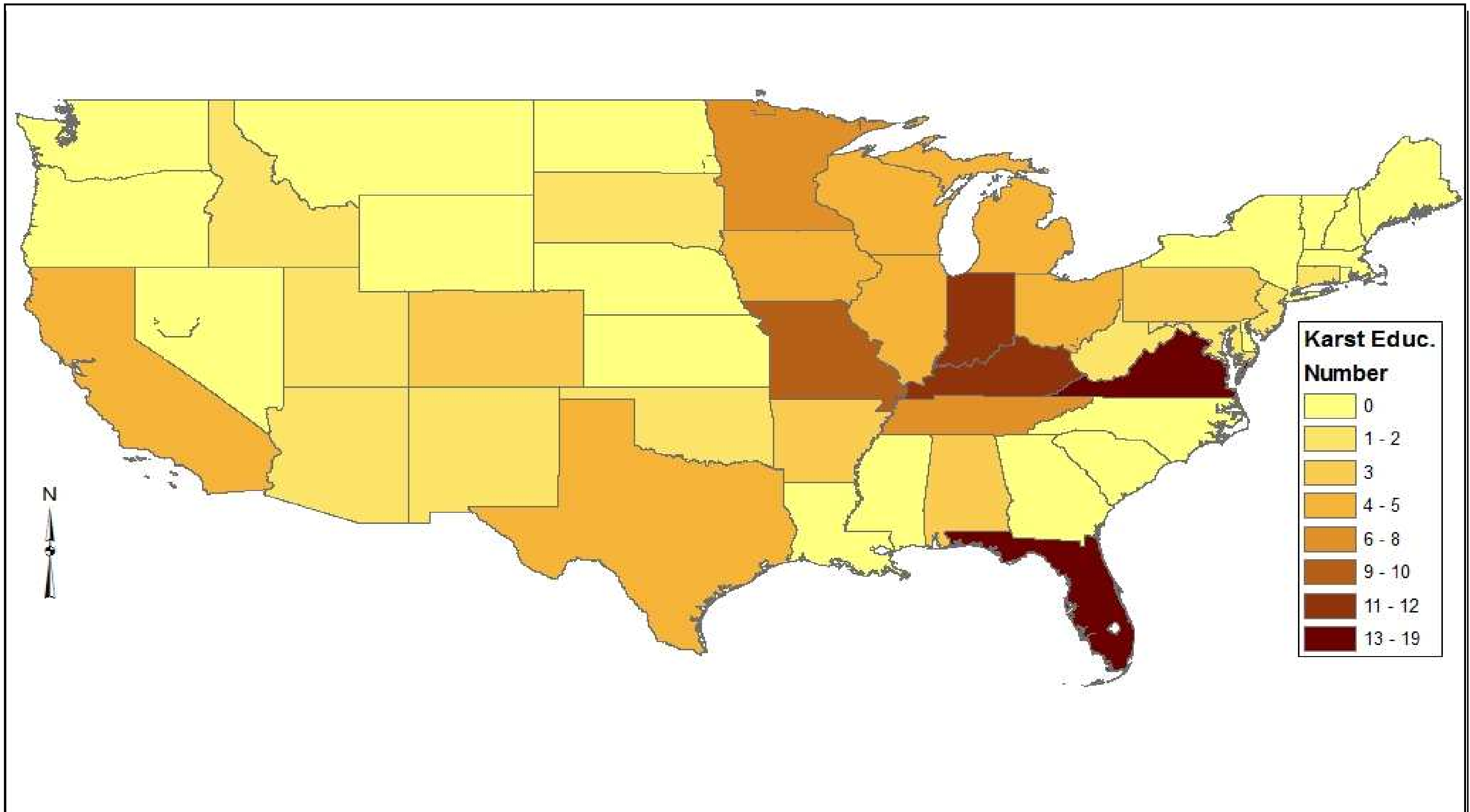

Figure 4.3: Map of Efforts Compared to Karst Areas. Created by Leslie A North.

Contrary to what one may suspect, the amount of karst environments in a nation or state does not correlate with the quantity of educational opportunities for children or adults (see Figure 4.3). For example, few or no educational opportunities exist in Georgia, Alabama, and Tennessee despite these three locations having some of the most renowned karst features in the United States. In Alabama, only NGOs reportedly pursue karst education, while in Tennessee governmental agencies primarily concentrate on youth and bats, not on adult learning or karst. Although a lack of karst education may be understandable in states such as North Carolina and Rhode Island which have little in the way of karst landscapes, the lack of holistic karst education in large karst regions is unfortunate and most likely perpetuates karst disturbance. Nonetheless, local-level, small-scale karst education opportunities may exist that were not found because of the time and monetary constraints of this study.

No karst educational programs are undertaken at the national-level in most Caribbean Islands that contain karst. Furthermore, only one national-level effort was found in both France and Germany, and two in Italy. Results from Romania and Slovenia, two significant karst locations, were overall inconclusive, but personal communications and archival searches indicate that karst-specific educational efforts directed at the general public are probably non-existent or significantly minimal. The only locations with abundant educational programs were in Canada, Australia, and New Zealand. Promising pursuits were also uncovered in England. In each of these locations, education is seen as important by both governmental and non-governmental organizations, and unlike in other countries which may also highly value education current funding allows support for the perpetuation of existing and development of new programs.

Multiple caving grottos and associations, particularly in the Caribbean region, attributed their lack of educational pursuits to their infancy as established organizations. Furthermore, although justifications for these findings were highly varied a consistent complaint was a lack of financial and personnel resources and/or support from government agencies and members of the general public to implement karst education programs. Unsurprisingly then, the lack of funding is the dominant cause for the dearth of karst education. As Merriam and Brockett (1997) indicate, geographic, demographic, education, socioeconomic, and/or other cultural determinants can limit willingness or access to informal environmental education even when environmental education programs are abundant. Validating this claim, the findings of this study reveal the importance of the influence of a country being more or less developed on environmental education in karst regions. The implementation of karst regulatory policies and management strategies cannot overcome the financial barriers and lack of infrastructure faced in developing regions, but instead will merely strain already strained resources. Thus, the data collected during this research suggest karst education and outreach campaigns worldwide should increase their focus on providing monetary and personnel resources rather than the content of educational material alone to overcome these significant barriers of less developed regions to both increase and improve karst education.

One limitation or unintentional bias of the data collection in this study in finding karst education efforts in foreign countries was the language barrier in non-English speaking regions. Efforts were consistently made to overcome this issue and avoid such biases by employing the use of translational services. However, the finding that English speaking countries possessed the most educational efforts cannot be ignored in that it may not reflect the actual situation on the ground and may simply be an artifact of the language barrier.

The opinion of this researcher is that in the United States, Virginia offers the most extensive and comprehensive karst-specific educational pursuits for the general public and children. Government agencies, particularly the Department of Conservation and Recreation (DCR) are instrumental in increasing karst knowledge in this State. For instance, a karst working group was created within the DCR and charged with the responsibility to aid in both education and protection efforts specifically designed for karst landscapes. The existence of this group can be attributed to the notion that many of Virginia's government agencies adhere to the philosophies of Aldo Leopold (please see Chapter 2) and therefore feel that conservation is to establish a state of harmony between man and the land. Particularly, the DCR feels this can only be achieved through the pursuit of both land protection policy and educational programs. While many states have only one or two advisory boards to oversee the development of resources related to a wide variety of environmental issues, Virginia's DCR has created multiple boards comprised of personnel educated in karst environments that are responsible for developing programs to promote karst conservation to ensure appropriate and abundant policies and education programs are created in Virginia, the agency's resources are organized into six distinct environmental topics and multiple advisory boards (Orndorff, personal communication, 2010; Virginia Department of Conservation and Recreation Website 2011).

In addition, highly active NGOs and karst attractions, are dedicated to protecting the State's karst environments and demonstrate this support by supplementing all efforts pursued by the DCR. Moreover, as aforementioned, multiple media outlets which reach thousands of Virginian residents have produced special news reports on karst environments in recent years. Lastly, as one of the most comprehensive and influential education program in the United States, the *Virginia Naturally* program has spread to multiple states across the United States. Thus, as clearly stated in Zokaites (2007), the successes of Virginia's karst educational program should be emulated by all karst states if karst is to be protected.

Conclusions

In reviewing the state of karst science education efforts it was found that while the scientific knowledge regarding karst exists, it is not disseminated to the population at large. Consequently, policymakers charged with protecting these terrains do not have the required information that they do for other environmentally sensitive landscape such as wetlands or coastlines, thus effective management of karst areas cannot occur. Although successful, many of these projects are primarily geared towards the development of karst education for youth, not adult learners. As previously stated, education can be a powerful tool for conservation and management in any environment, but particularly for karst terrains where education and management strategies are typically lacking or in their infancy.

Ideally, a well informed populace will make informed decisions. Yet, the exposure to cave and karst environments knowledge through actions by governmental and non-governmental organizations is apparently limited in much of the world, perpetuating an inadequate and/or erroneous understanding of this type of terrain. Thus, another venue is clearly needed to fill these educational gaps. The following Chapter discusses karst education through tourism venues, particularly show caves, to establish if these locations are in fact fulfilling the educational needs of the general public which currently are not being met by other agencies, clubs and organizations.

CHAPTER FIVE: ASSESSMENT OF CURRENT SHOW CAVE INTERPRETATION AND MANAGEMENT PRACTICES

Historically, the focus of both publicly- and privately-owned show cave tours has been entertainment, with little attention being paid to increasing public knowledge of karst environments. However, this unfulfilled opportunity is starting to be addressed through the promotion of land stewardship education because of: 1) increased public awareness due to high profile news events; 2) rising volunteerism; 3) private sector partnerships with governmental agencies; 4) increased acquisition of karst land by nonprofit organizations; and 5) the development of cave protection regulations. Particularly at federally-owned facilities across the world, the incorporation of interpretive exhibits in visitor centers is being pursued and additional education and science-centered tours are now offered to increase knowledge (see Chapter 2 for examples). Yet, no study could be found which investigated how many show cave facilities worldwide are serving the entertainment desires of their audiences while also contributing to their level of karst knowledge. This is somewhat disappointing as an assessment study of this nature could help establish where future development and implementation of quality karst education programs are needed to promote karst, and not simply cave awareness, since caves are merely one component of larger, interconnected landscapes.

A lack of program review at karst facilities created the need for a systematic collection of the educational activities offered by show caves and the characteristics of any uncovered programs/opportunities at these locations. Challenges for a complete evaluation of the effectiveness and efficiency of karst interpretation programs included time, expense, criticism of subjectivity, and overall complexity. Thus, the abundance of these challenges prevented the pursuit of a full evaluation of the world's show caves, and, consequently, the only viable alternative is a scaled down evaluation that exposes the broad-scale features of existing karst environment education and its inadequacies. The following discussion summarizes the findings of this alternative evaluation and analyzes the overall trends and characteristics of show cave programs and opportunities in the United States and internationally.

Show Cave Participation

To complete an assessment of current show cave characteristics, data were collected through personal communications (face-to-face, telephone, and email), archival research, and the use of SurveyMonkey®. Please see Chapter 3 for detailed descriptions of each of these utilized methodologies. For the purposes of this project, assessment of each show cave was based on:

- presence of karst-specific information on show cave webpages
- presence and characteristics of any educational program for school children/adult public and specialized science-based tours

- reported incorporation of both cave and karst science during interpretative guided tours
- variety of educational opportunities offered at visitor centers (signs, displays, exhibits, videos, brochures, etc.)
- whether measures are taken to evaluate existing interpretative programs.

From June 2010 to September 2010, 168 facilities worldwide (53.1 percent of the 316 total successfully contacted show caves) fully participated in this study by participating in the SurveyMonkey® survey and/or a telephone, email, or face-to-face interview. These facilities are located in the North and Central America, Oceania, Europe, the Caribbean, and Africa. Specific countries include the United States, Australia, New Zealand, Italy, Canada, Dominican Republic, Jamaica, Belize, Malta, Crete, Croatia, Slovenia, Czech Republic, Germany, Switzerland, Ireland, and Turks and Caicos Islands, amongst others. See Appendix C for a complete list of contacted show caves and facilities which participated in the study.

117 show cave managers, owners, interpretation coordinators/managers, and an additional 185 tour guides from around the world participated in this study's SurveyMonkey® survey during the data collection period. Figure 5.1 shows a breakdown of these specific participant job classifications. Of the management and owner participants, 55.3 percent held positions at privately-owned facilities, while the remaining 44.7 percent worked at publicly-owned show caves. Similarly 58.7 percent of tour guides worked at private facilities and 41.3 percent at public karst attractions, so both privately- and publicly-owned

facilities were each reasonably represented in the data set. In regards to participation by publicly-owned facilities, a comparable number of state- and federal-level employees were represented for both tour guides and management-level staff data sets.

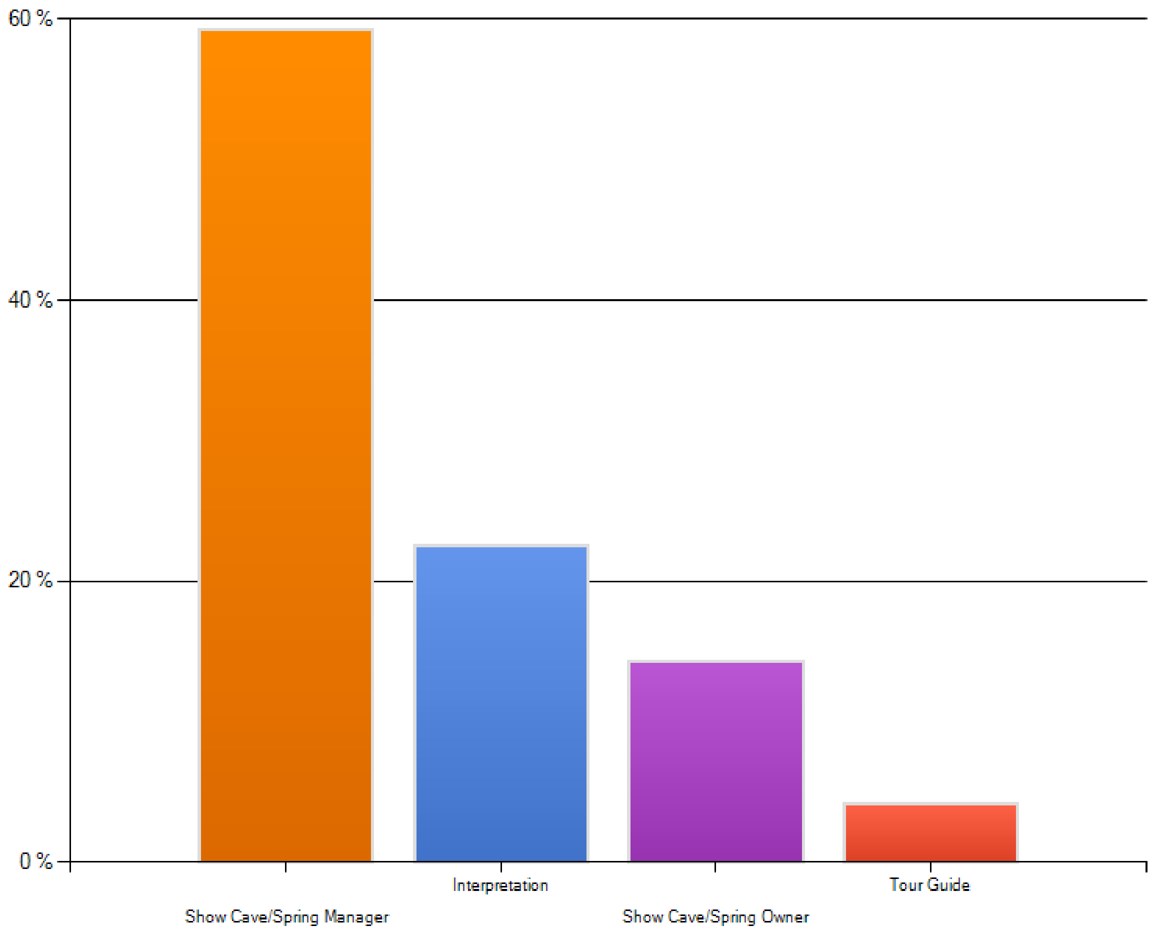

Figure 5.1: Distribution of SurveyMonkey® Survey Participates. Tour guides who began this survey (designed for managers, interpretation staff, and owners), were directed the survey developed specifically for guides.

Each SurveyMonkey® survey question was completed by 103 individual managers, owners, and interpreters (88 percent of the total participants), and by 166 tour guides, representing 89.7 percent of the total guide interviewees. In addition, 8 face-to-face interviews and 21 complete telephone interviews were conducted in the United States. Telephone contact was made with an additional 16 show cave managers, owners, and operators at varying international facilities to help gather data from facilities. These discussions were meant to gather information from facilities who previously had not participated in the electronic survey or who expressed interest in providing responses via a means of communication other than the distributed survey. Abbreviated telephone interviews were also conducted whenever necessary to collect supplemental data not uncovered through archival research or clarify responses to the SurveyMonkey® survey instrument.

At the federal and state level (US and internationally), participants were purposeful selected to exemplify a wide variety of positions and backgrounds. For instance, United State National Parks participants included head managers to third ranking management personnel. Interpretation staff members were also selected at varying levels of management positions. Moreover, in the United States, although more state than federal officials were contacted simply because of the larger quantity of state-level parks in the country, a lack of participation by multiple state personnel resulted in participation by comparable numbers of both federal and state-level officials. Thus, personnel at national parks and state parks are represented in this study's data set. Internationally, personnel at government facilities as well as personnel working with government departments which oversee the running of these facilities, such as the New South Wales Office of Environment and Heritage in Australia, were contacted whenever possible. Therefore, it is not likely that the positions of interviewees influenced the results of this study, as no single position served as a larger source of data than others; no skewing of the data is, therefore, suspected.

Show Cave Assessments

Figures 5.2 and 5.3 illustrate the distribution statistics of the characteristics of educational tools, K-12 programs, tour content, and use of program evaluation, collectively, at privately- and publicly-owned show caves in the United States and internationally. The closer the diamond graphic is to one, which is representative of the categorical mean, the more 'yes' responses were recorded at show caves for each of investigated category. The lack of positive responses is represented by the diamond graphic reaching closer to zero.

Although no significantly statistical differences were uncovered when making regional-level or ownership comparisons of show cave characteristics, some inferences can be made. For instance, many international caves have efforts to support at least four of the five investigated assessment categories in some capacity (educational tools, science on websites, educational programs for children, etc.), indicating there is diversity in educational opportunities where they are pursued. In contrast, although more show caves in the United States overall seem to widely support the investigated categories, only one or two of these categories are typically supported at a single facility so the diversity of educational characteristics is reduced. A detailed discussion describing each of these features of karst attractions follows.

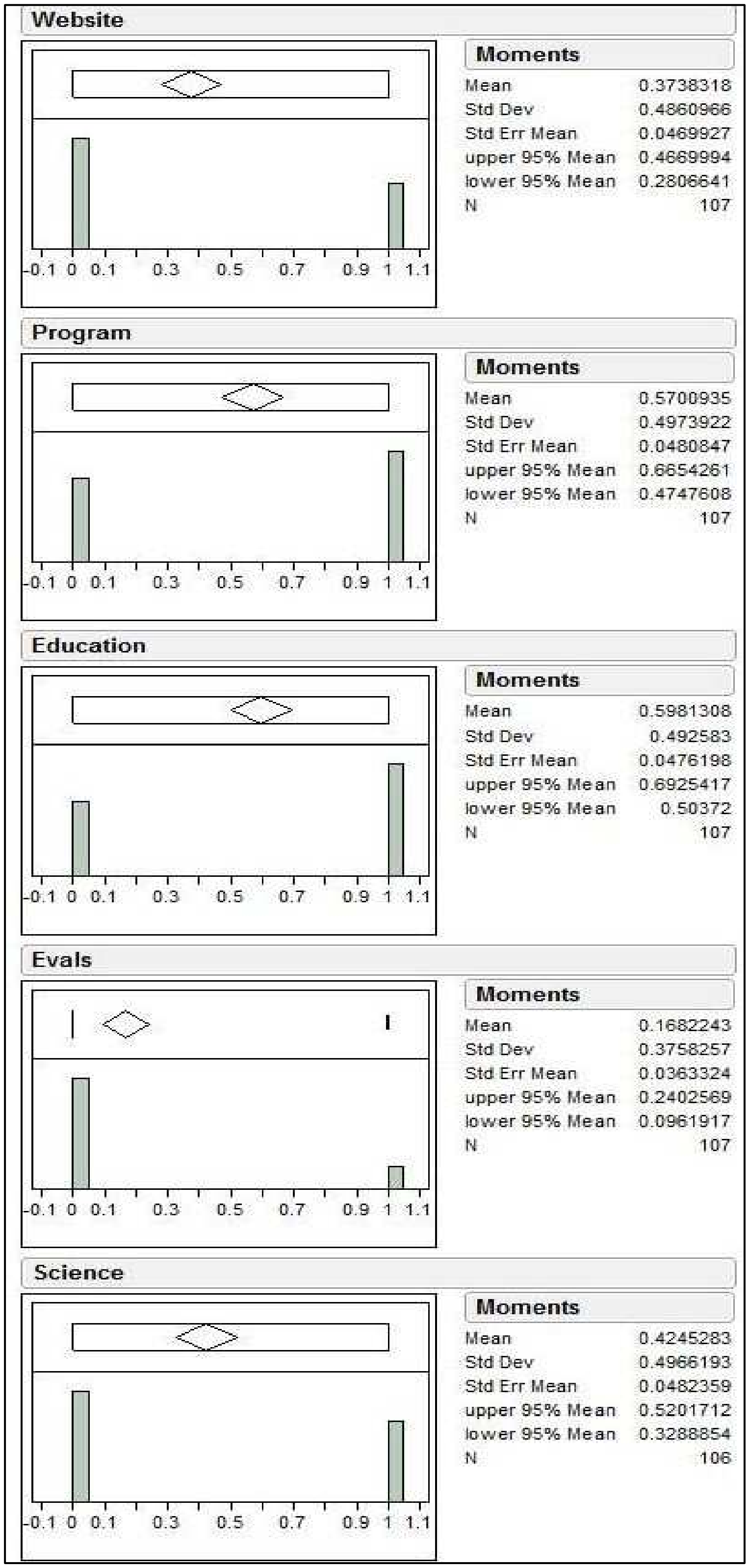

Figure 5.2: Data Distribution of Show Cave Characteristics in the US. The height of the left- and right-side bars is proportional to the number of 'no' and 'yes' responses, respectively.

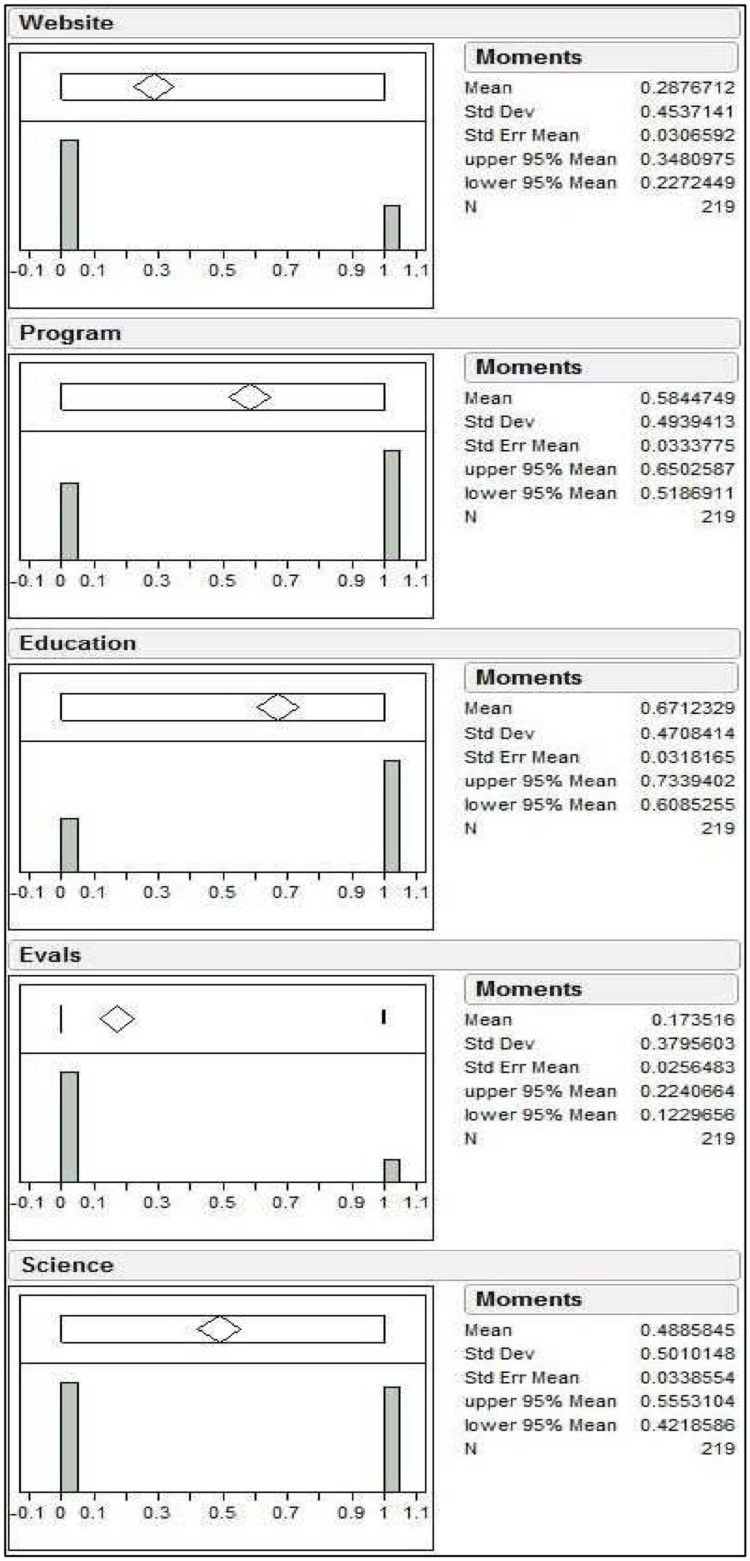

Figure 5.3: Data Distribution of International Show Cave Characteristics. The height of the left- and right-side bars is proportional to the number of 'no' and 'yes' responses, respectively.

Pursuit of Interpretative Program Evaluations

Collectively, an overwhelming number, 91.2 percent of the 212 privately-owned investigated show caves in the United States and internationally, have not undertaken a complete evaluation of their guided tours or any interpretative materials offered at their site. Consequently, they are unaware of the learning outcomes, enjoyment level, and effectiveness of their interpretative programs. In contrast, although multiple publicly-owned and/or managed facilities also reported a lack of program evaluation, 63 percent of the 114 state or federal-level facilities worldwide that were successfully investigated during this study have pursued at least one partial program evaluation, indicating evaluation is more frequently pursued at public, rather than private facilities. Notable differences between United States and international facilities, independently, were not uncovered.

Rather than conducting program evaluations, 84 attractions, including those both publicly- and privately-owned, specifically base the quality of their facilities offerings and tours on little more than the trends in the number of annual visitors and "loyalty of their customer base." Evaluation categories such as effectiveness of tour content and its deliver, knowledge outcomes of school programs, and the true satisfaction of departing guests are not considered. Eight publicly-owned and five privately-owned karst attractions indicated evaluations were regularly performed in the past, but budget constraints have prevented program reviews in recent years. These facilities were located in New Zealand, Australia, Italy, Britain, Greece and the United States. However, 78.2 percent of tour guides who participated in this study's electronic survey stated they were regularly evaluated on their interaction and professionalism with customers, delivery of tour content, and ability to answer visitor questions, while only eight percent, nearly all at publicly-owned facilities, also reported they are evaluated on accurate tour content. This highlights the emphasis on customer relations and experience rather than tour content at privately-owned facilities worldwide.

K-12 formal environmental education programs at karst attractions feature great diversity in educational curricula, activities, length of contact, and the presence of pre- and post-visit material provided to teachers. Evaluation of these programs is more frequently pursued than education for the general public. In contrast to evaluation of educational and entertainment material for the adult general public, personnel at 28 percent of the 109 investigated facilities in the United States and 36 percent of the 207 international facilities stated some degree of evaluation is conducted specifically for the programs designed for school-grade children. These program evaluations are conducted using any combination of pre- and post-outcomes assessments, interviews with teachers and school administrators, and teacher and student opinion feedback.

Internationally, sixteen percent of facilities, largely publicly-owned, also review local earth science educational standards annually to ensure their programs are closely aligned with and successfully meeting required learning objectives. However, as aforementioned, these objectives are frequently not translated to educational opportunities for the adult general public. Moreover, in the United States, state and/or federal earth science educational standards are frequently not reviewed by many privately-owned karst attractions despite the presence of educational programs for children. Thus, although not required by any national or state laws for karst attractions, the benefits of learning at these facilities, such as reinforcement of in-class topics, may be reduced if the content of children programs is not aligned with in-class topics. Instead, survey and interview participants at private facilities in the United States repeatedly cited environmental and natural resource government agencies and/or federal-level karst attractions as the propagators of science-based children programs and associated learning materials. This finding closely corresponds with the evaluation of data of karst education efforts discussed in Chapter 4, which revealed government-level agencies in the United States serve as both regulatory and educational agencies. In contrast, international agencies, particularly those in Europe, are primarily viewed as regulatory bodies and not a source of educational information and programs.

Overall, the lack of program evaluation at show cave facilities, regardless of ownership/management or location, is disappointing because program assessments are essential for the revealing whether a facility is serving the needs of their audiences and contributing to the level of cave and karst knowledge among the general public and school children. Furthermore, evaluations establish where future development and the implementation of material are needed and the desirable characteristics of this material. A lack of dedication to and acknowledgment of the importance of karst education for the general adult public at karst attractions worldwide is also emphasized by the apparent shortage of program evaluation for general tours and educational tools, particularly when compared to the extent of evaluation of K-12 programs. Simply put, data reveal the universal trend that the level of concern for adult learning is negligible compared to that of children, and a clear understanding of the exact educational benefits of show cave facility's interpretative offerings is unknown.

Variety of Educational Opportunities

The presence of educational material on facility websites can serve as an important advance organizer. Ausubel (1978, p. 252) defines advance organizers as "introductory material at a higher level of abstraction, generality, and inclusiveness, than the learning passage itself, and an overview of the principal ideas that… achieves its effect largely by the simple omission of specific detail." Hence, with this theory in mind, advance organizers introduce audiences to the words and ideas they will most likely encounter during educational experiences to allow them time to organize the information and begin thinking comprehensively about the concepts presented to them.

Presumably, in today's information age, a large percentage of the populace visits websites to gather information about a karst attraction such as what a person can do at the facility, tour times, prices, and the physical address.

If karst environments are discussed on these websites along with cave geology and history which are in fact typically mentioned, eventual show cave visitors could be introduced to a beneficial advance organizer with little to zero added cost to the business. Yet, despite the ease with which an educational opportunity could be pursued via webpages, only 29.7 percent of international facilities and 63 percent of the total show caves investigated in the United States had karst-specific material on their webpages. However, although 63 percent of United States show caves represent a large portion of the total show caves in the country, the incorporation of educational material on existing websites is still insufficient given the minimal to nonexistent costs associated with it. Variability of the presence of website material amongst international sites is likely attributable to differences in the degree of economic and infrastructural development in foreign countries. For instance, England and Australia, both well-developed nations, each have a multiple show caves with website content, while locations that do not are mostly in developing countries, such as the Caribbean region. The widespread use of the internet and ease of access to high speed internet services in the United States likely contributes to the higher percentage of website usage in the country compared to many international locations. Yet, insufficient science information on 37 and 70.3 percent of United States and international show cave websites, respectively, highlights a noteworthy, simple educational opportunity that is universally neglected.

In addition to webpages, information contained within show cave interpretative centers does not only serve as advanced organizers, but can also help to diversify learning opportunities, thereby maximizing the potential for visitors to increase their level of cave and karst knowledge. Interpretative signs and exhibits were the most commonly noted educational tool implemented at karst attractions, with 54 percent of facilities featuring educational opportunities extending beyond spoken tour content to visitors. In contrast, interactive displays were present at only nine percent of these facilities, special educational events and activities at only six percent, and lectures, workshops, and cave maps at two percent. The use of educational videos at 40 percent of karst attractions is surprising despite the added costs of their creation and the maintenance of small theaters/viewing rooms and video technology.

No significant regional differences were noted with regard to the presence of a particular educational tool. However, more than 89.4 percent of publicly-owned/managed facilities in the United States and internationally have educational tools designed to supplement tour content compared to only 50 percent of privately-owned operations. This finding was commonly attributed to the added cost for private operations to create and maintain these tools, although over sixty percent of interviewees failed to provide any reason for their lack of educational tools or justification for their use of particular educational tools at their sites.

When educational tools are present at show caves, they more frequently incorporate both cave- and karst-specific information than spoken tour content. For instance, the role of water in karst environments, sensitivity of groundwater to pollution, soil erosion, and/or anthropogenic degradation of caves and sinkholes are discussed through the use of these tools at 91 facilities. Additionally, consistent with the entire dataset accumulated while conducting show cave evaluations, bats and/or cave science were the most frequently cited information provided through displays and exhibits. In fact, each facility offering educational tools stated bats and caves as the primary topics of their interpretative tools. This finding is likely representative of the public's fascination with caves, which is perpetuated by popular media such as *Journey into Amazing Caves*, and all forms of wildlife. Recent concerns over bat health were also highlighted during data collection, as White Nose Syndrome was mentioned by all but 15 contacted facilities in the United States and 36 internationally show caves despite the prevalence of the disease being largely restricted to the US.

On the whole, educational opportunities beyond guided tours are only present at just over 50 percent of the nearly 316 show caves successfully evaluated during this study. In addition, this study noted the inaccuracy of an understandable assumption that facilities with interpretative tools that discuss the science of karst environments have tours that also feature karst as well as cave science (see discussion further below). For example, Harrison's Cave in Barbados maintains a $40 million interpretative center which features exhibits on what is karst, the role of hydrologic cycle in cave and karst development, the interconnectedness of karst terrains, and the distribution and importance of karst terrains, amongst other topics. Each visitor to the facility is also shown a ten-minute video which covers the development of the island and carbonate rocks. The operation is also currently developing a wild cave tour which will incorporate karst science. However, the word 'karst' is not mentioned at any time during the guided tram tours offered by the facility, and geology in general is only minimally discussed. Instead, the cave tour focuses on little more than the development and beauty of the cave's widespread calcite formations.

Overall, the exclusion of karst-specific educational content during guided tours is driven by the fears of loss of entertainment value which typically dominate management and interpretation decisions at show caves. Yet, Reinforcement of spoken and written educational information is necessary to maximize learning (Jurin et al. 2010), but facilities typically fail to do so even when the scientific information is available for use. There is little assurance that visitors will in fact visit and read interpretative exhibits while visiting facilities or that they will correctly understand the material. Thus, cave operations should not solely rely on efforts outside of the guided tour to promote karst education.

Interpretative Guided Tour Characteristics

Regional comparisons of the presence of karst science in guided show cave tours are shown as part of JMP categorical models (Figures 5.4 and 5.5).

The models are ranked by the number of cases and 'yes' responses, which explains why France, the Czech Republic, and Slovak Republic are at top of the list. However, inferences should be based on the dominate colors shown in the model. Specifically, the more evenly distributed color representation between the five investigated categories, the more educational options offered at a Country's show caves. Thus, Jamaica, Switzerland, and the Turks and Caicos Islands caves appear to have multiple educational opportunities, unlike Puerto Rico and Chile where show caves offer few options for increasing karst knowledge.

Internationally, the Czech and Slovak Republics, Australia, Slovenia, Britain, and Italy, have the highest ratio of show caves with karst science incorporated into their tours for the adult public. Thus, international locations with the greatest quantity of karst also have karst attractions which further emphasize the importance and sensitivity of karst terrains. Thus, since these locations are sites with some of the largest quantities of karst terrain, the presence of this karst may be directly influencing the pursuit and dedication to promoting karst science. However, other locations, such as Romania and France, which also have large quantities of karst, do not have tours that incorporate karst science, so presence of karst is not always influential internationally. Show caves in Belize, Bermuda, Brazil, and Costa Rica fail to offer any educational opportunities, especially through the guided tour experience. However, it should be noted that a limitation of this study is that the scientific accuracy of reported karst material for guided tours could not be evaluated in many instances.

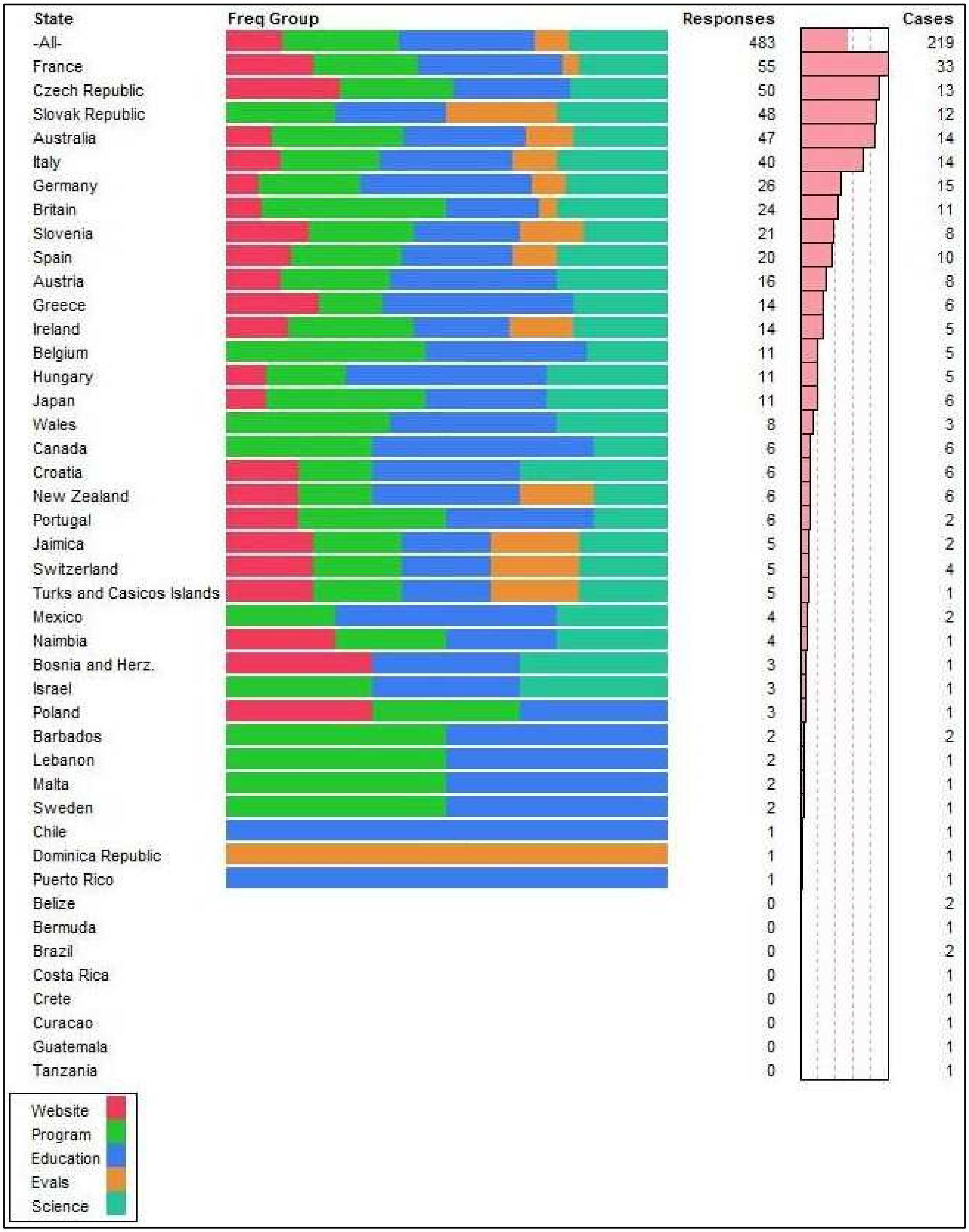

Figure 5.4: International JMP Diagram of Show Cave Characteristics. Diagram shows country-level distribution of 'yes' responses to the five investigated show cave characteristics (presence of karst science on websites, existing K-12 programs, educational tools (displays, signs, exhibits) available, pursuit of program evaluation(s), and karst science incorporated into guided tours).

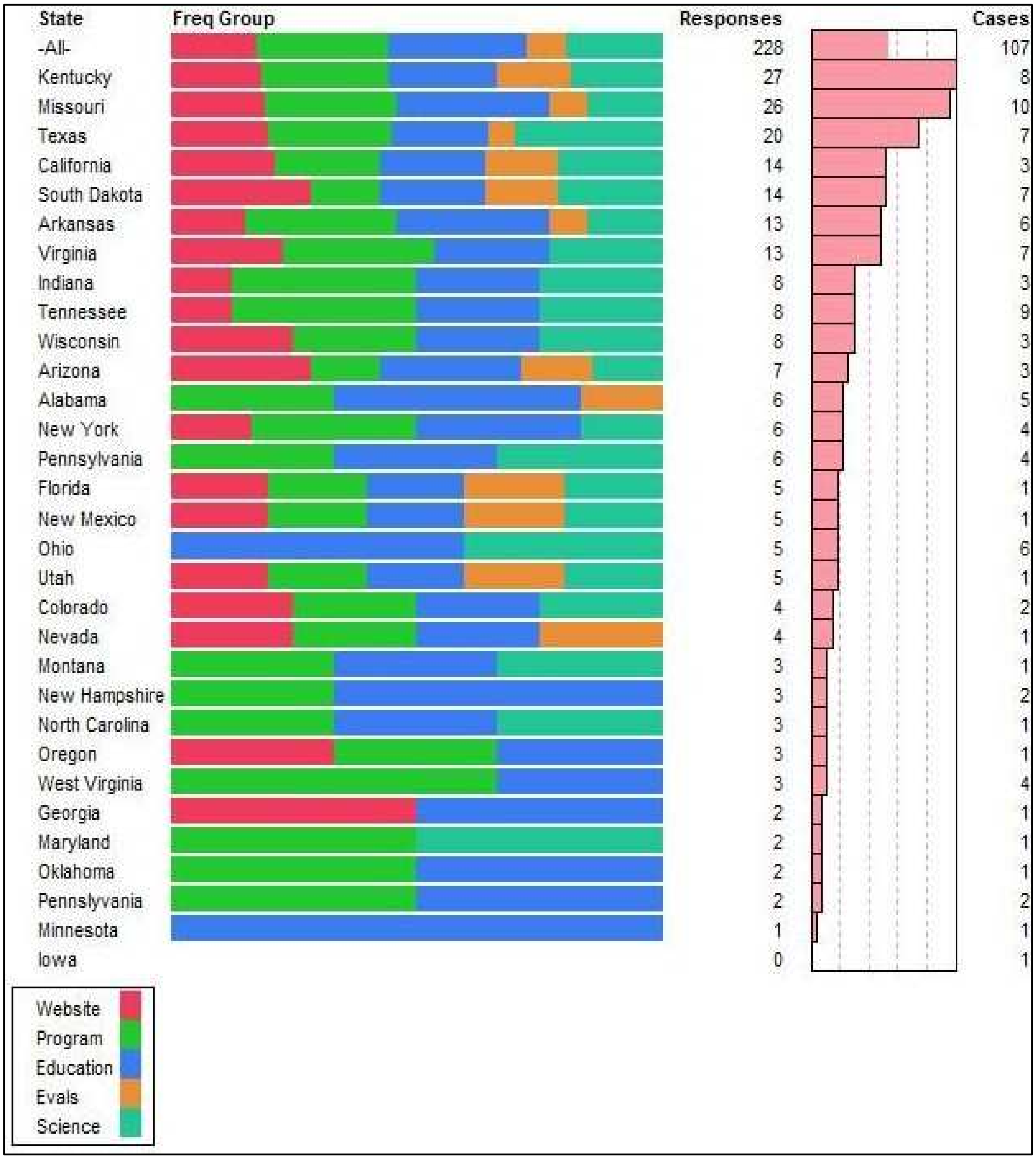

Figure 5.5: US state-level JMP Diagram of Show Cave Characteristics. Diagram shows state-level distribution of 'yes' responses to the five investigated show cave characteristics (presence of karst science on websites, existing K-12 programs, educational tools (displays, signs, exhibits) available on grounds, pursuit of program evaluation(s), and karst science incorporated into the guided tour experience).

In the United States, show caves in Texas, Ohio, Kentucky, California, and Missouri reported the most tours which incorporate karst science and/or the importance and sensitivity of water in karst areas. Yet, many of the US states with the largest percentages of karst education efforts do not have cave tours which mimic the same level of commitment to increasing the degree of karst knowledge as the grottos, museums, science centers, and government agencies in their regions or many international locations. Virginia is the most notable example of this, in that it has a large number of comprehensive efforts for the general public (see Chapter 4), yet many of the show caves located in the state do not show this same commitment to increasing karst knowledge.

Each show cave in the Czech and Slovak Republics have karst science incorporated into their tours, educational material on their website, interpretative signs, displays, and/or exhibits present and programs for school children. This is because each show cave in these nations is overseen by a single agency, the Czech Show Caves Administration and the Slovak Show Caves Administration. Although these agencies do not oversee day-to-day operations, they are responsible for helping develop educational resources both on the web and at each show cave, distributing information related to hours of operation and location, creating applicable school programs, and assisting sites in gaining access to tour content material when requested. Thus, this organizational structure obviously is having a positive impact on promoting karst knowledge in the Czech and Slovak Republics and, therefore, could be beneficial for improving karst knowledge in karst regions across the globe (see below).

Although some show caves recognize the importance of their role in educating the general adult public and children, education is still not pursued at many locations primarily for monetary and lack of knowledge/expertise reasons. Specifically, over 69 percent of SurveyMonkey® survey participants cited financial burdens as the reason for not developing science-rich websites and tours, or utilizing interactive displays, signs, and/or exhibits. These participants maintained that they do not have the financial resources to purchase cave and karst texts, train their tour guides properly, access research papers, attend workshops, or hire outside karst consultants. Without being able to utilize these resources, the facilities have limited access to accurate, up-to-date science and, therefore, remain largely unknowledgeable about karst environments. Furthermore, even if financial burdens can be overcome, 41 percent of participants feel the lack of cave/karst-science understanding and interest by management-level staff would still hinder the development of science-rich tours. For instance, even when access to reputable sources is achieved for the development of maps, displays, and/or interpretative signs, data reveal approximately 56.9 percent of the investigated show caves in the United States and 51 percent of international facilities still do not mention karst or groundwater during their standard public tours. Thus, there is a significant discrepancy in the use of outside resources when developing spoken educational content versus pre-developed, published opportunities.

Previous research about learning in informal settings reveals spoken material has a more profound effect on learning when compared to written content. This is partially attributed to the notion that visitors must be internally motivated to visit and closely read maps and interpretative signs or partake in interactive displays. Furthermore, there is no opportunity for questions if the read material is not completely or properly understood, so visitors may in fact create their own, often inaccurate, truth from the material.

Participants who confessed that their facilities do not have adequate levels of science incorporated into tours commonly stated that tour content focused solely on archaeological or historical use of their cave, or indicated that the facility was still a "work in progress." Other participants felt incorporating science is not necessary because they strictly serve as an entertainment venue. For instance, as stated by a Japanese participant, "Our agency does not have the resources to develop in-depth science-based programs. That has been deemed unnecessary for an entertainment-oriented tourist destination." Similar statements were offered by a management member of Waitomo Caves in New Zealand. Other participants felt their facilities overall provided both cave and karst material, yet karst science at these facilities is actually only primarily discussed in interpretative centers and not incorporated into tour content. Yet, as previously discussed and clearly stated by a participant from Minnesota, "If visitors read the information in the exhibit room of the visitor center, yes, they would learn what karst is and the close connections with surface water and groundwater. Hopefully this would instill some sort of appreciation that may affect future behavior. The reality is few people will take the time to read information at exhibit signs or displays."

The source of tour content can also serve as an indicator of the potential quality of the material. Thus, SurveyMonkey® survey participants were asked, "From where does your facility receive its tour material?." Responses from worldwide participants showed that the sources for this information were primarily geology textbooks and scientific reports from researchers and government agencies (42 percent of respondents). This was then followed by:

a) United States National Speleological Society which is used as a resource by facilities all of the world (16 percent)
b) local cavers (12 percent)
c) local universities (10 percent)
d) staff will no guidance (8 percent)
e) input from customers (2 percent)
f) historical writings (2 percent)

Other show caves (21 percent) are a significant source for guided tour information which is alarming in that the potential for erroneous science interpretations spreading to multiple facilities and consequently to large quantities of the general public is heightened. In addition, a probable result arising from this situation is the perpetuation of cave tours lacking high quality material. However, the sharing of data can also have a positive impact on tours if the original interpretations are in fact accurate and science-rich. While more data are needed to conclusively state which of these two alternatives are more prevalent, the recorded lack of a scientific background by many interpreters, managers, and guides may certainly increase the likelihood of negative consequences occurring through this sharing of information.

Even when quality educational resources are accessed and provided to participants, 32 percent participants believe their facilities avoid the incorporation of larger quantities of cave and karst science because of a fear of loss of business from a perceived danger of decreasing the entertainment value of the tourists' experience. Thus, some participants believe entertainment and education cannot simultaneously occur during guided tours. However, as is discussed in Chapter 6, this assumption may not be valid.

Despite the above findings, none surprisingly, data from SurveyMonkey® survey participants indicate that owners, interpreters, managers, and tour guides generally feel the educational quality and quantity of the tours offered at their representative facilities is high. Figures 5.6 and 5.7 illustrates a breakdown of responses from owners, interpreters, managers and tour guides when asked about the quality of guided tour content. Take note that 82.5 percent of the total management-level participants and 86.3 percent of tour guides indicated a score of four or five, five being the best, when asked to rank their tours using a 5-point Likert scale.

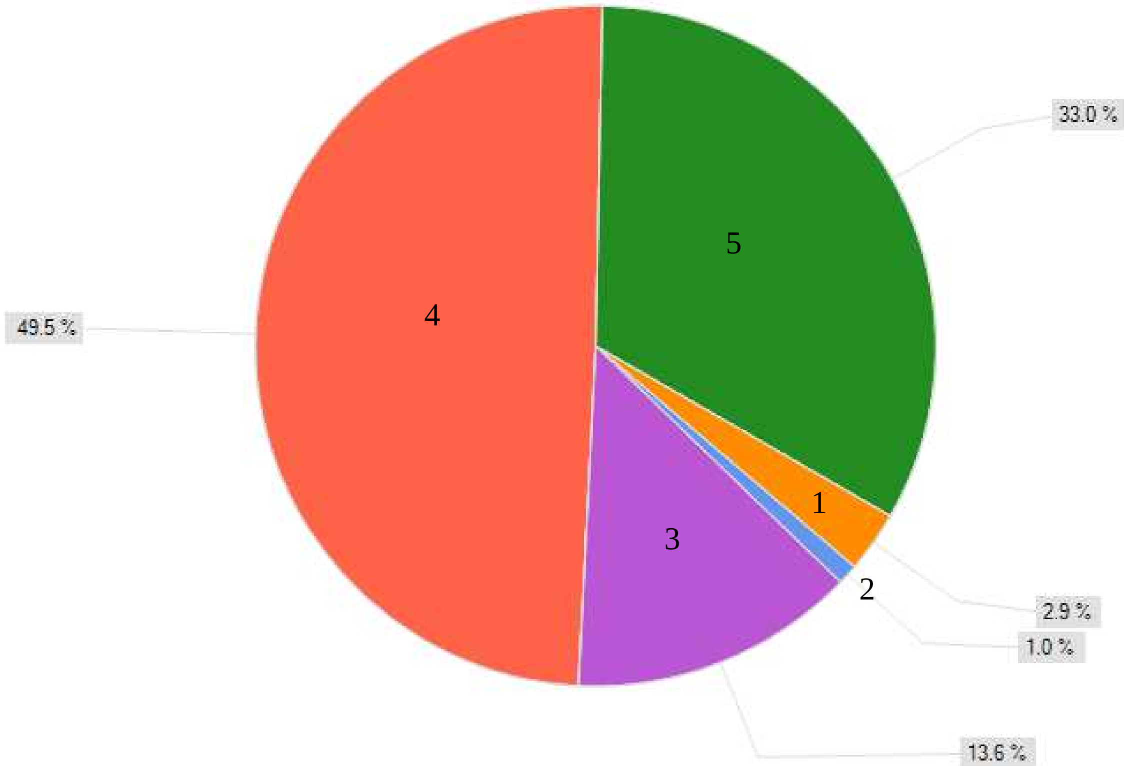

Figure 5.6: Response Distribution Regarding the Educational Quality of Show Cave Tours (Management). Responses obtained from managers, owners, and interpreters who participated in the online survey when asked to "On a scale of 1 to 5 (five being the best) how would you rank the educational quality and quantity of tours provided at your representative facility?".

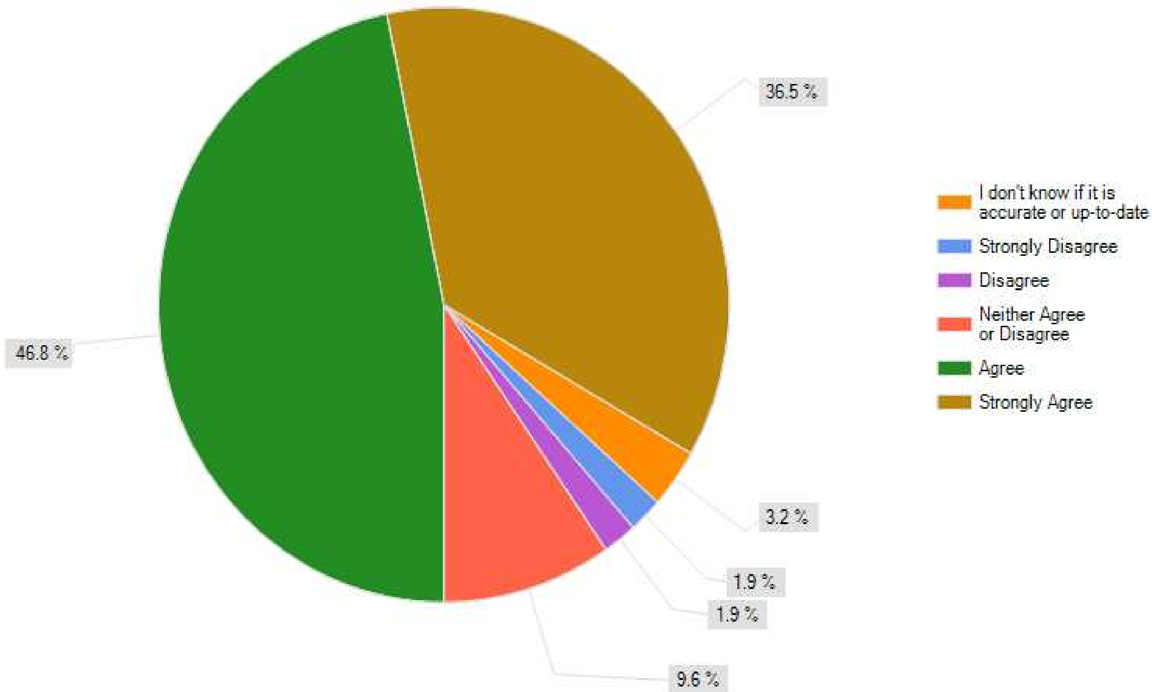

Figure 5.7: Response Distribution Regarding the Educational Quality of Show Cave Tours (Guides). Responses obtained from guides presented with the statement "The educational information provided on tours at your facility is factually correct and incorporates the latest science about karst landscapes."

When asked to justify their answer to the aforementioned question, the largest percentage of participants felt their tour content was of high quality and quantity because of the source of their material. For instance, local caving associations, universities, and geologists were indicated as sources of the educational material incorporated into public tours. Figure 5.8 specifies the percentages of science-specific tour material for the general public which tour guides feel is incorporated into tours at their representative facilities. However, although valid, interviewees commonly indicated the quality and quantity of tour content still largely focused on cave science as opposed to karst environments as a whole, which minimizes the degree that the visitors can understand the interconnectedness between surface and subsurface karst features. Furthermore, eighteen respondents indicated a significant difference between the quality and quantity of tour content, stating the quality of the presented material was good, but quantity was lacking. A comparable number of participants felt the opposite trend was true, indicating educational material was abundant, but the quality of the material was questionable due to a lack of access to proven karst and geological information specific to their region and/or show cave. Yet, both plentiful and high quality educational material is needed to maximize learning at karst attractions.

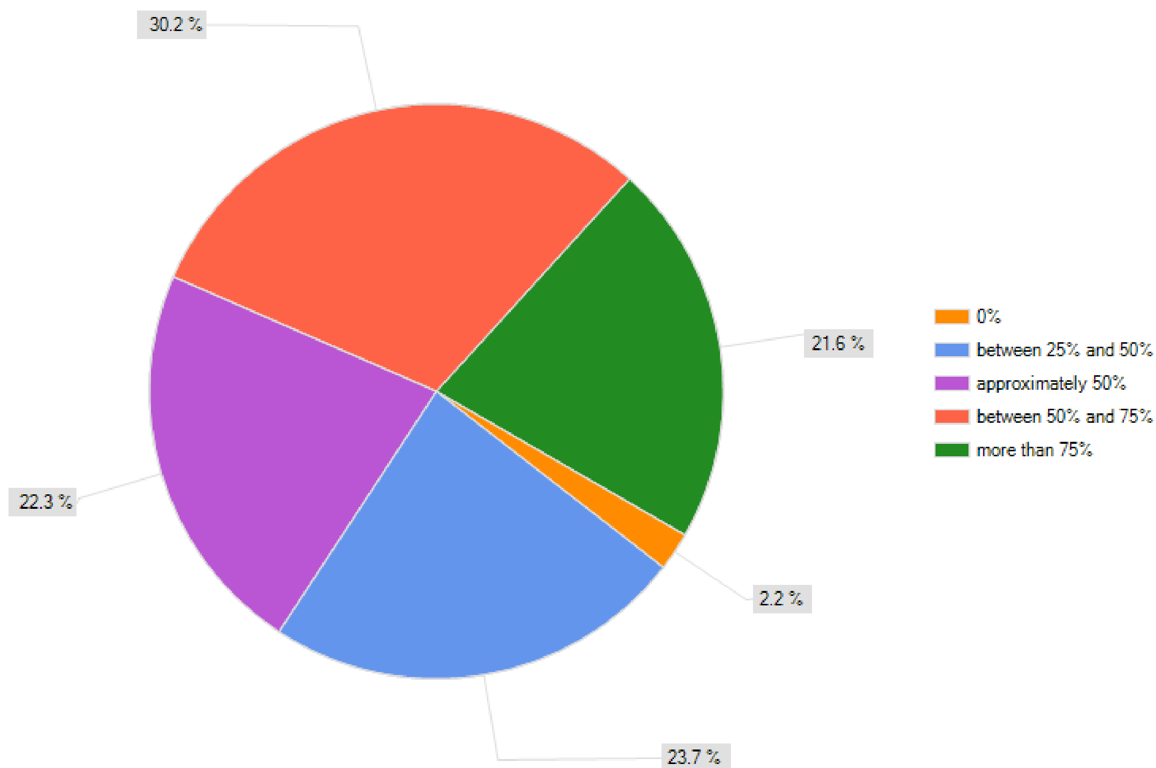

Figure 5.8: Response Distribution Regarding Science in Tours for the General Public (Guides). Responses obtained from tour guides when presented with the statement "On average, what percentage of the tour material provided to the general public at your facility is concentrated on cave and karst science?."

Survey participants felt their facilities provided both school groups and the general public with adequate information related to cave and karst science (Figures 5.9 and 5.10). Explanations for their selections concerning content for school groups typically emphasized that tour content for children was frequently changed to meet the specific needs and wants of individual teachers, yet overall maintained a high level of accurate science. The review of show cave characteristics undertaken during this study confirmed part of this finding in that 191 privately- and publicly-owned show caves, or nearly 60 percent of the total investigated sites in both the United States and internationally have educational programs developed for school children.

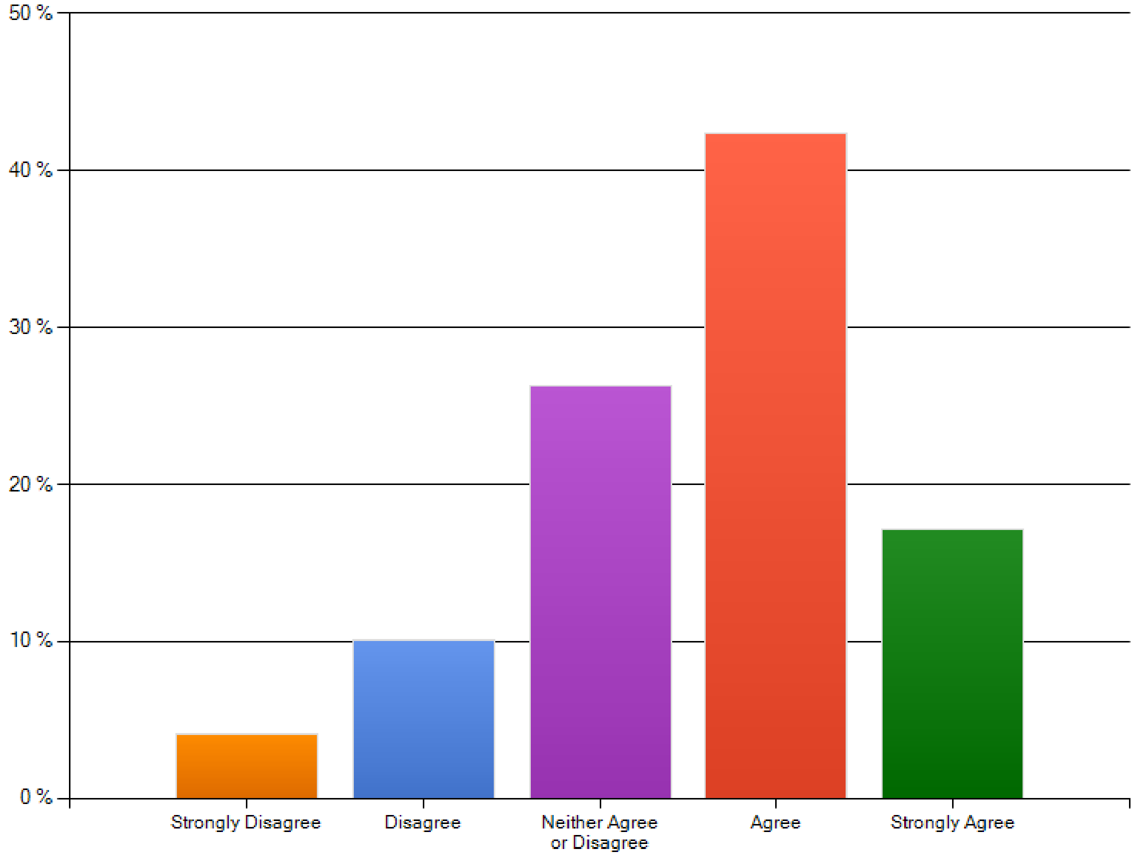

Figure 5.9: Response Distribution Regarding Science in Tours for the General Public (Management). Responses obtained from managers, owners, and interpreters when presented with the statement, "Your facility provides the general public with adequate holistic information related to karst terrains."

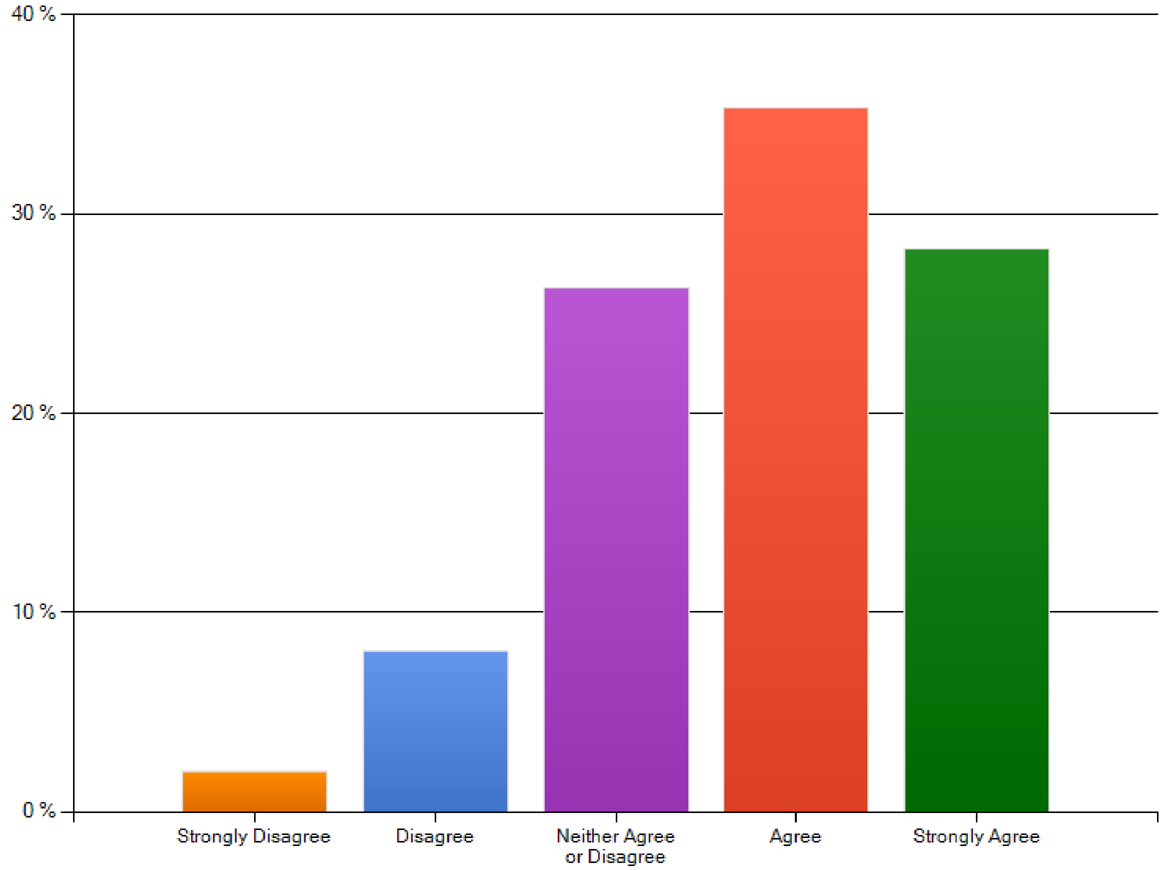

Figure 5.10: Response Distribution Regarding Science in Tours for School Children (Management). Responses obtained from managers, owners, and interpreters when presented with the statement, "Your facility provides the school children with adequate holistic information related to karst terrains."

Overall, as the aforementioned data suggest, while efforts directed at the needs of children were confirmed and may be deemed sufficient, education through for members of the adult general public is lacking. Even where show cave operators are beginning to recognize the monetary value of combining education with entertainment, the educational material does not incorporate concepts of a holistic karst system and instead focuses solely on cave interiors.

Yet, as outlined in Chapter 2, education for children is not enough for the protection and stewardship of natural environments.

Disconnects of Opinion and Show Cave Actuality

There is an obvious lack of karst education at show caves which was revealed through the above data (also see Chapter 6); however, when survey participants were asked if the general public is educated enough about karst science in their regions and countries, 82.3 percent of 103 managers/owners/interpreters indicated "no." 71.4 percent of these participants also stated school children are not adequately educated in both cave and karst science, suggesting the existence of a disconnect between the current pursuits of show caves and their acknowledgment of a lack of karst education. Additionally, although 41 respondents believe students are sufficiently exposed to cave and karst science while learning basic geology concepts in classrooms, 18 of the same participants also acknowledge the importance of adult learning in stimulating child learning. For example, an American respondent stated, "If adults don't give value to karst, kids will rarely be taught that info or give it value." Thus, these participants are acknowledging the importance of educating adult populations for not only the benefit of the adult, but also children learning, yet programs for adults are significantly lacking at show caves.

Ironically, when participants were asked if they feel privately-owned show caves and springs have a role to play in educating the general public about karst environments, nearly 50 percent of respondents 'strongly agreed' while an additional 37.3 percent 'agreed.' Zero respondents stated they 'disagreed' and only one interviewee from France 'strongly disagreed' with this statement (Figure 5.11). Similarly, 59.8 percent of respondents strongly agreed and 29.3 agreed show caves should be held partially responsible for educating school children (Figure 5.12). Explanations for these selections further emphasized the participants' belief that karst attractions are in part responsible for increasing karst knowledge. These included:

- "EVERYONE has a role to play…whether they do so or not is another question,"
- "We all have a role and responsibility, but often ignore it in the interest of sensationalism and profit,"
- "Every cavern has this responsibility as a steward of the land we all need to be part of the solution, not adding to the problem," and
- "We are the first, and probably the only, line of exposure for the general public regarding education in karst environments."

Yet, each of these responses came from participants at facilities where karst knowledge was reportedly not significantly incorporated into tours or other educational experiences, further illustrating a significant disconnect between the participants belief and the actual execution of efforts to promote karst education.

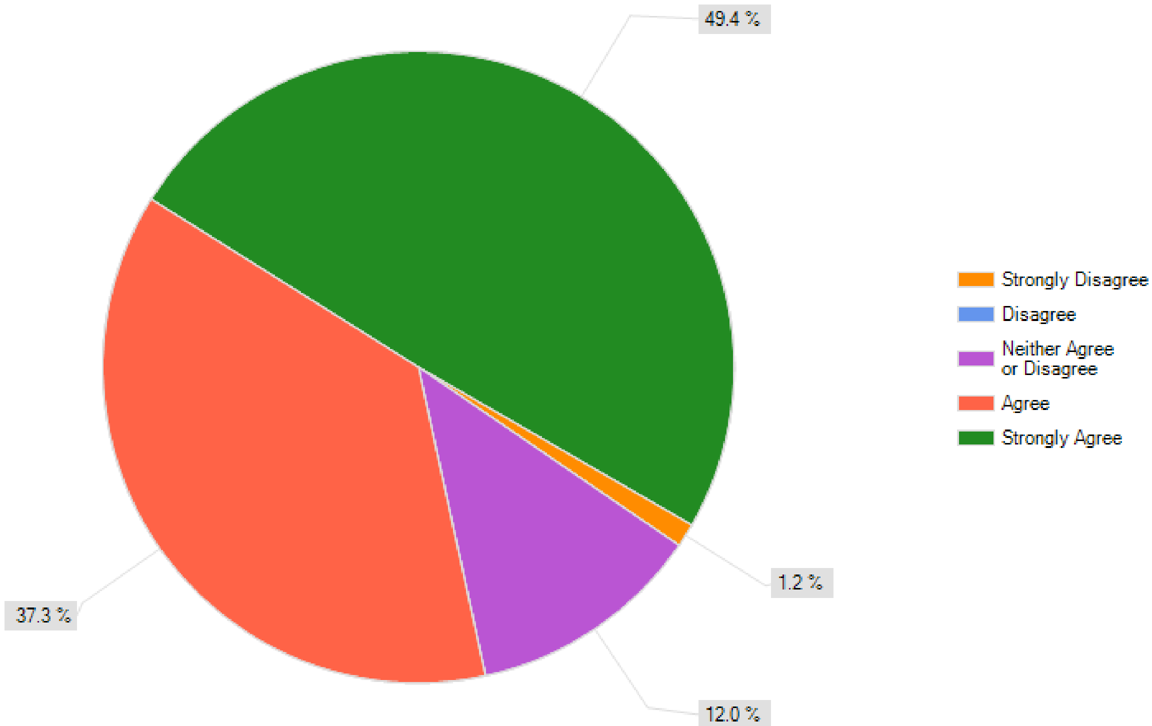

Figure 5.11: Response Distribution Regarding the Role of Show Caves in Adult Education. Responses obtained from managers, owners, and interpreters when presented with the statement, "Do you feel publicly-owned show caves have a role to play in educating the general public about karst environments?."

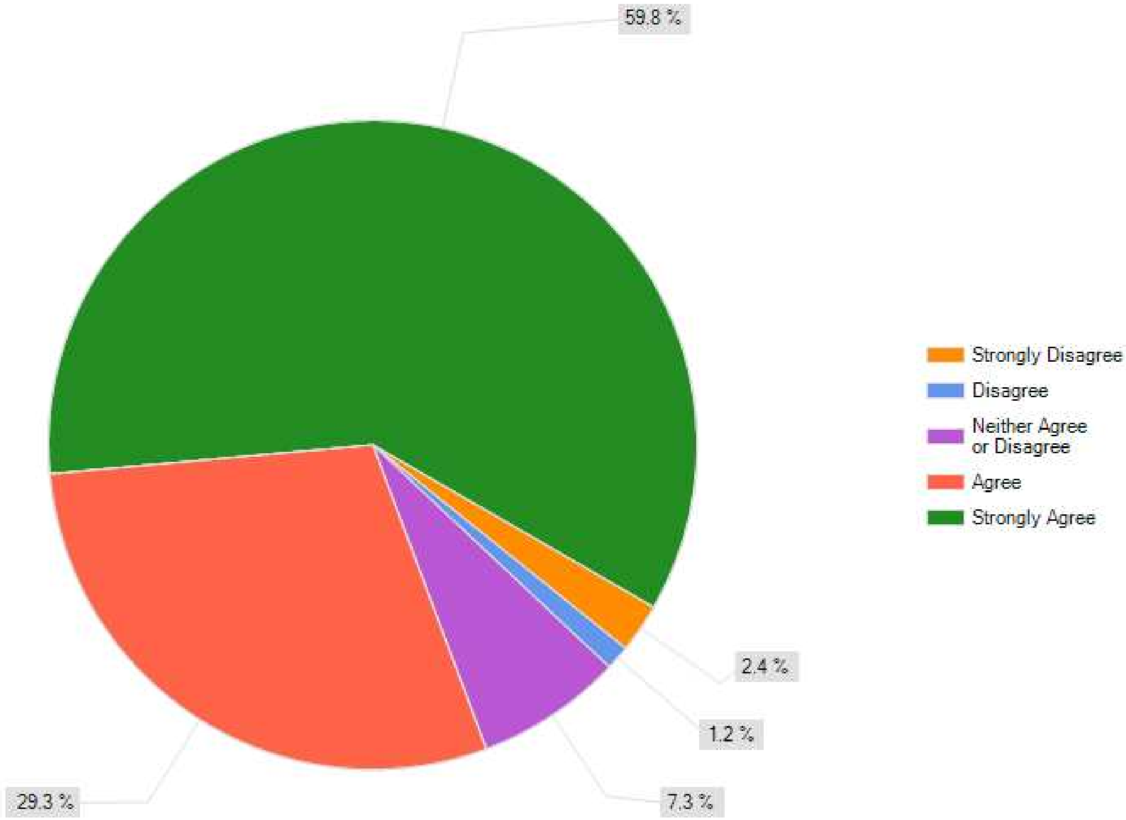

Figure 5.12: Response Distribution Regarding the Role of Show Caves in Youth Education. Responses obtained from managers, owners, and interpreters when presented with the statement, "Do you feel publicly-owned show caves have a role to play in educating the school children about karst environments?."

Lastly, 70.7 percent of participating tour guides believed show caves and springs should increase their focus on karst education, and 86.8 percent of the 166 tour guides which completed the survey thought increasing the quality and quantity of karst information will *not* discourage customers from visiting. However, these sentiments are also in direct contrast to nearly all of the above data which clearly illustrates efforts are insufficient for increasing the level of karst knowledge for the general public in many regards and in most locations.

Implications and Conclusions

Generally, multiple facilities do offer cave and sometimes karst-specific educational material on their websites which may often serve as an advanced organizer for visitors. However, as the data above indicate, karst education is, overall, minimal at show cave facilities worldwide. Multiple SurveyMonkey® survey participants felt the tour content at their representative facilities is of high quality and quantity judged by little more than the source of their material. Survey participants also feel their facilities provide both school groups and the general public with adequate information related to cave and karst science. Data reveal show cave personnel feel karst attractions should be playing a role in educating both the general public and school children about caves and karst environments, and acknowledge the general public is largely unaware of karst science. Thus, if karst education at show caves is still insufficient and disconnects exist between actuality and acknowledgment, how should the concerns for public understanding of karst be addressed? To this affect, managers, owners, and interpreters were asked if karst show caves and springs should be required by law to have a greater focus on karst. Not surprisingly, only 10.8 percent of respondents agreed to this statement, while 36.9 percent neither agreed nor disagreed and 52.4 percent either disagreed or strongly disagreed (Figure 5.13). Comments used to justify these selections included:

- "How will they enforce the law,"
- "Government should not be dictating how we run our business and tour!,"

- “You can't force people to provide education unless they are a public school facility,”
- “Legislating educational content would be a huge mistake. Such legislation would be impossible to enforce and would likely only lead to large increases in paperwork and no increase in education”

Based on these comments and selections, and the notion that the passing of a law would be a very time intensive process that would need a great deal of political and public support, federal- or state-level legal mandates for tour content are unlikely to be a widely acceptable solution to this problem. Furthermore, if mandates were to be issued, the implications for cave owners could be significant in that their entire tours, procedures, and operations would be changed. In the United States, rights of business owners may also be infringed on in that freedoms of private businesses are highly valued in the country. Because of these implications, multiple owners may choose to close their businesses, which would also result in no beneficial educational experiences for the general public. However, the pursuit of legal mandates for increasing karst education at show cave facilities is not dire since other approaches to promoting a more aligned front for karst knowledge are available and more likely to be widely accepted. For instance, 66.7 percent of participants agree that some standardization of the objectives of tour content, not the specific wording, is necessary for improving the level of karst knowledge. Specifically, one participant from a private facility in Indiana stated, “Show cave owners need to be educated and guided so they realize how important it is for them to teach our young people and see that it is beneficial to their business." Thus, objectives could be established which would include discussing karst as well as cave science, not simply caves or cave biota which is currently the central topic of guided tours, and promoting the discussion of human degradation to karst and cave environments to improve the overall scientific quality and quantity of guided tours. Guidelines would also help promote the reinforcement of learning across show caves and eliminate the delivery of erroneous data to the general public. Agreeing to these universal (or at least country- or state-level) objectives could be required prior to business licenses or permits being issued or renewed, yet how facilities choose to meet the goals of these objectives/guidelines would be more flexible than those issued in a law and, therefore, businesses would likely be more receptive to these changes.

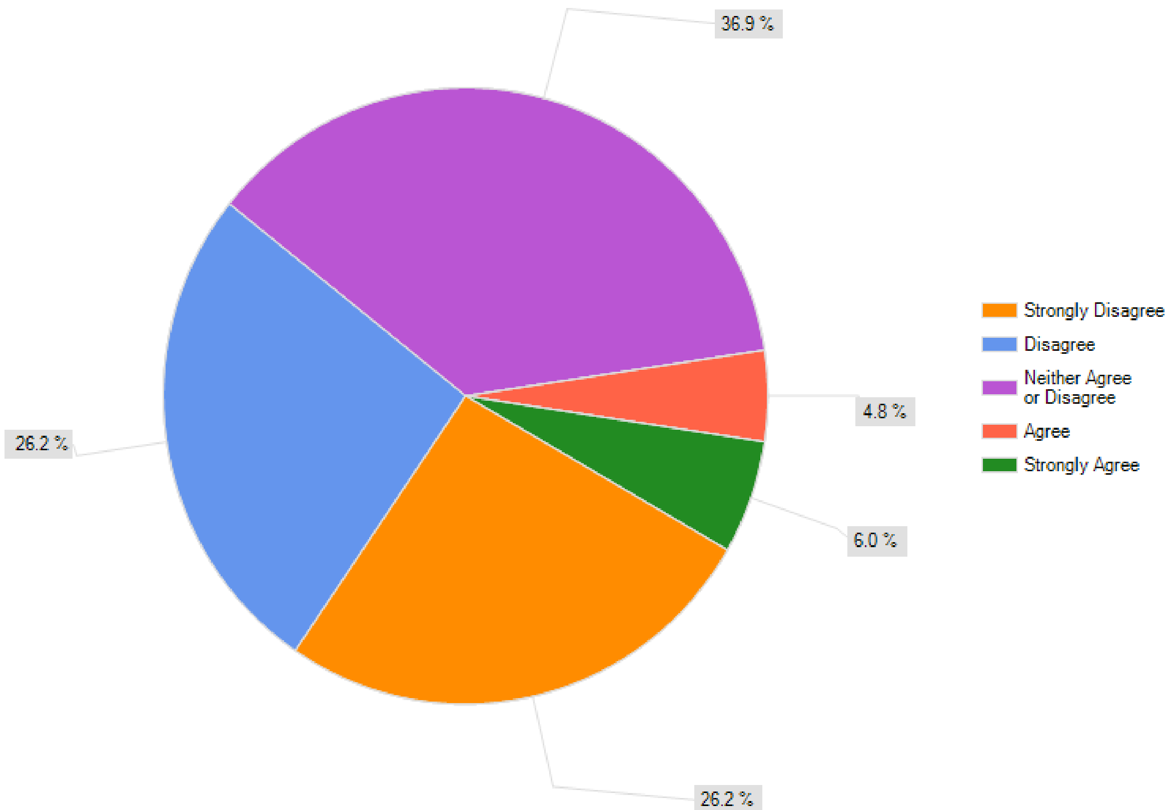

Figure 5.13: Response Distribution Regarding the Implementation of Show Cave Laws. Responses obtained from managers, owners, and interpreters when presented with the statement "Karst show caves and springs should be required by law to have a greater focus of karst education."

Pursuing more educationally-rich tours and developing additional interpretative opportunities such as signs and displays would result in a financial commitment upfront from facilities. These costs would partially come from the training of proper guides, see Chapter 6, and acquiring and interpreting scientific information that could entail purchasing expensive texts, managers and guides taking professional development courses or participating in karst workshops, and/or traveling to karst meetings/conferences. Thus, pursing karst education has the largest implications for show caves with smaller margins of profits, yet once outreach tools are developed and tours are changed, profit may increase due to greater customer satisfaction and attendance. Data presented in Chapter 6 reveal customer enjoyment and satisfaction is not hindered by the incorporation of science and that many customers actually prefer tours that do more than point out cave formations and instead incorporate science and history.

If interpretative trails or centers are provided to customers, a facility's customer base (and profit) may also be increased by visitors not necessarily interested in taking a guided tour. As an example, Lost River Cave and Valley in Bowling Green, Kentucky, maintains interpretative trails, picnic areas, and a welcoming 'front porch.' Local residents frequently take advantage of this facility and rarely fail to spend money in their visitor center while exploring. So, although revenue is not always accrued through guided tours, revenue still comes into the show cave attraction and visitors become more educated about karst on the trail paths. Florida Caverns State Park is a similar example, yet this facility offers a small interpretative center equipped with interactive displays, signs, and short videos from their cavern. Multiple visitors travel to the show cave, and rather than taking a guided tour, learn about karst while exploring the free interpretative center and provide revenue through gift shop purchases.

An assumption of this research is that a lack of education will have implications on future karst policy development. Although the implementation of karst policy is obviously not currently investigated since extensive longitudinal data is necessary (see Chapter 7), the history of environmental policy development in the United States and internationally reflects a trend of increased public outcry and science education leading to policy development. For instance, multiple waste management policies and water resource policies were developed after pollution was noted from poor management practices (Vaughn 2008). Thus, if enough people become educated about karst terrains and their importance particularly about water supplies, while touring show caves pressure can be exerted to develop karst legislations (if even initially at a local-level).

In conclusion, even more important than threatening the karst terrains specifically, this degradation is jeopardizing the fresh drinking water resources and often highly fragile cave and spring biota that may hold valuable scientific information which these environments contain. Show caves can help to fill this educational gap and thereby potentially decrease instances of disturbance with little expenditure of money or man power by simply improving guided tours and extending existing educational programs for children to interested adults. Although public facilities may have access to more resources and often full time personnel who are able to help develop educational tour content and resources, even private facilities with minimal margins of profit could implement these changes at their facilities through the use of outside resources, such as efforts by caving grottos (highlighted in Chapter 4), to improve visitor karst knowledge.

Both private and public facilities should invest in education in that they are both visited by members of the general public, and the more opportunities for encountering educational material, the better the chances for causing significant and meaningful improvements to public karst knowledge. Furthermore, private facilities, just as publicly-owned show caves, are unavoidably impacting the cave and karst environment they own or manage, so the potentially positive benefits of these negative impacts should be maximized. Yet, as uncovered during this research, fear of loss of entertainment value and a lack of education on the behalf of managers, owners, guides, and interpreters tend to dictate educational decisions, particularly those related to guided tours, despite the need for karst education. As shown in the following chapter, however, these reasons may be wholly unjustified.

CHAPTER SIX: THE GUIDED SHOW CAVE EXPERIENCE

This study's field-based component took place at two privately- and two publicly-owned show cave locations in the United States. In addition, data related to show cave operations as they relate to guided tours, such as tour guide training procedures, and opinions on show caves serving as centers for karst knowledge dissemination through guided tours were solicited both internationally and in the USA through personal communications and the distribution of an electronic survey. Characteristics of selected show cave facilities are summarized below followed by a review of guide training practices implemented worldwide and those undertaken as part of this study.

Research Sites

The four show caves which participated in this study were selected based on the following considerations:

1) facility's willingness to participate
2) cave ownership
3) estimated annual visitation
4) time and budgetary
5) range of on-property educational opportunities such as sites with multiple cave exhibits (Florida Caverns and Mammoth Cave) to

sites such as Cumberland Caverns which has no additional educational resources beyond the guided tour experience

6) constraints for conducting the surveys

Additionally, for the purposes of this study inclusion as a research site considered their representativeness of the multiple spectrums of visitor experiences which are encountered at show caves in the United States and worldwide. As a result, show caves with varying ownership status (federal, state, and private) and tour lengths were selected. Caves with varying tour group sizes (ranging from 25 to 120 guests) were also included to account for potential differences in visitors' experiences from tour size, since smaller numbers on tours may lead to guides having greater influence on improving the visitor's knowledge of karst. Lastly, caves with different physical features and experiences were taken into consideration during the selection process. These differences included the amount of decorations (the ornate Cumberland Caverns as opposed to the dry, largely undecorated passages of Mammoth Cave) and property/cave entrance characteristics (the forested sinkhole entrance of Florida Caverns to the large karst valley and stream passages at Lost River Cave).

1. Mammoth Cave National Park (Public, national-level)

Mammoth Cave National Park is a public facility located outside of Bowling Green, Kentucky. The park was established in 1941 and became a World Heritage Site in 1981. The cave system represents the world's longest known cave. Cumulatively, over 500,000 cave and surface visitors enter the park annually (visitation estimate includes visitors who solely enter the park for personal hiking, camping, and/or canoeing; thus some guests, not all participate in one of multiple ranger-led interpretative activities (Mammoth Cave National Park, undated website; Meredith, personal communication, 2010; Toomey, personal communication, 2010).

A wide variety of cave tours are available to the public from 1¼ hour (Frozen Niagara) and 5 hour (Grand Avenue) walking tours to a 5½ wild cave trip. The summer season, when the park receives the greatest number of visitors, over thirty guides are needed per day, with the total number of guides who work throughout the course of the summer being approximately 60 (Meredith, personal communication, 2010). In contrast, during the winter season only six to eight guides cover the weekday schedule for the park, and about a dozen guides fulfill weekend tour schedule needs.

Four guided tours through Mammoth Cave are considered by the park interpretation staff as "geology" based. These are: Grand Avenue, River Styx, New Entrance, and Frozen Niagara. For the purposes of this research, surveys were only distributed to visitors participating in these science-centric tours. The remaining tours of the facility are purposefully void of most cave and karst science, focusing instead on the cultural and historical aspects of Mammoth Cave and the surrounding area. Additionally, although the River Styx tour is considered a geology tour, the tour was not operational at the time of data collection due to flooding of cave passages, so data from this tour were collected. *Table 6.1* summarizes the characteristics of each of the tours investigated as part of this study.

Table 6.1: Summary of Characteristics of Mammoth Cave National Park Tours Investigated as Part of this Study.

Tour	# of Annual Tours Lead	Annual Participates	Tour Length	Tour Guidelines	Selected Purpose/Objectives
Frozen Niagara	1,129	~ 29,000	~ ¼ mile, 1 ¼ hrs	Limited to 38 visitors	Cave formations, geologic processes, human impact to cave, importance of caprock
New Entrance	1,544	~ 101,000	~ ¾ mile, 2 hrs	Limited to 114 visitors	Geologic processes, human impacts to cave, vertical/horizontal passage,
Grand Avenue	373	~ 23,000	~ 4 miles, 5 hrs	Limited to 78 visitors	Cave biodiversity, geologic processes, cave exploration, human impacts to cave, gypsum

2. Florida Caverns State Park (Public, state-level)

Located near Marianna, Florida, Florida Caverns State Park was opened to the public in 1942 and is the State's only facility offering guided cave tours to the general public. These tours last approximately 45 minutes to 1 hour, and include a brief natural trail hike to the cave entrance. Visitors are encouraged to see the facility's interpretative center which includes a variety of exhibits and a brief video on cave geology and formations, the cultural history of the cave and area, and cave biota. Park visitors can also camp, swim, fish, picnic, canoe, hike, and take horseback rides. Annual visitation to the park averages over 80,000; however, in 2010 just over 50,000 visitors went on cave tours with nearly half of these from April to August (Florida Caverns State Park, undated website; Banta, personal communication, 2010).

Unlike Mammoth Cave National Park where a variety of different cave tours are available for members of the public, Florida Caverns offers a single tour for the public (maximum of 25 participates) and more science-rich tours for school groups who have made prior arrangements. The primary objective of these tours is to have visitors understand the unique history of the cave and how the actions of humans above ground can have implications below ground for caves and caverns. Sub-themes for the tour include:

- Caverns are created with water as the primary architect
- The Civilian Conservation Corps of the 1930's played a primary role in the development of Florida Caverns
- Humans can impact cave ecology through actions above ground
- The direct connection underground aquifers have with the surface
- The source for drinking water throughout much of Florida.

3. Cumberland Caverns (Private)

Cumberland Caverns, which was opened to customers in 1956, is a privately-owned facility in McMinnville, Tennessee (Cumberland Caverns, undated website). The show cave has no interpretative center, and similar to Florida Caverns, only offers one standard tour for members of the general public. However, educational tours for children, wild cave tours, and an overnight adventure are available at this facility. Visitation to the facility can vary greatly from year-to-year, but the facility typically averages 15,000 to 20,000 people per year (Jones, personal communication, 2010). Other opportunities such as camping or swimming are not available. However, multiple customers do visit the facility's grounds to explore horseback riding and/or hiking trails.

The 1½-mile general public tour through Cumberland Caverns averages 1½ to 1¾ hours in length, and includes a walk down a small interpretative trail prior to reaching the cave's entrance. The information presented during this tour included cave decoration formation, exploration, human use (particularly saltpeter mining), and basic geologic processes forming and shaping the cave. The Caverns are renowned for a religion-based soundtrack and light show at the conclusion of tours. Although tour guides are provided with topics which they may choose to discuss in the various rooms of the cave, similar to at Mammoth Cave National Park, guides at this facility are encouraged to develop their own script so long as the objectives required by the cave owners are discussed (Jones, personal communication, 2010).

4. Lost River Cave and Valley (Privately managed)

Lost River Cave and Valley is a privately-managed facility in Bowling Green, Kentucky. The show cave has a unique location in that it is approximately 40-minutes drive from Mammoth Cave National Park and is very close to Western Kentucky University. This cave was found hundreds of years ago and has served as an operating mill and as a community night club since the mid-1900s.

However, it was only recently opened to the public for the current tours in the late 1990s. Prior to this time the cave was used as a large dump for area citizens until Friends of Lost River Cave leased the property from Western Kentucky University, removed more than 80 tons of garbage from the site, and introduced underground boat tours (Holt, personal communication 2010; Lost River Cave and Valley Training Manual Spring 2010).

This 68-acre facility consists of karst uplands and associated valley, blue holes, a spring, and the cave. Interpretative trails are available throughout the property. Wetland and butterfly sanctuaries are also present at the location. The show cave and surrounding nature sanctuary receive over 80,000 visitors annually with the main draw being the only underground boat tour in Kentucky. The 45-minute to 1-hour tour includes a ½-mile walking portion which explores the valley and karst windows and the $^{1}/_{3}$-mile boat tour. Tours are lead by a single guide with up to 40 persons per tour. However, when necessary, the boat portion of the tour will include two boats, with two guides.

The themes and messages of Lost River Cave and Valley guided tours were the most comprehensive of the four facilities investigated during this study. Specifically, the primary and sub-themes include:

- Lost River Cave and Valley is a window into an underground world (Primary)
- Living in karst country (what is karst, how formed, impacts, importance)
- Lost River Cave and Valley as a habitat for native wildlife
- Historic life in the valley and on the ridge-top

- Prehistoric Indians presence
- Cave mills
- The Civil War and Lost River Cave
- Lost River Cave Night Club
- A community saves a cave (Friends of Lost River Cave)

Establishing Tour Guide Training Procedures in the USA and Abroad

As discussed in Chapters 3 and 5, an electronic survey was distributed to tour guides at show caves across the world to solicit opinions and information about guide training procedures, tour evaluation, and the incorporation of science into tours, amongst other topics (please see Chapter 3 for detailed information about this data collection procedure). In total, 185 guides representing both privately- and publicly-owned show caves participated in this portion of the study. The following section details a selection of data from this survey. The remaining data are presented in Chapter 5.

Tour guides at karst show caves worldwide typically have little background knowledge in karst. For instance, 74 percent of tour guides who participated in the electronic survey distributed during this research had little if any formal geology, karst, or environmental background prior to employment at their respective show caves. Additionally, multiple guides indicated their only exposure to caves and karst was through information they had personally sought in books and magazines, show cave tours they experienced as tourists, or televised programs and movies discussing caves such as *Journey into Amazing Caves*.

participation in caving grottos and/or other group's activities was cited as experience by 18 percent of participants. However, discussions with grotto members which took place while collecting data presented in Chapter 4, revealed that multiple grotto participants are also not versed in cave and karst science.

Tour guides previous exposure to caves and karst were as varied at the four study sites as at all other caves encountered during this research project. For instance, a guide at Lost River Cave has a college degree in geology while another guide is a member of the armed forces and has no experience in caves or karst. In fact, the latter guide only works at the facility between military assignments. At Mammoth Cave National Park, a large majority of their guides also have little background in karst aside from what they are provided with after gaining employment at the park. Additionally, many of the park's employees, as well as those at Lost River Cave, are only seasonal so they have limited time to build their cave and karst knowledge through the park's abundant resources. Multiple full-time guides at Mammoth Cave have served for more than ten years.

Guides at Florida Caverns State Park collectively had the least amount of cave and karst experience prior to employment at the park. Specifically, only one guide at the park considers himself experienced in karst, although others have lived in north Florida for majority of their lives and have therefore visited area caves and springs multiple times. Similar to Florida Caverns, the guides of Cumberland Caverns had limited experience or backgrounds with karst prior to their employment. Aside from one guide who indicated he is active in karst education pursuits at area schools and environmental functions, all other guides at the facility stated their karst experiences are primarily limited to personal show and wild cave visits. Yet, despite the lack of prior knowledge of karst, most of the guides encountered during this research were enthusiastic about caves and were interested to learn more about karst.

The lack of karst experience and knowledge by show cave tour guides throughout the world is significant in that it highlights the importance of guide training. For tours to be both entertaining and educational, guides themselves must first be well versed in cave and karst science. At many facilities guides are allowed freedom and flexibility when creating their personal tours (in fact, every guide that participated in the survey stated they were allowed some freedom in their specific tour content). This can allow for guides unfamiliar with cave and karst science to provide poorly understood or erroneous information to show cave customers. However, 66 percent of these guides also indicated that they are given scripts to help deliver the information they present. In short, as stated by a guide from the Missouri, United States, "we study and come up with our own story line that best represents the tour and group that you are touring, but as with most caves that I have worked at guides are encouraged to mold their own tours, but with a list of things you have to say." Although this structure is necessary for enhancing the overall show cave experience for customers in that it allows for repeat customers to have differing experiences and more personalized tours, the limitation of this structure is the lack of scientific background of many guides, and as discussed below, the typically minimal amount of training they undergo.

The Impact of Tour Guide Training and Content

Despite the importance of guide training for the promotion of accurate cave and karst science, allowing necessary freedoms in tour content, and enhancing customer experiences, training procedures vary significantly from facility to facility and are overall insufficient. For instance, 37 percent of guides who participated in the electronic survey were trained with a single day of instruction and are given assigned readings. These guides were not individually assisted with developing interpretative tour content. Similarly, 26 percent of surveyed guides stated their training consisted of little more than a brief meeting with management personnel and being instructed to study cave- and historically-based readings (independently), and in many instances they were also responsible for finding these readings on their own. An additional 21 percent of guides stated their training solely consisted of following current guides which, as discussed in Chapter 5, can lead to the continuation of erroneous information from guide to guide especially when limited guidance is offered by management teams. Only 9 percent of guides stated they were offered comprehensive informational packets and multi-day training with facility operations management and interpretation personnel, and were instructed to follow current guides before being allowed to lead tours themselves.

Table 6.2: Tour Guides Discuss Training Procedures. Specifically, the following are selected tour guides responses when asked, "What process was involved in preparing you to lead tours at your facility? Please be as specific as possible."

Participant Comment	**Ownership**	**Location**
Two weeks of in-class training, then 2-3 weeks of job shadowing.	Public	South Dakota, USA
Interviewing other guides, reading books, exploring the landscape and cave, and studying maps; then creating my own outline and sticking to it.	Private	Canada
Shadowed tour guides for about a week, watched cave geology videos, read books on cave and karst geology, took several tests.	Private	Pennsylvania, USA
I knew absolutely nothing about caves so I learned from other guides and continued learning.	Private	Belize
Private caves I have worked at did not give much training, but at my facility now, I was given a 2 week in-service with 1 day spent with a state geologist.	Public	Arkansas, USA
We had to go through the cave with a script of what things needed to be said. We were given our own voice though in how we told our guests about the cave. We then had to follow 4 tours to see where to place our guests so that they could hear and see.	Private	France
Following other guides, reading script, reading additional materials.	Public	New Zealand
Books were given to me on the resources and I had access to our park library. Additionally, if I had questions I could ask our resource division rangers.	Public	New Mexico, USA
4 days of going on tours with an experienced guide	Private	Virginia, USA

Overall, based on survey respondents and interviews at privately- and publicly-owned facilities, guide training procedures vary significantly and no pattern of training procedures based on cave ownership emerged. Thus, this finding highlights the notion that the additional time and manpower resources typically available at publicly-managed facilities do not always translate into better trained guides or more educationally-rich tours at these locations. See Table 6.2 for a selection of tour guide responses when asked about the process involved in preparing them to lead tours and note the diversity of practices. These responses represent the most frequently noted training procedures.

Unlike the results of the worldwide survey discussed above, guide training at each of this study's research sites consists of multi-day training and following current guides. However, there is variation in the level of information guides are provided with to supplement these training sessions. For instance, at Mammoth Cave National Park guides receive multi-day introductory training related to the objectives set forth by the interpretation management staff. Although karst environments are very briefly discussed during this training, this is quite minimal compared to learning about cave science. Guides are provided with short booklets on the science and history of the cave, and scientific books are provided at the facility for guides to review on their own. Using this material and the aforementioned tour development guidelines (see Table 6.1) guides are allowed to create their own interpretative program provided he or she covers the objectives outline by management. Guides are required to submit outlines for their programs and have them approved by their immediate supervisors before presenting said program. These guides are periodically evaluated on the tour content, how they conduct tours, and their interactions with tourists, although the latter two are the primarily focus of the evaluations.

Florida Caverns State Park and Cumberland Caverns have a similar guide training structure as Mammoth Cave National Park, which includes multi-day information sessions and tailing current guides, yet the guides at these two facilities are provided with the least amount of 'take-home' material. In contrast, Lost River Cave and Valley offers employed guides the most comprehensive training of the four research sites. During the facility's multi-day information sessions, guides learn about every aspect of the cave and valley including cave and karst geology, the cultural history of the cave and surrounding area, natural flora/fauna, and cave ecosystems. They are also schooled in effective interpretation techniques. Guides are supplied with comprehensive seven-chapter guidebooks which contain scientific articles and generalized summaries of these writings, reviews of the material taught during the information sessions, visuals explaining more difficult scientific concepts, and explicit guidelines for effectively guiding tours and developing tour content to meet the goals of the facility. Additionally, during training workshops guides are lead throughout the facility grounds to allow for the visualization of the cave and karst science concepts discussed in the classroom. Guides at this facility are regularly evaluated by the facility manager, and in contrast to many show caves, are critiqued primarily on the accuracy and delivery of their tour content as opposed to customer relations.

Despite the ownership and management differences in worldwide show cave facilities and their training practices, tour guides at both privately- and publicly-owned facilities are recognizing the importance of proper training for tour improvement. For instance, when survey participates were asked "What do you feel would help you improve your tours?," 81 percent of guides indicated training and/or access to more educational material and consistent updates on this material as it becomes available via books or online resources would be beneficial. Leading smaller tour groups were also indicated by 34 percent of guides as a means to improve their tours, and 8 percent of surveyed tour guides desire training in interpretation techniques. No patterns in regional or ownership/management differences were associated with these responses. Thus, it seems tour guides universally agree more training and materials are needed for them to effectively develop and lead show cave tours.

Show Cave Tour Outcome Assessments

To gain a better understanding of the current characteristics and learning outcomes of show cave tour content, which are directly influenced by tour guide experience and training, pre- and post surveys/outcome assessments were distributed to guests at each of the four field sites selected for participation in this study before guides were retrained and changes to tour scripts implemented. The end goal of employing pre- and post-surveys was to determine current cave- and karst-centered learning from experiencing a guided show cave tour. Following this initial set of survey assessments, guides at each facility were observed while leading tours to determine what may have influenced guest assessment scores and then trained on interpretation techniques and cave and karst science. Following, tour scripts were adapted to incorporate more information on karst environments, not simply caves, in an overall attempt to increase the educational quality and quantity of each guide’s tours. Another set of pre- and post- surveys were then distributed to establish if any change in the knowledge outcomes of tour customers occurred with the implementation of improved tours. Please see Chapter 3 for a complete review of this study's outcomes assessment methods and considerations.

Pre-Training Survey Outcomes

Pre- and post-surveys were distributed at each site to establish the level of karst understanding of customers prior to visitation and to create a baseline for the degree of karst learning customers encounter during a guided tour. Survey questions included:

1) Please define the word karst or describe a karst landscape.
2) How is karst and caves formed?
3) Please indicate whether the following statements are true or false.
    a) Limestone rock acts as a good filter for water.
    b) Water can rapidly travel from the surface to subsurface in karst.
    c) Caves serve as a pathway for water to travel through karst.
    d) Cutting down trees is good for karst.
4) Describe how humans may impact karst through the following practices:
    a) Fertilizing lawns
    b) Filling in/closing sinkholes
    c) Dumping trash in sinkholes
5) Living organisms that are beneficial to humans are found caves?
6) Name one way pollution on the surface can make its way underground in karst areas?
7) Generally, how large might the area above ground be that affects a cave?

During the summer and fall of 2010, these surveys were completed by 114 Cumberland Caverns visitors, 126 at Florida Caverns State Park, 131 at Lost

River Cave, and 120 Mammoth Cave National Park. The same numbers of surveys were distributed at each facility following the retraining of guides and implementation of the more educationally-extensive tour content. Equivalent numbers of surveys were completed by males and females and different aged participants. See Appendices H through K for the complete data sets for each facility and Appendix F for the complete survey instrument.

On the whole, these pre- and post-surveys revealed that with the exception of knowledge related to cave biota (specifically bats), members of the general public visiting these show caves have little knowledge of karst terrains. 87.3 percent of the 972 adult survey participates who visited the four sites, collectively, were unable to answer more than two questions correctly at either time of pre-tour karst assessment distribution. Additionally, only 41 of these customers were able to correctly define karst and 57 visitors were able to vaguely describe how karst and/or caves form. No statistically significant differences were noted between post-tour assessment scores and gender, age, education, or residence at any of the four research sites before.

Unfortunately, post-tour surveys collected prior to implementing any tour changes revealed only 15 percent of visitors to three of the researched facilities (Cumberland Caverns, Florida Caverns, and Mammoth Cave), demonstrated an increase in karst knowledge (Figures 6.1-6.4), highlighting the potential inability of the initial tour content to educate about karst. Although Florida Caverns revealed a change from less than 10 percent to just over 20 percent increase in positive response, post-tour visitor surveys revealed customers were still largely unable to define or describe a karst landscape (question 1). Correctly answering questions related to how human actions, such as filling sinkholes (4b) or fertilizing lawns (4a), impact karst terrains was also still largely unfeasible. Characteristics of limestone rock such as the flow of water through karst (3b) or ability of limestone to filter pollutants (3a) were incorrectly answered by most guests. Noteworthy changes in the number of positive responses when visitors were asked about cave formation (question 2) were only documented at Mammoth Cave National Park and Florida Caverns State Park. Thus, the only noteworthy change in pre- and post-scores at each of the four study sites was related to the benefits of cave biota, particularly bats, which is central discussion points at most show cave tours (see Chapter 5).

It should be noted that an unexplainable decline in positive responses occurred at Florida Caverns and Cumberland Caverns. One limitation of this research is there is no guarantee that even if discussion topics which correspond to surveyed questions were covered during tours, visitors were listening and digesting the information. Pre- and post-survey affect, in that visitors see the survey twice, could also result in changes in positive responses and may therefore by a limitation of this study. Furthermore, a potential limitation could be that the survey instrument may have been too easy. However, the significant difference between percentages of post-tour, post-guide retraining positive responses and post-tour, pre-guide retraining correct responses (see discussion below) helps to illustrate that these survey data are in large part the result of tour guides not conveying information clearly or at all and are not the result of the aforementioned study limitations.

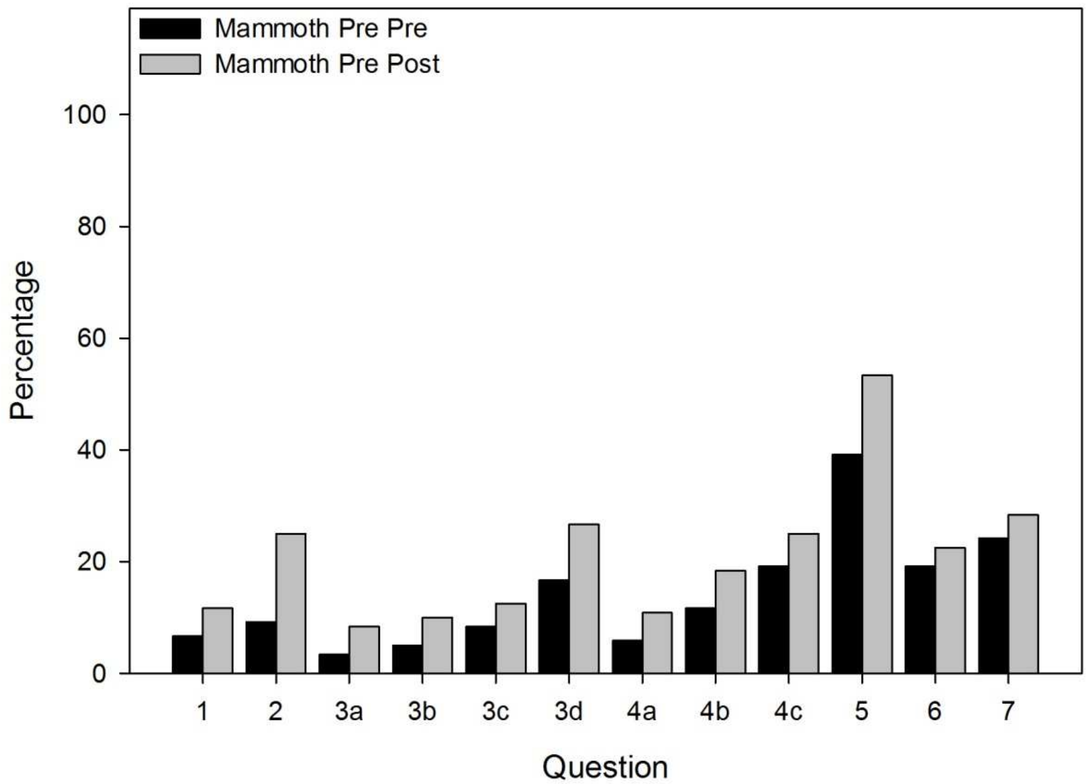

Figure 6.1: Mammoth Cave National Park Pre- and Post-tour Responses. Data were collected prior to the re-training of guides and implementation of tour content changes.

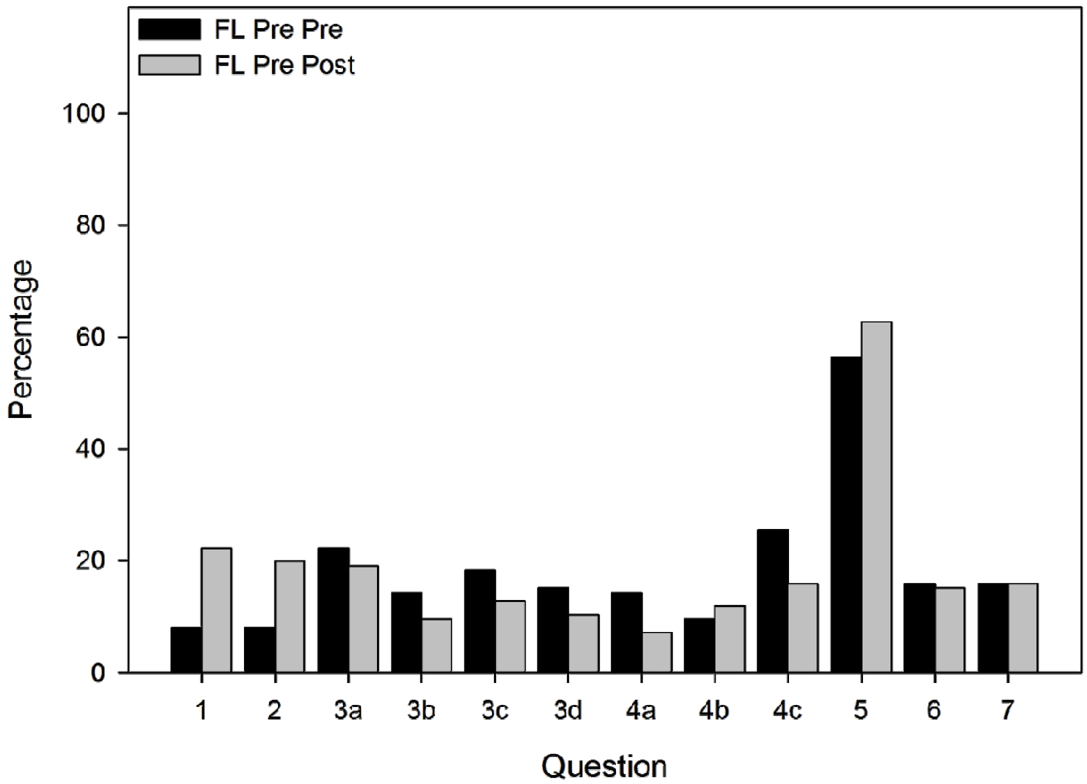

Figure 6.2: Florida Caverns State Park Pre- and Post-tour Responses. Responses collected prior to the re-training of guides and implementation of tour content changes.

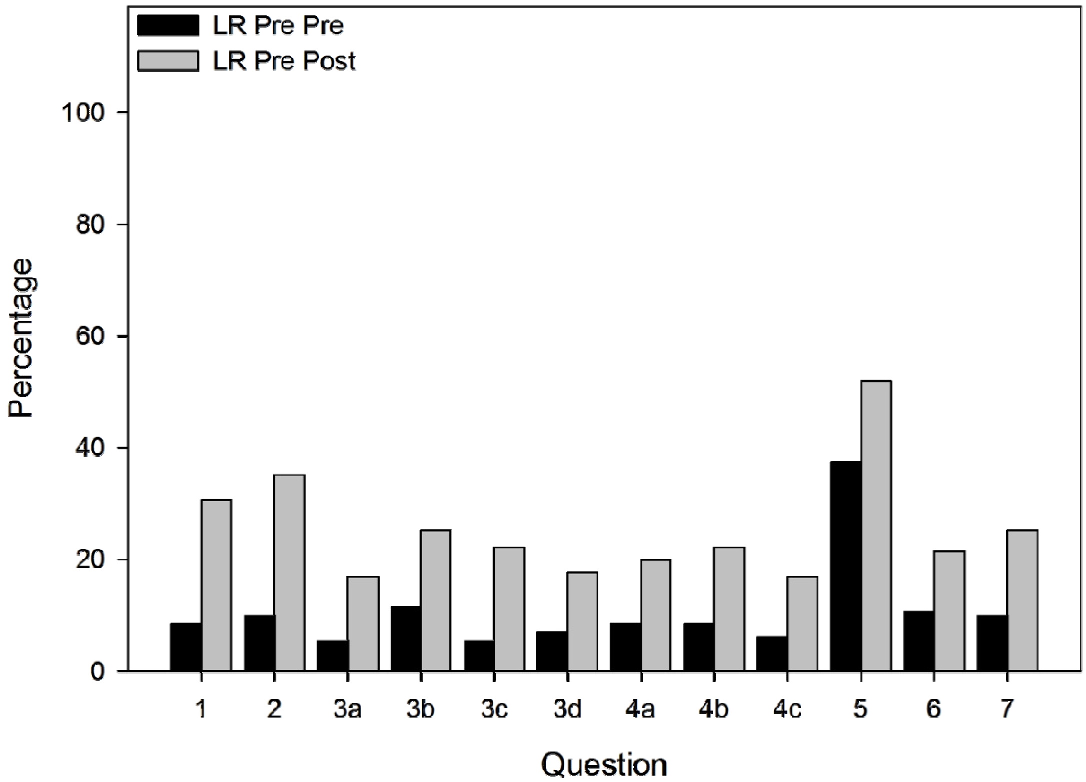

Figure 6.3: Lost River Cave and Valley Pre- and Post-tour Responses. Data were collected prior to the re-training of guides and implementation of any tour content changes.

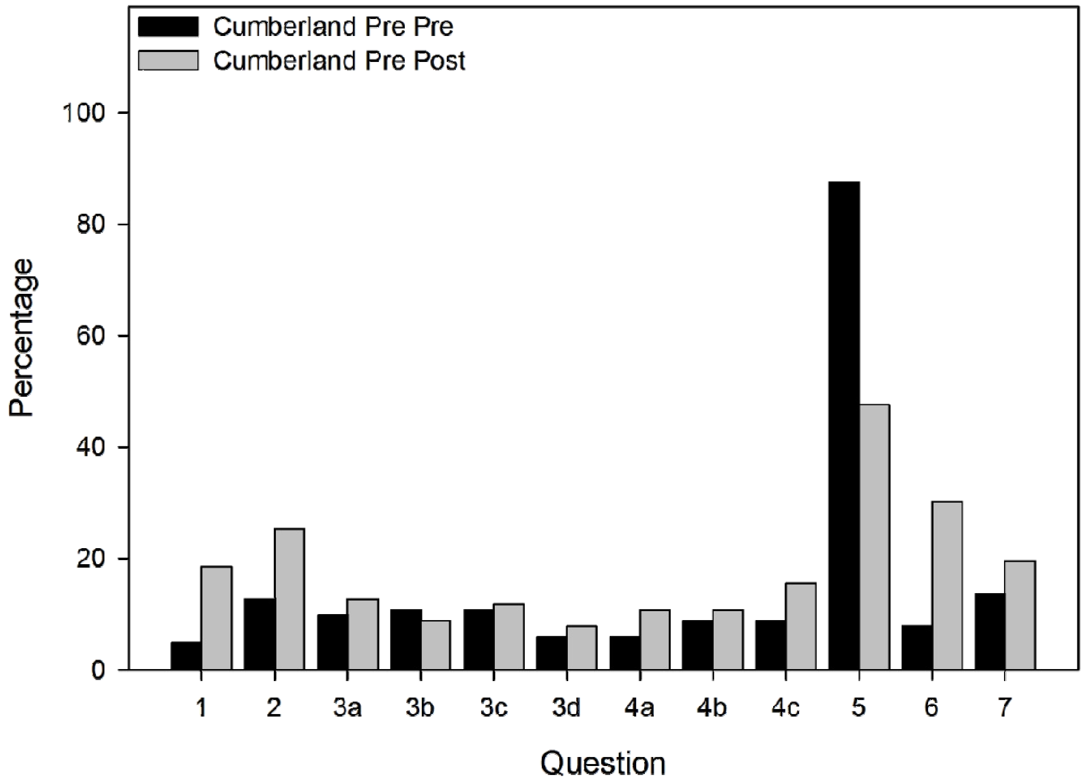

Figure 6.4: Cumberland Caverns Pre- and Post-tour Responses. Data were collected prior to the guide retraining and implementation of content changes.

In contrast to the remaining research sites, visitors to Lost River Cave and Valley had the most significant change between pre- and post-tour survey scores (see Figure 6.3). At the facility guests were able to accurately describe a karst landscape, the negative impacts of human actions on the land surface, the formation of caves and karst, and the inability of limestone rock to filter water. However, no substantial change was noted when asked about biota.

The increase in positive responses between pre- and post-tour surveys at Lost River Cave compared to the relatively insignificant change in karst understanding recorded at the other sites highlights the importance of guide training, tour content, and the physical characteristics of a show cave on learning. For instance, the Lost River Cave property contains a karst valley and multiple blue holes which are explored during the regular guided tours. As aforementioned, this facility's tours include a brief interpretative boat ride through the cave. Each of these features allows visitors to more easily visualize the presence of water and its influence on the landscape. Furthermore, Lost River Cave once served as a large community dump. This pollution and the resulting environmental and human health issues are discussed during each of the guided tours of the cave and valley. In addition, tour guides discuss cave pollution and discoloration of the walls which occurred when an agricultural site and leaking septic tanks were positioned on the land surface surrounding and directly above the cave.

The very close proximity of Lost River Cave and Valley to Western Kentucky University could also contribute to the increased commitment to promoting karst knowledge since scientific resources can be provided to the facility by University researchers with ease. Mammoth Cave National Park, however, is located approximately 40 minutes from this same University and therefore has access to the same resources and research as Lost River Cave. In fact, more research has been conducted at Mammoth Cave than any cave in the United States. Yet, as discussed above, visitors are not leaving this location with the same level of karst knowledge as visitors to Lost River Cave although both of these locations reflected higher assessment scores than the other research sites (thus, influence from the proximity to the University cannot be wholly discounted). In fact, the manager of Lost River Cave was once an employee of Western Kentucky University, and employees at Mammoth Cave National Park are currently geology instructors for the school, so the relationships between these facilities are strong.

Revising Guided Tours

The overwhelming lack of karst knowledge by members of the general public both before and after cave tours described above emphasized the critical need for re-training of guides to attempt to increase the educational quality and quantity of their tours. Please see Chapter 3 for detailed information on the methods employed during this portion of the study.

Participation by guides at the studied caves varied for different reasons. Guide participation at Mammoth Cave National Park was restricted by management-level staff, so only two guides at this facility were able to undergo retraining and alter their current tours. Large differences in scheduled work hours of guides at Lost River Cave and Valley lead management at this facility to recommend only three guides at their location to participate in the re-training procedures. Each full-time guide at Florida Caverns State Park and Cumberland Caverns received changes to existing scripts which they could implement independently, but only three guides underwent in-depth training as part of this study to maintain consistency at each research site.

Overall, selected guides were from diverse backgrounds and had varying levels of experience leading cave tours and understanding cave and karst science. This helped mimic realistic training situations where tour outcomes could be affected by the enthusiasm of guides and their ability to absorb or understand the information provided to them during retraining sessions. For instance, a geology graduate student who studies caves, and a male with no background in geology or caves or real interest in developing an interest in Lost River Cave or karst environments were selected for retraining at Lost River Cave and Valley. At Mammoth Cave National Park an employee who has worked for the facility for over ten years and a young male with no geology background and minimal college coursework were retrained. At Florida Caverns State Park, those selected for retraining included a female, temporary employee who was new to the facility, an elderly male who has lived in the area for his entire life and worked at the park for over fifteen years, and a male who had personal interest in caves, but with no college-level education. Lastly, guides selected at Cumberland Caverns included a middle-age man active in local caving activities and educational presentations at local schools, a woman with a personal interest in caves but no formal cave or karst science training, and a male with two years experience at the facility but no previous exposure to karst.

After guides were selected, the process of attempting to improve the educational quality and quantity of cave tours began by reviewing existing cave scripts and/or interpretation guidelines for the presence and accuracy of karst-specific material. Changes were made throughout these existing scripts and guidelines to connect existing cave-specific content to concepts which highlight the interconnectedness of karst terrains. All recommended changes to the tour content and its delivery were made using the theoretical underpinnings of the Contextual Model of Free-Choice Learning and Conceptual Change Theory (please see Chapter 2) (Posner et al. 1982; Magnusson et al. 1997; Falk and Dierking 2000; Falk and Storksdieck 2005). For instance, the Conceptual Change Theory states that the most significant influences to learning occur when fallacies for previous understanding are first discussed and then replaced with more accurate and appropriate information. Thus, during their revised tours, guides were instructed to communicate common misconceptions about karst environments, such as the surface and subsurface are not connected, and how this fact is inaccurate and that actions on the surface do directly influence the subsurface environment.

The Contextual Model of Free-Choice Learning (Falk and Dierking 2000; Falk and Storksdieck 2005) states, among other elements, that learning is more positively influenced if it occurs within the physical environment. One example of the implementation of this theory was the effort to educate the public on how surface pollution can impact the subsurface and consequently drinking water. For instance, guests were shown how pollution enters a cave by pointing out physically polluted features in the caves, so visitors could physically see pollution (which prior to the implementation of tour changes was not pointed out to tour guests) and clearly demonstrate the connection between surface activities and the subsurface. Thus, by coupling these two theoretical concepts, increased understanding of the interconnectedness and complexities of cave and karst environments should result.

Overall, at each facility guides were instructed to explicitly spell and define the word 'karst' at the beginning of the tours and to briefly describe karst landscapes and their interconnectedness. Guides were instructed to provide this information prior to entering the cave so visitors could visualize the entire karst landscape. The notion of caves and sinkholes as one small component of larger karst systems and the role of these features in karst, such as pathways for water, were also reviewed. When discussing the formation of speleothems, which typically entails describing how water comes from the land above and near the cave, scripts were changed to also discuss how other human pollutants from the land surface (such as pesticides on lawns) can seep through bedrock and reach the subsurface. Unless already discussed, the formation of caves (and karst) was included as was the ability of water to rapidly flow through karst. Cave managers and interpretation staff instructed guides to study the material and make changes to their individual tours as necessary to incorporate the new suggestions. Guides were also presented with a PowerPoint-based karst lecture (see Appendix G) and readings to increase their understanding of the karst science integrated into their tours.

Following the incorporation of this new material each guide chosen for participation was individually evaluated on the delivery and content of his or her tour and provided feedback as to where and how changes should be made (see Chapter 3). As per permit/research agreements and the request of management personnel at each site, copies of guide scripts and any associated changes cannot be included in this dissertation.

Post-Training Survey Outcomes

With the new tour content and its delivery fully implemented, pre- and post-tour surveys identical to those used to initially evaluate karst learning at each selected facility were distributed to participants of tours lead by the retrained guides. All data collection procedures remained the same as the prior round of survey distribution.

To recap, as revealed by pre- and post tour surveys, little enhancement of karst knowledge resulted after the public went on a show cave tour prior to implementing tour changes. In contrast, post-training surveys collectively found a 78 percent increase in karst knowledge between pre- and post-tour surveys. This indicates that proper training of guides and relatively minor changes to existing tour content and its delivery can have statistically significant impacts on the degree of karst learning at show caves (Figures 6.5 and 6.6).

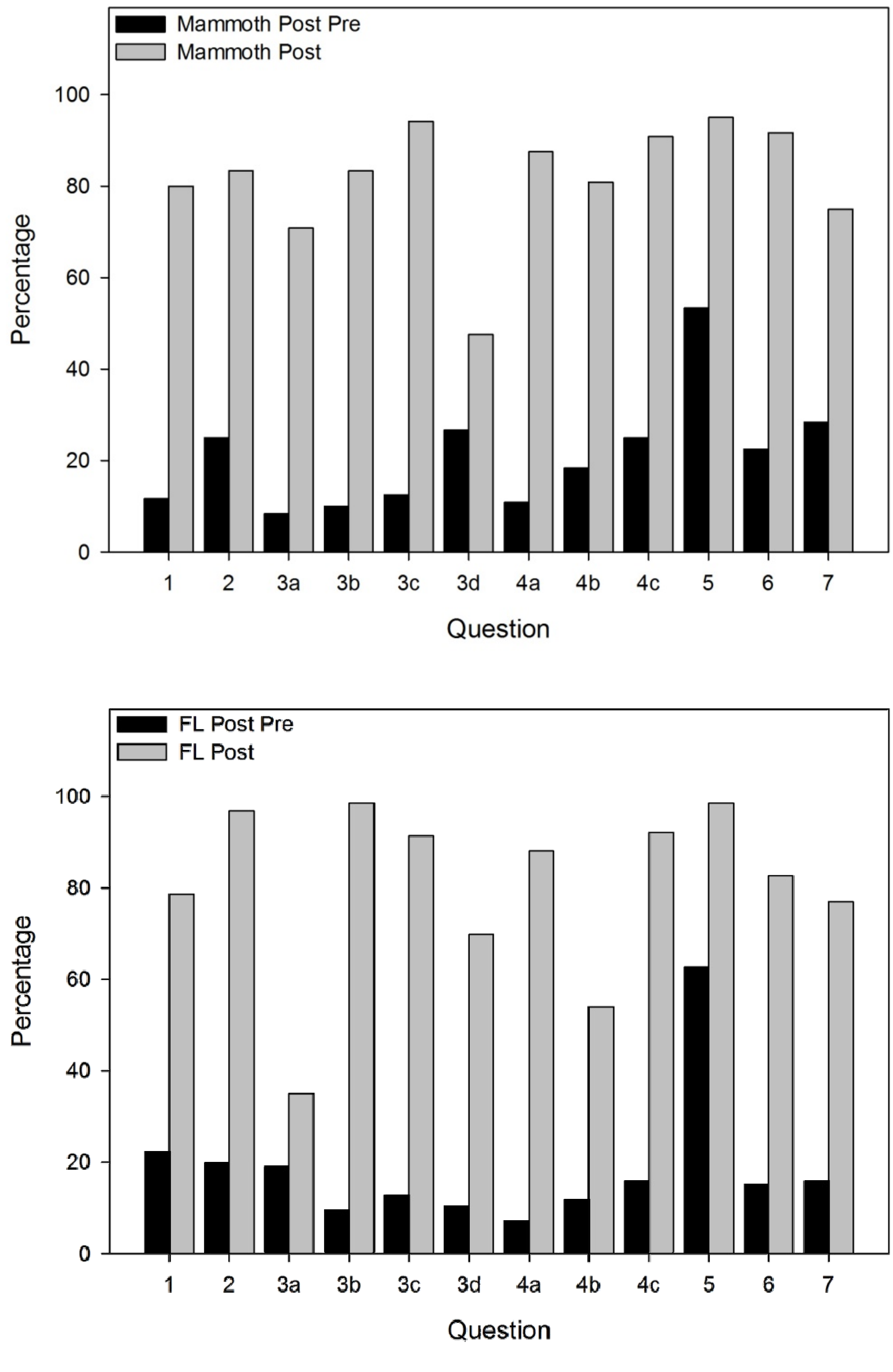

Figure 6.5: Post-tour Responses for Mammoth Cave (top) and Florida Caverns (bottom). Data collected before guided retraining (post, pre) and after (post).

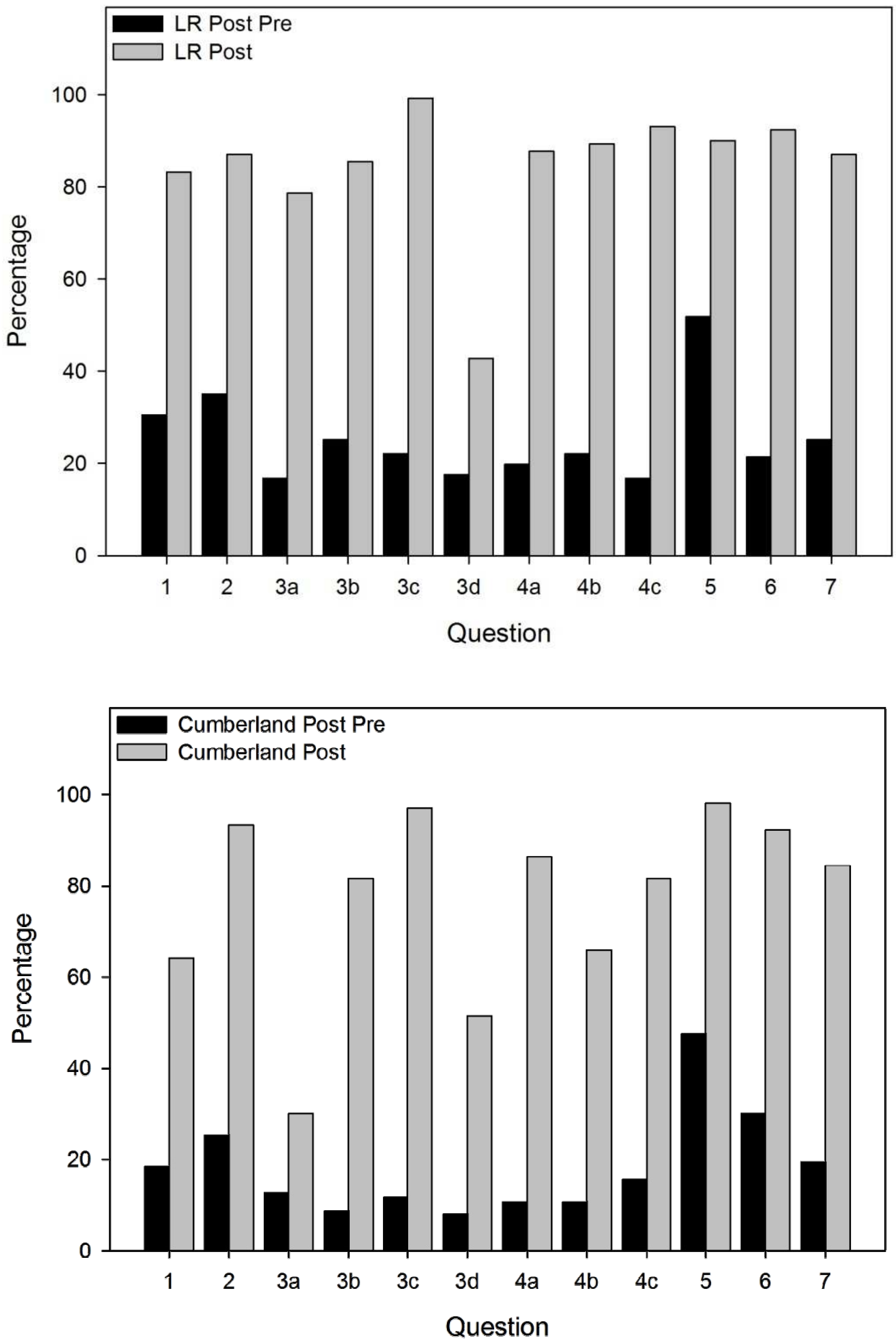

Figure 6.6: Post-tour Responses for Lost River Cave and Valley (top) and Cumberland Caverns (bottom). Data collected before guided retraining (post, pre) and after (post).

Analyzing survey data for each facility independently reveals survey questions with the largest change from pre- to post-tour surveys varies slightly by facility (see Figures 6.7-6.10), yet the largest overall improvement in post-tour learning (seen by comparing responses to all questions collectively) were noted at Lost River Cave and Florida Caverns State Park, while the least improvement was seen at Cumberland Caverns. These observations are, however, not statistically significant.

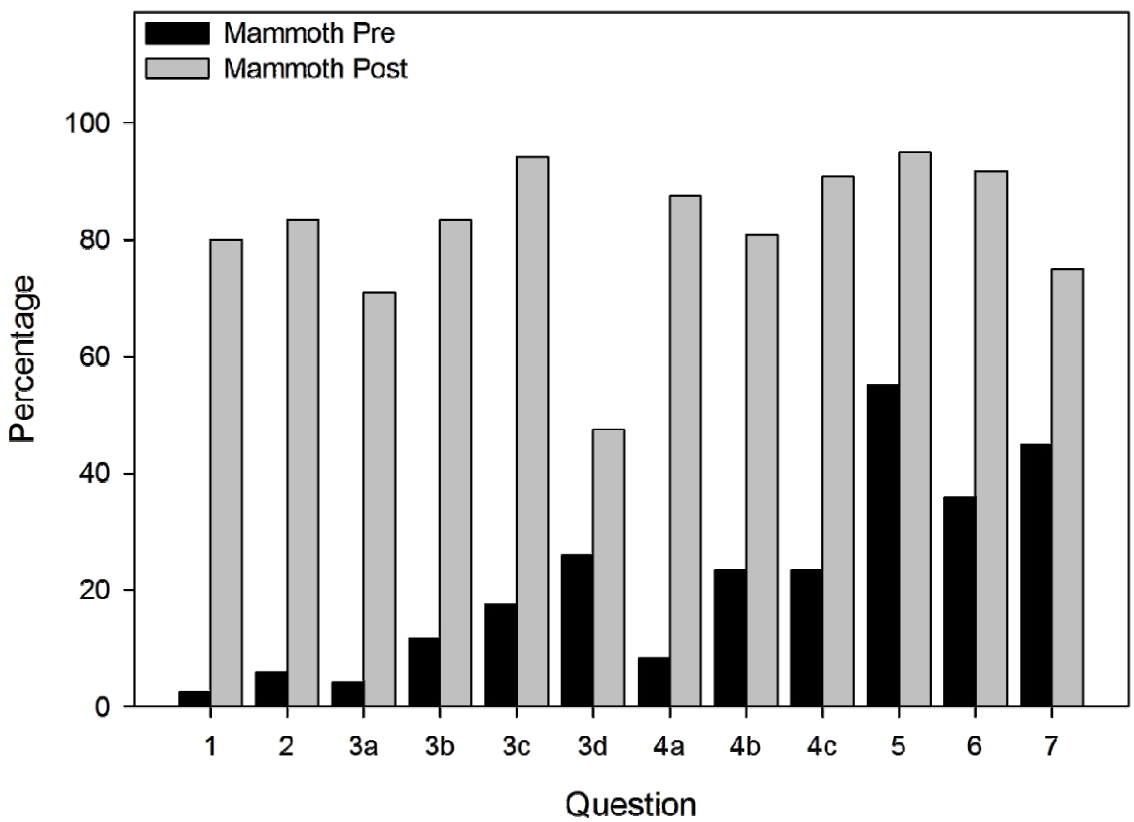

Figure 6.7: Mammoth Cave Pre- and Post-tour Responses (Post Training). Data collected after guides were retrained and tour content changes implemented.

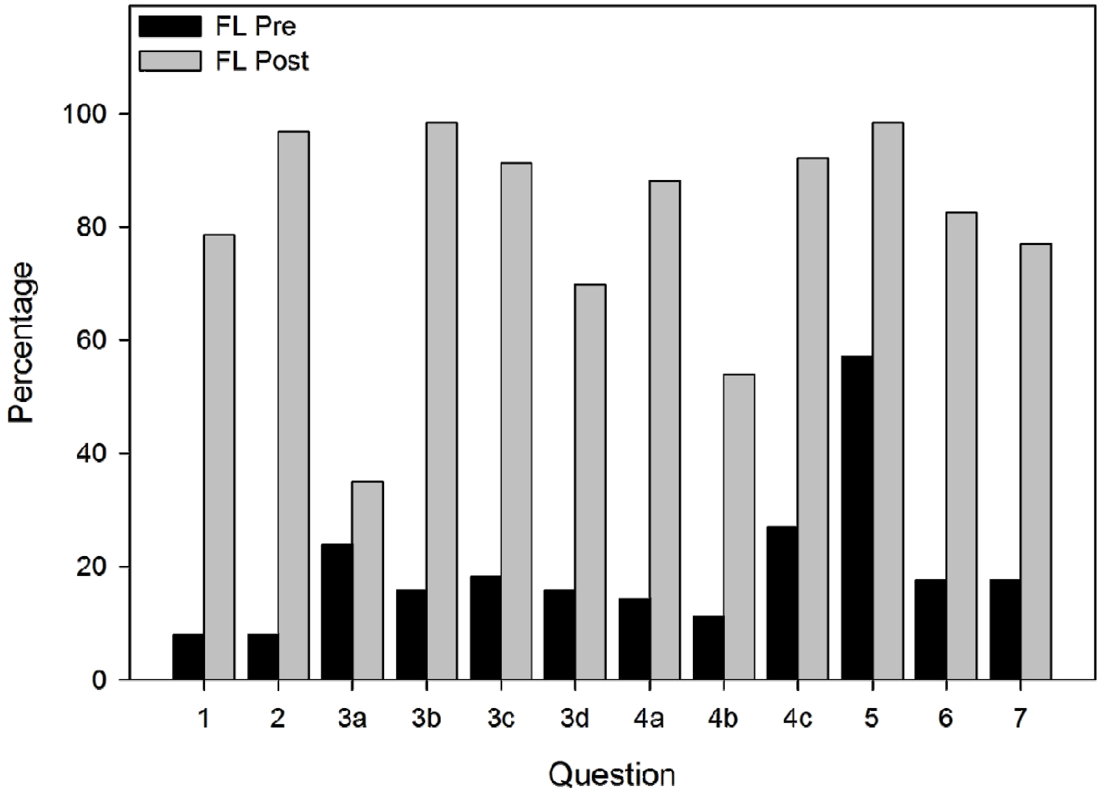

Figure 6.8: Florida Caverns Pre- and Post-tour Responses (Post-training). Data collected after guides were retrained and tour content changes implemented.

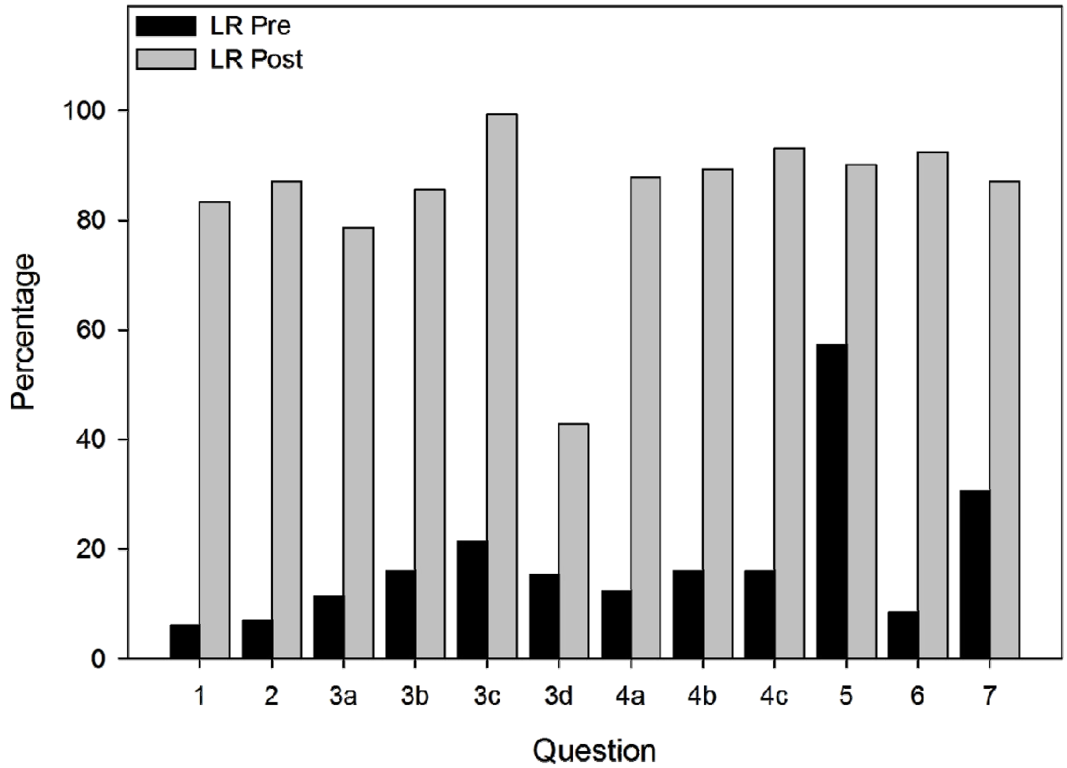

Figure 6.9: Lost River Cave and Valley Pre- and Post-tour Responses (Post-training). Data were collected after guides were retrained and tour content changes implemented.

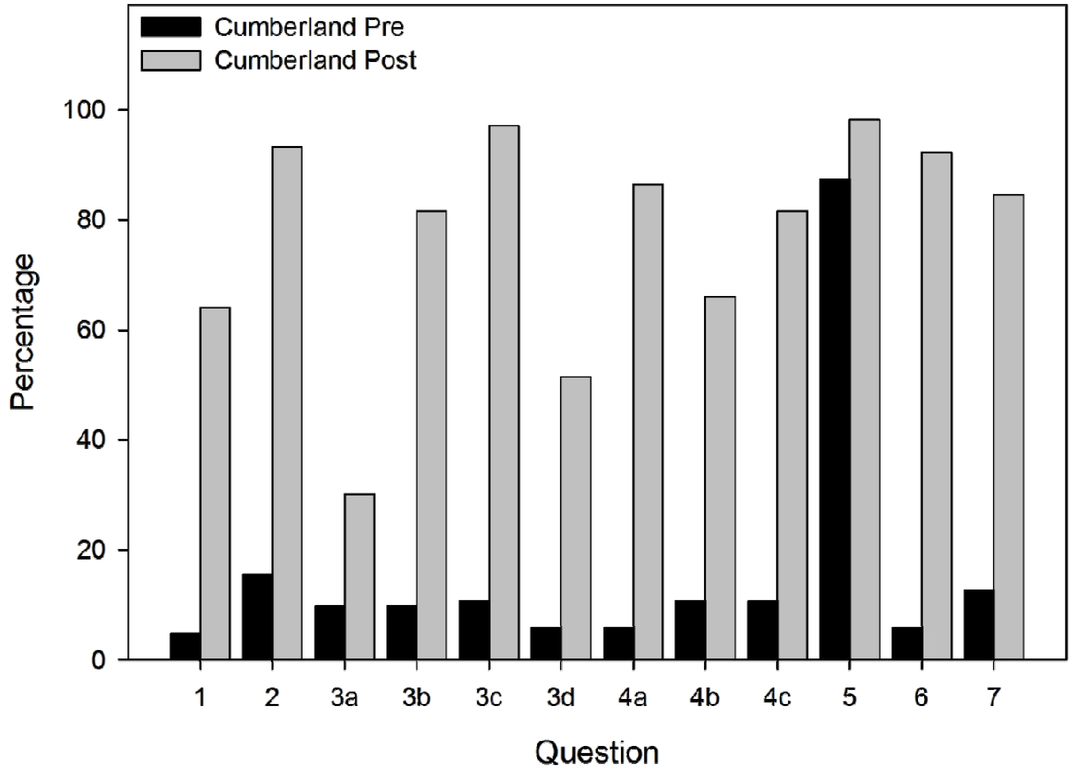

Figure 6.10: Cumberland Caverns Pre- and Post-tour Responses (Post-training). Data were collected after guides were retrained and tour content changes implemented.

Although no statistical differences were noted, visitors to Cumberland Caverns were the least successful at defining 'karst' or describing a 'karst landscape' on post-tour surveys despite the incorporation of the word into tour content (Figure 6.10). This may be the result of guides not clearly describing the term when the researcher was absent or the visitors were not listening to guides given the likelihood of being distraction by the grandeur of the cave. Nonetheless, significant improvement in the ability of guests to correctly describe karst and how caves and karst form from pre- to post-tour surveys was noted at each research site.

The series of questions specifically related to water, particularly Question 3a which asked guests to answer true or false to the statement, "Limestone rock acts as a good filter for water," showed the least amount significant of change from pre- to post-surveys. In fact, less than 30.1 percent and 34.92 percent of guests at Cumberland Caverns and Florida Caverns, respectively, were able to correctly answer this question post-tour (see Figures 6.8 and 6.10). Yet, guests were able to correctly answer questions 3b (water can rapidly travel from the surface to subsurface in karst areas) and 3c (caves serve as a pathway for water to travel through karst terrains). Specifically, more than ninety percent of guests to each of the four study sites could correctly answer question 3c as true, with over 99 percent of Lost River Cave and Valley guests correctly answering the same question. This finding supports the Contextual Model of Free-Choice Learning (Falk and Dierking 2000; Falk and Storksdieck 2005) in that guests were able to more clearly understand the latter questions related to the flow of water through a cave since they could hear or see water in the karst environment during their tour. Thus, the boat tour of Lost River Cave undoubtedly contributed to over 99 percent of guests to their facility being able to correctly answer question 3c. Positive response to question 3d (role of trees) was statistically lower than the remaining questions in the "3" series. Thus, the notion of trees providing some of the CO_2 needed for developing karst was not fully understood or explained by guides.

Questions regarding how humans may directly impact karst landscapes through fertilizing lawns, filling in and/or dumping trash into sinkholes or caves showed large improvement from pre- to post-tour surveys. Respectively, 66.02 and 53.97 percent of Cumberland Caverns and Florida Caverns guests were able to identify reasons why closing sinkholes can be detrimental to karst environments, compared to 89.31 and 80.83 percent of guests at Lost River Cave and Mammoth Cave. Although tour group sizes are comparable to Florida Caverns State Park and Cumberland Caverns, visitors at Lost River Cave more often answered this series of questions correctly than visitors to any of the remaining three study sites (this observation is not statistically significant at the 95 percent confidence interval (Figure 6.9)). Once again, these findings are likely attributable to the tour environment at Lost River Cave and Valley which has historical and scientific reports of damage caused to the karst environment of the Bowling Green, Kentucky area and the tour cave. Based on the learning theories highlighted in Chapter 2, the truthfulness and reality of these "stories" allows visitors to become more emotionally attached to the factual information of the tours and, therefore, more likely to remember and understand the spoken words.

The least significant change from pre- to post-tour answers at each of the four research sites were noted for question 5, which asks participants to identify if species beneficial to humans are located within caves, since pre-tour scores for this question were already initially higher than all other question responses. Positive responses to this question were also very high on pre-training surveys. This finding supports data collected in Chapter 4, which noted the significant prevalence of educational material for the adult general populace and children specifically related cave biota, particularly bats, compared to educational efforts for karst science. Although still high, Lost River Cave and Valley had the least number of correct responses to this question, which should be expected in that bats are not a central topic of the tours at this facility.

Post-tour performance on question 7 was slightly poorer compared to most assessment questions. The question asked people to identify the typical land area above a cave that may have the greatest influence on a cave, a question that attempted to measure visitor understanding of the connectedness of the surface and subsurface in karst regions. Retrained guides were never specifically told to quantify a land area above a cave that may impact the cave environment during tours (since it would not be known in most locations), which likely attributed to the reduced number of correct responses to this multiple choice question. Thus, although some visitors were able to correctly deduce (or randomly guess) that the land directly above the cave and nearby influence the subsurface environment based on the content of the tour, many others drew the conclusion that all of the land in a state directly influences a cave. This finding illustrates the need for specificity during karst tours in that visitors may draw inaccurate conclusions about karst environments since their understanding and exposure to the terrains prior to the cave tour are poor.

Influence of Survey Participant Characteristics

At Cumberland Caverns no statistically significant difference was noted between level of education and total quiz score (p=0.281). However, qualitative comparisons of median test scores between these groups indicates that persons with only a high school-level education scored lower than persons with some college or a bachelor's degree. The low sample set of persons reporting a masters-level education prevents comparison with other education levels. No statistically significant difference was also noted between age of participant (p=0.094), location of residence (p=0.124), or sex (p=0.124) and positive quiz responses.

Data from Florida Caverns were similar to those of Cumberland Caverns. For instance, no statistically significant difference was noted between level of education and positive quiz responses (p=0.068). However, the power of the performed ANOVA test (0.379) is lower than the desired power of 0.800. Thus, statistically speaking, there is a possibility that a difference does exist even though it was not detected. The same situation was revealed when comparing survey participants' ages to quiz responses; no statistically significant difference was determined (p=0.096), yet the power of the performed test was 0.306. At a 90 percent confidence level, there is a significant difference in the data. No significant differences exist between primary residence (p=0.487) or age (p=0.725) and quiz scores.

Statistically significant differences do not exist between age of participants (p=0.378), level of education (p=0.186), primary residence (p=0.364), or sex (p=0.417) and post-tour survey responses at Mammoth Cave National Park. Likewise, statistically significant differences also do not exist between age (p=0.582), residence (p=0.530), or sex (p=0.130) and quiz results at Lost River Cave and Valley. However, although no statistically significant difference exists between the level of education and survey responses at Lost River Cave (p=0.654), similar to results from Florida Caverns, the power of the performed test (0.049) was below the desired power of 0.800, so this negative result is interpreted with caution.

Inferences and Conclusion

Guides' previous exposure to caves and karst environments is not found to have a large impact on visitor experiences during guided tours or learning outcomes. As aforementioned, retrained guides were purposefully selected to reflect diversity in backgrounds and level of enthusiasm for caves and karst. Despite these differences, comparable numbers of positive responses to questions on the survey instrument were documented. Thus, regardless of whether a guide is working towards a degree in cave geology or is merely working at a show cave for little more reason than a lack of another job, show cave tour guides can be trained to provide enjoyable and educational tours with relative ease. Therefore, influencing the karst knowledge base of show cave visitors can be achieved by training guides using such methods as in-class learning sessions, individual guidance of scripts, and explicitly providing and interpreting scientific material.

Guides uncomfortable with their tour content or who do not understand the value and importance of promoting karst education for the general public (such as decreasing anthropogenic karst disturbance and protecting valuable water supplies) may impact the learning experience of their guests about karst by showing little enthusiasm. As a result, guests may begin to show disinterest in caves and karst, and therefore be less receptive to learning about karst science and its importance. Once guides were retrained they began to feel confident with the scientific content they were presenting and showed enthusiasm for learning about karst, not simply cave decorations, which was transferred to guests and reflected in the overwhelming number of '4' and '5' likert-scale survey responses and complete lack of '3' replies to the questions: "On a scale of 1 to 5 (5 representing the greatest) how would you rate the quality of your tour guide?," "how would you rate your tour in terms of enjoyment," and "Rate your overall satisfaction with your tour today." These responses, coupled with the notion that every surveyed guest indicated they were visiting the cave for purely entertainment or curiosity reasons, indicate the inaccuracy of the common manager and owner assumptions that guests do not want to be educated during show cave tours and that entertainment and education cannot exist simultaneously (please see Chapter 5).

Little influence on learning during show cave tours occurs from age, residence, sex, level of education, or purpose for visiting (all visitors indicated they visited the show cave because they wanted to see a cave or strictly for entertainment purposes). Although not statistically different, it is possible that females had higher average scores than males, in that more females had a series of correct responses than males.

The factor shown to have the largest impact on karst learning during a guided tour experience is the physical characteristics of the show cave property. For instance, Lost River Cave reflected the highest post-tour scores both before and after guide retraining. As aforementioned, this facility has a unique cave tour experience which features a boat tour and walking tour through a karst valley and around a series of karst windows. As a result, over 90 percent of visitors to this facility correctly answered questions about caves serving as a pathway for water, but had the lowest score for a question regarding the existence of cave biota in the cave. Cave biota, particularly bats, are not as prevalent at this facility as the others that were researched and therefore cave species are not a central topic of the Lost River Cave and Valley guided tour. Similarly, visitors to Florida Caverns State Park more frequently indicated the correct answer, 'false,' when asked "cutting down trees is good for karst." At this facility, tours begin with a walk along a heavily-wooded trail, so the role of trees in karst and cave development is discussed while visitors are experiencing a forested environment (which correlates with the learning theories and interpretation guidelines highlighted in Chapter 2). Furthermore, this show cave property also features a karst spring which allows guests to visualize water in the environment. Overall, every karst terrain and cave environment varies, with each having unique entrance features, surface features, biota, etc. Maximizing the benefits of each uniqueness by using them to visually illustrate karst-science topics to customers on tours is essential to the successful promotion of public karst understanding.

In contrast to this finding, differences in the presence or lack of speleothems do not significantly impact tour learning. For instance, although Cumberland Caverns and Florida Caverns are highly decorated show caves, while Lost River Cave and Valley and Mammoth Cave are not, post-training scores still greatly improved over pre-training survey scores and no strong statistically significant differences between site scores were noted. Guides and management personnel at multiple show caves, including the four research sites, repeatedly stated guests often do not pay attention to the tour content because he or she is “too busy taking pictures” and otherwise looking at the formations. This study has shown that this reasoning for poor tour content and/or the lack of knowledge customers depart show caves with is simply inaccurate. Tour guests can be educated about karst regardless of the grandeur of a cave’s size or number of beautiful decorations.

Ownership was found to have little significant impact on tour learning. For instance, the privately-owned facility of Cumberland Caverns had the least change from pre- to post-tours, while Lost River Cave and Valley, had the largest change although it is also a privately-managed facility. Likewise, Mammoth Cave National Park, which theoretically should have the most educational resources and personnel to create interpretative tours since they are a United States national park based on a karst resource, did not reveal any significant differences in tour learning or emphasis on cave and karst science compared to the remaining research sites. Thus, cave and karst experts/researchers/explorers wanting to assist in promoting the level of public karst knowledge in their region should not automatically assume area state and federal facilities have karst science sufficiently incorporated into tours. These facilities, which often have more visitors than smaller, privately-owned operations due to their status as a government facility, may be as desperate for help developing and incorporating karst science into their tours as local privately-owned facilities, yet are likely not getting assistance due to clearly wrong assumptions. Lastly, this study shows publicly-owned facilities should be attempting to do more with the manpower and monetary resources they may have access to.

Access to outside scientific resources were not influential on tour content in that both Mammoth Cave National Park and Lost River Cave and Valley are within an hour drive of Western Kentucky University which houses the Hoffman Environmental Research Institute, Center for Cave and Karst Study, Karst Field

Studies Program, and Crawford Hydrology Lab, yet prior to guide retraining, visitors at Mammoth Cave National Park had comparable post-tour learning outcomes to Cumberland Caverns and Florida Caverns State Park. Thus, access to and the presence of outside resources has little impact on the use of those resources. Cumberland Caverns was able to collect tour information using web resources and cave science books prior to initiation of this project, yet simply never incorporated the information into their tours. In short, access to information does not always correlate into utilization of said information. This seems to be particularly true when cave and/or karst experts/researchers are not available to assist in the actual interpretation of information. Providing karst material is not enough, we must ensure that the material is clearly described in layman terms and that managers are clearly shown where and how the material can be incorporated into existing tours.

Even though each of the four researched show cave facilities had varying tour sizes, every site had visitors who were able to perform well on the outcomes assessment after guide retraining and tour content changes were undertaken. Hence, tour size is not considered to have a significant influence on learning. However, this result does contradict with some post-tour interviews where multiple visitors expressed the desire that their tour group be smaller since they had difficulties hearing the guide. Discussions with visitors to Mammoth Cave National Park and comments written on surveys from this facility also consistently stated they would have been able to offer better descriptions of karst environments and explanations for how karst is formed, yet they were distracted by the excessive number of other guests and/or could not hear the guide as clearly as desired. Thus, since entertainment and satisfaction are of high importance to show cave operators and managers, it is recommended that cave operators pursue smaller tour groups to create an opportunity for improving the education of tour groups and entertainment simultaneously.

In conclusion, this study found that show caves can easily and effectively change their current tour content to increase their educational quality without negatively impacting its entertainment value. Instituting the required changes only needed two days of training and slight changes to existing tour scripts such as spelling the word karst, discussing previous misconceptions about caves and karst prior to offering new, more accurate information, and using the physical environment to specifically demonstrate instances of anthropogenic disturbance. Each of these suggested changes were based on informal learning theories which are designed to maximize learning in environments such as show caves (see Chapter 2). Thus, providing cave and karst science information to show cave operators, getting their interpretation staff to incorporate this information into tours and having knowledgeable staff to train guides are a bigger challenge than changing tour content. Yet, as shown by data collected at Mammoth Cave National Park, even when facilities do have ample access to scientific resources at no cost, there are no guarantees the resources will be incorporated.

CHAPTER SEVEN: SUMMARY AND CONCLUSIONS

Karst terrains are interconnected, fragile environments which possess water, mineral, and fossil fuel resources, as well as unique features, such as caves and springs. The rapid transport of percolating water through karst, inability of carbonate bedrocks to effectively filter water, and highly specialized nature of subterranean biota, heightens the susceptibility of these landscapes to extensive environmental degradation from human action (van Beynen et al. 2006; North et al. 2009). Commonly unobserved or ignored instances of disturbances occur because of the poor dissemination of scientific information to the general populace and policymakers, and are compounded by budgetary and time constraints of municipalities curtailing or ignoring enforcement of karst regulations (Hildreth-Werker and Werker 2006; Fleury 2009).

It is hoped a remedy for karst management shortcomings will come by aiming educational efforts pertaining to the vulnerability and interconnectedness of karst terrains at the general public. Little is known about how this may be specifically accomplished in karst regions. However, as previously discussed, the initial guiding principles of environmental education are designed to encourage people to be active participants in the fight for environmental protection through the exposure to standardized (or formal) environmental curriculum (Weilbacher 1993). Because the average person only spends approximately three percent of his or her lifetime in school, merely a small percentage of a person's knowledge is actually obtained in formal educational settings (Falk 2001). For years, multiple informal learning attractions such as museums and zoos have recognized this inability of formal education to fulfill the learning needs of society and, in response, have continually expanded support for their outreach programs. Informal karst attractions have not responded in the same manner, nor have many researchers made significant attempts to comprehensively evaluate karst education, which is quite unfortunate since karst education is not incorporated in any significant manner in formal learning settings.

Consequently, there is a need for a continued comprehensive study investigating the role of informal environmental education as an option to facilitate the protection and conservation of all aspects karst terrains. The purpose of this study was therefore to evaluate and develop an understanding of the potential role of informal environmental education at show caves. More specifically, the purpose of this study was threefold: 1) analyze current informal karst education efforts being pursued in the United States and abroad, 2) qualitatively and quantitatively establish the characteristics of the educational material currently presented to tourists visiting show caves, and 3) evaluate the effects of providing high quality and quantity educational karst material to visitors through the re-training of current show cave guides at four study sites in the United States. Utilizing a variety of research techniques including archival research, personal interviews, electronic surveys, and outcomes assessments, each of these aforementioned goals were achieved (please see below).

These data collection techniques were employed to help answer a series of four research sub-questions:

1) What is the status and overarching characteristics of karst-related education opportunities in the United States and abroad?

2) What are the characteristics of the educational material currently presented to tourists visiting show caves in the United States and internationally, particularly Europe? Do differences exist?

3) How and where do karst attraction operators obtain their karst-related educational materials? Do differences in the nature of educational material exist with ownership (i.e. private vs. governmental) at karst attractions?

4) What barriers/obstacles stand in the way of successfully educating visitors to karst attractions, despite an increased amount of educational material (i.e. funding, cooperation, implementation)?

Investigating the first of these questions (determine what is the status and overarching characteristics of karst-related education opportunities in the United States and abroad) required systematically reviewing karst-specific educational endeavors in the United States at both a national- and state-level and international programs nationally. Analysis of the characteristics and major trends of all karst educational efforts seemingly revealed abundance in both the

United States and abroad. However, in actuality over 54 percent of the educational pursuits in the United States focus solely on cave environments or are only narrowly concerned with karst terrains as interconnected, unique and fragile environments. A result of this narrow education focus on caves is that these efforts fail to increase the public understanding of karst environments as being complex, interconnected and distinctive when compared to other landscapes. Instead our current efforts are more likely perpetuating the series of common karst misconceptions highlighted in Chapter 2, including the notion that caves and sinkholes are exclusive landscape features which have no influence on groundwater quality or other neighboring karst landforms.

As the extensive review of literature in Chapter 2 clearly illustrated negative impacts to karst landscapes and their features are common and widespread. Yet, scientific knowledge regarding karst is not disseminated to the population at large. Specifically, this research revealed a lack of focus on adult learning in the United States. Children are the target audience in only 11 percent of karst education efforts reviewed in foreign countries, while 41 percent of United States education endeavors are directed strictly at children. Although 41 percent is a minority of the total efforts in the United States, this percentage is considerably higher compared to international locations. Additionally, although adults can utilize them, most of the remaining 59 percent of endeavors are developed for children, meaning adults are still not the target audience. Yet, adult actions, not those of children, are the primary source of degradation in natural environments, and adults have a greater ability to influence policy development and enforcement in communities (Swan and Stapp 1974; Fagan 1996). Even though educational programs for children are important, these endeavors will likely not result in an immediate decrease in the occurrence of significant karst degradation. As a consequence of this, the benefits of these educational pursuits will only be valuable for reducing karst degradation once the educated children reach adulthood. Meanwhile, multiple karst landscapes will continue to become impacted, with many of them quite likely driven to the point of complete, irreversible degradation.

Another finding drawn from data presented in Chapter 4 is the fact that international environmental agencies are primarily not the source of educational material and instead strictly serve as regulatory bodies. In the United States such agencies commonly provide educational materials when budgets and time constraints are not prohibitive. Additionally, an overwhelming number of endeavors by non-governmental organizations/groups consist of little more than website content in both the United States and abroad, due to financial shortages. Thus, possible sources of karst education for the general public are already limited and are continually becoming even more limited as economic downturns impact regions worldwide. As a result, every opportunity for karst education, such as show cave tours, should attempt to maximize karst understanding by providing high quality, entertaining karst science-rich tours, and all karst outreach programs which funding still permits must increase the breadth of their educational content from a cave- and sinkhole-centric focus to a karst- and groundwater-centric focus.

Contrary to common assumptions, the quantity of education opportunities for children and adults in the United States and internationally do not correlate with the amount of karst in a nation or state. Thus, the limited actions of governmental and non-governmental groups to increase karst knowledge is apparently low in much of the world regardless of the presence of karst landscapes or exposure of the population to cave/karst environments, thereby perpetuating an inadequate and/or erroneous understanding of this terrain. Even environmental policy and other management strategies in karst terrains are lacking or inefficient (Fleury 2009) and therefore cannot currently be relied upon for the immediate protection of karst. To supplement the current inadequacies of karst policy and fill educational gaps, another approach is clearly needed, such as investigating the potential educational benefits attainable through both privately- and publicly-owned karst tourism attractions.

Chapters 5 and 6 examined karst education through tourist venues, particularly show caves, in an effort to establish if these locations are in fact fulfilling the educational needs of the general public which currently are not being met by other agencies, clubs and organizations. In general, operators of most nature-based tourism facilities "have no idea whether their clients' understanding and appreciation of nature…are enhanced as a result of their guided tour experience" (Weilker and Ham 2001, p. 4). As revealed through this study, the same can be said for karst-themed tourism facilities, particularly show caves. In fact the historic focus of both publicly- and privately-owned show cave tours has been entertainment, with little attention being paid to increasing public knowledge of karst environments. Saveland (1974) argues although the informal education function at these venues sometimes becomes a secondary priority to entertainment, their acceptance of an obligation to educate symbolizes the public's general acceptance of learning about environmental issues outside of traditional classroom settings. Yet, no study could be found which investigated how many show cave facilities worldwide are serving the entertainment desires of their audiences while also contributing to their level of karst knowledge.

The results of Chapters 5 and 6 found no statistical significant differences were found when making regional-level or ownership comparisons of show cave characteristics. However, many international caves have efforts to support at least four of the five investigated assessment categories in some capacity (educational tools, science on websites, educational programs for children, etc.), indicating there is diversity in educational opportunities where they are pursued. Nonetheless, the learning and enjoyment outcomes of these efforts and those undertaken at United States show caves are unknown. This is because an overwhelming number, 91.2 percent of the 212 privately-owned show caves in the United States and abroad, collectively, have not undertaken a complete evaluation of their guided tours or any interpretative materials offered at their site. 63 percent of the 114 state or federal-level facilities worldwide which were investigated during this study, have pursued at least one partial program evaluation. Thus, privately-owned worldwide show caves base the quality of their educational efforts on the number of visitors they receive and emphasize customer relations and experience rather than tour content when evaluating tour guides. Simply put, data reveal the universal trend, regardless of ownership/management or location, that the level of concern for adult learning is negligible compared to that of children and there is no clear understanding of the benefits of most facilities ’ varied interpretative offerings.

Contrasts in the variety of educational opportunities available at show caves and their underutilization were found during this research. For instance, despite the ease with which show cave websites could serve as an advanced organizer for visitors (Ausubel 1978), only 29.7 percent of international facilities and 63 percent of the total show caves investigated in the United States had karst-specific material available on their webpages. The lower percentage of website usage amongst international sites is likely attributable to differences in the degree of economic and infrastructural development in foreign countries. Moreover, although 63 percent is a majority of facilities in the United States, the lack of abundant science information on 37 percent of US show cave websites, where access to internet resource are abundant and widespread, highlights a useful, simple educational opportunity that is not used to its fullest potential. Moreover, as Merriam and Brockett (1997) argue the geographic, demographic, education, socioeconomic, and/or other cultural determinants of a region are clearly limiting willingness or access to informal environmental education.

No significant regional differences were noted with regard to the presence of any other interpretative learning tool. However, more than 89.4 percent of publicly-owned/managed facilities in the United States and internationally have educational tools designed to supplement tour content compared to only 50 percent of privately-owned operations. This finding reflects the role of money in operational decisions at private facilities (since diversifying education rarely comes without added monetary and man-power costs) and emphasizes the need for developing future studies which can demonstrate the usefulness and importance of pursuing the diversification of education at private facilities so cave managers are more inclined to educate their customers.

Reinforcement of spoken educational information is necessary to maximize learning (Jurin et al. 2010), yet facilities typically fail to do so even when the scientific information is available for use. In particular, this study found the inaccuracy of a common and understandable assumption that facilities with interpretative tools on the science of karst environments also have tours which feature karst as well as cave science. Not including karst education during tours was driven by fears of the loss of entertainment which typically dominates management and interpretation decisions at show caves. However, learning which occurs through informal institutions is commonly referred to as free-choice learning, "learning experiences where the learner exercises a large degree of choice and control over the what, when, and why of learning" (Falk 2005, p. 265). Yet, as this research shows, the general public is typically not given the choice to learn about karst while exploring caves. Too often managers are making the rash decision that entertainment and education cannot coexist or that people don't want to be educated, which this study demonstrates in not necessarily true.

Internationally, the Czech and Slovak Republics, Australia, Slovenia, Britain, and Italy, which possess large areas of karst, have the highest ratio of show caves with karst science incorporated into their tours for the adult general public. In the United States, show caves in Texas, Ohio, Kentucky, California, and Missouri reported the most tours which incorporate karst science. Other states have little to any karst and/or show caves. In the United States, locations with the largest percentages of karst education efforts typically do not have cave tours which mimic the same level of commitment to increasing the degree of karst knowledge as the grottos, museums, science centers, and government agencies in their regions. Yet, as previously discussed, available resources for multiple grottos, museums, science centers, and government agencies is decreasing in karst regions all over the world as economic crises loom, leaving karst education to fall to the wayside. Thus, if multiple show caves continue to not contribute to or supplement existing efforts to educate the general adult and youth populace, karst knowledge will likely continue to decrease in quantity and therefore it can be assumed that instances of karst degradation will continue and potentially increase because of growing human populations and rural/urban development ventures.

The source of tour content, which can also serve as an indicator of the potential quality of the material, was found to vary significantly between facilities. Specifically, data reveal the primary source for information are geology textbooks and scientific reports from researchers and government agencies (42 percent of survey respondents), followed by the United States National Speleological Society (16 percent), local cavers (12 percent), universities (10 percent), and other show caves (21 percent of respondents). The notion that the two largest sources of information are textbooks, which require personnel (who are usually uneducated about karst) to interpret the material by themselves, and other show caves, which may be offering erroneous data, suggests problems with the dissemination of education at karst attractions. This problem can be easily addressed by the development of holistic and accessible education resources. Additionally, when caving groups are the source of educational content at show caves, their main focus of caves alone may cause the perpetuation of tour content at karst facilities to concentrate purely on caves.

Perhaps the most striking finding of the data presented in Chapter 5 is the disconnect between manager, operator, tour guide, and interpretation staff opinion about the role of show caves in education and current show cave characteristics. Specifically, despite the overwhelming lack of focus on karst terrains during cave tours which was revealed during this research, 82.3 percent of the aforementioned personnel indicated 'no' when asked if the general public is adequately educated about karst science, and 71.4 percent when asked the same question about youth populations. Additionally, 87.3 percent of participant agreed or strongly agreed that privately-owned show caves have a role to play in educating the general public about karst, while 80 percent felt show caves should be held partially responsible for educating school children.

This finding suggests the inaccuracy of common perceptions of show caves not understanding the importance of karst education and/or facilities do not want to be bothered with educational endeavors. The real root of the lack of education at show caves is funding and availability and understanding of resources. If free resources were made readily available or caving grottos, nonprofit organizations, and universities invested more time into assisting these facilities, the educational gap which is perpetuating karst degradation could be overcome. Instead, too often these sources of knowledge either focus on studying the degradation of the cave itself, relay scientific messages to owners without offering simple, interpretative explanations that could be presented to visitors, or solely develop educational tools such as signs and brochures rather than developing tour content.

In order for this research to encourage show cave owners and managers to promote education at their facilities around the world, they must first be shown that entertainment and education can simultaneously occur and that many of their guests may want to experience more science-rich tours.

Additionally, evaluating tour learning outcomes increases the organizational capacity of facilities to make evidence-based decisions about interpretive program designs and areas for improvement. Thus, show cave facilities were investigated to determine what visitors are currently experiencing at show caves, the role of a cave's physical features and tour guides on learning, and the educational quality of the guided tours to determine if manager's perspectives about the quality of their offered tours are accurate.

Collected data from four United States show caves and an electronic survey found karst learning through show cave tours is insufficient. In total, 87.3 percent of 972 participants to four study sites were unable to answer more than 2 of 12 questions correctly about karst environments either before or after the completion of their tours. In fact, only 37 individuals could correctly define karst and 42 could vaguely describe cave/karst formation before tours. Even after tours only 15 percent of visitors surveyed prior to the implementation of tour content changes showed any improvement in their assessments. No statistically significant differences were noted between assessment scores and the gender, age, education, or residence of those individuals surveyed.

Directed by the Contextual Model of Free-Choice Learning (Falk and Dierking 2000; Falk and Storksdieck 2005) and Conceptual Change Theories (Posner et al. 1982; and Magnusson et al. 1997), tour guides were re-trained on delivering tours and changes were incorporated in existing tour scripts. The result of these changes was a 78 percent increase in karst knowledge between pre- and post-surveys, which is in direct contrast to initial assessment scores. This finding is understandable when considering that the goal of environmental interpretation in informal settings is to communicate material concerning environmental sustainability issues in a way that is entertaining, meaningful, and interesting, so a visitor is personally motivated to absorb new knowledge (Heimlich 1993). Encouraging guides to create cognitive conflicts (see Chapter 2) by asking visitors about their existing perceptions and understanding of caves and karst, and then illustrating why these perceptions were inaccurate before discussing accurate cave and karst science proved highly effective at promoting learning. Furthermore, Tilden's (1977) guidelines for interpretation successfully helped improve tours that discussed relevant and current cave and karst issues and drew from personal experiences of the visitors and guide to evoke positive feedback from guests and improved attitudes about the value of protecting karst areas from degradation. Thus, when guides equipped with a full understanding of interpretation techniques they are able to deliver tours which allow visitors to easily depart facilities with a greatly improved understanding of karst terrains, thereby supporting existing informal learning and interpretation theories.

Visitors to Lost River Cave and Valley showed the greatest improvements in post-tour scores, while the least improvement was seen on visitor surveys from Cumberland Caverns, although both of these facilities are privately-owned. Likewise, although Mammoth Cave National Park is a federally-owned facility, and therefore likely has access to the greatest quantity of financial support, educational resources, and personnel able to train guides and develop interpretative tours, the learning outcomes from facility did not stand out as significantly different from the remaining research sites either before or after guide retraining was undertaken. Thus, differences between educational experiences at publicly- and privately-owned show caves are negligible and are most influenced by the physical characteristics of the show cave property (which is suggested in the Contextual Model of Free-Choice Learning). For instance, the highest post-tour assessment scores were noted at Lost River Cave and Valley where visitors can physically see water flowing through the cave and are shown cave damage caused from subsurface practices. Therefore, we should not solely rely on public facilities to promote cave and karst education as many world regions, including the United States, commonly do. These facilities' access to resources may have negligible positive impacts on learning if educational tools are not properly used and/or the physical environment of the karst attraction is not conducive for learning.

Messages which members of the public may encounter at both public and private karst attractions, particularly those in the same region, should contain similar conservation and scientific messages. Webb (1998) argued for the importance of a consistent vision is science education endeavors, stating "if policy elements are not aligned, the system will be fragmented, send mixed messages, and be less effective." Yet, mixed messages are the central theme of current show cave interpretative outcomes in that karst or the role of water is rarely discussed during guided tours even though these topics may be featured in other interpretative tools (exhibits, signs, etc.), so whether caves are a component of larger karst ecosystems can become confusing. Thus, not only are many karst-specific conservation-minded messages failing to be delivered to show cave visitors, but when they are, as revealed during this research, many messages are inaccurate or fail to emphasis karst as holistic, interconnected systems, leaving visitors confused and unaware of the sensitivity of karst. Nonetheless, the difficulty in correcting these inaccuracies in current show cave educational pursuits arises in how to encourage these operations to pursue education when they have little personal incentive to do so.

As discussed in Chapter 5, federal-level legal mandates will likely never be successful at achieving the above goal, particularly in the United States, because of concerns over enforcement and infringements on freedom. However, other forms of policy, such as business licensing could be implemented. For instance, to meet the terms of their licenses, tour operators in Hervey Bay, Australia, must provide visitors with scientific education about whale conservation during their whale-watching tours (Peake et al. 1997). The intention of these projects is to protect the resource (what populations) which providing a livelihood for tour operators. Since caves are simply one component of larger karst systems, a similar argument for protecting the resource from degradation can be made for show caves needing to offer educational components to remain operational. This system would likely be better received at many international locations where the government is technically the owner of the subsurface. In fact, a successful system of this nature is established in the Czech and Slovak Republics where the Show Caves Administrations of these countries offer assistance in developing tours and additional educational opportunities to guarantee the dissemination of cave and karst science to cave visitors.

Aside from legal mandates, private facilities could also be encouraged to promote karst education if their efforts are advertised as ‘green.’ Businesses around the world are increasing their customer base and acceptance in communities by branding themselves as ‘green businesses’ or ‘environmentally friendly.’ In fact, visitors to Lost River Cave voiced satisfaction in the dedication of the facility to environmental sustainability, and enjoyed the conservation and protection messages during their tours.

Recommendations for Show Cave Management

The results of this study indicate that karst attractions are viable locales for enhancing visitors’ knowledge of cave and karst environments. With time this may lead to decreased anthropogenic disturbance and supportive attitudes toward karst resource protection and conservation. However, the data presented here also suggest that the adoption of specific management recommendations is instrumental for immediately improving karst knowledge outcomes of cave visitors. These recommendations include:

1) Increase the number of guides leading trips when large groups are touring the cave or even reduce the size of these groups. Multiple participants at Mammoth Cave National Park stated their guides provided the information requested on the outcomes survey, but they were unable to fully hear that information which affected their ability to answer the questions. These visitors also indicated the guides had begun delivering the information prior to them entering the staging area since the single-file passages through the cave preventing them from moving quickly. So, although tour size has no direct impact on whether educational tours can be successfully presented to show cave visitors (correct survey answers at Florida Caverns where only 25 people are permitted on tours were comparable to survey results at Mammoth Cave where tour sizes can reach upwards of 130 guests), the size of the tour can impact the ability of visitors "at the back of the line" from receiving the same quality tour as those in the front.

2) Develop incentives for the retention of experienced and educated guides. Guide transition is high at many show caves. The transiency of guides leads to the need for monetary and time resources to continually train new guides. This may also lead to the poor training procedures that were encountered during this research. Specifically, since the cost to buy new print new training booklets and time investment of existing personnel increases with each guide needing to be trained, training procedures and materials offered to guides are likely reduced to help offset accruing costs. Thus, if greater emphasis

was put on the importance of being a tour guide perhaps more personnel would choose to stay for longer periods of time at the facilities despite considerable low pay scales in many instances.

3) Although a greater cost would come of this suggestion, professional development opportunities should be offered for guides whenever possible (this could also serve as an incentive for guide retention, so the benefits are two-fold). Guides properly educated about karst and water resource science, environmental education, water resources management, and interpretation will be more able to provide additional karst information to their visitors and will be able to deliver more convincing and enthusiastic tours. This, in turn, may also lead to greater customer satisfaction and visitation.

4) Guide training should reflect multi-day in-class sessions followed by practical tour training where managers provide direct feedback as to the content of the tours, not simply its delivery. Scientific materials should be interpreted for guides and they should not be left to do so themselves as the guide is most probably unfamiliar with karst and therefore may not be able to comprehend the scientific information provided.

5) Specific goals and objectives of the tours should be provided and should emphasize karst, not simply cave science.

6) When possible, facilities should maximize their property's potential for illustrating science-based karst conservation messages by adding multiple interpretative tools and karst science on their webpages, developing educational

trails to other karst features on the show cave property so concepts of karst as a interconnected system are visually reinforced, and clearly pointing out instances of anthropogenic disturbance in order to the maximize the potential learning outcomes achievable at their specific location. Furthermore, show caves should provide information on ways visitors can immediately begin to participate and support karst conservation. Show caves are essentially the ‘first line of defense’ in the battle to increase the level of karst understanding worldwide, and therefore should be serving as source of information on all aspects of karst.

7) Improving and changing tour content should always be evolving and ongoing. Compliancy on behalf of tour guides is a major concern when tour content is never changed or adapted. This, in turn, can lead to disinterest of visitors regarding the cave and karst information he or she is presented with during a guided tour. Furthermore, since return visitation is a goal of show cave operations, guests who understand a show cave’s tours are consistently changed to reflect the latest available science and karst degradation data may be encouraged to return. Offering different stops along the tour path whenever possible will also help contribute to meeting this management suggestion.

8) Cooperation is vital for the protection of karst environments and their associated valuable resources, such as groundwater supplies. Thus, facilities should cooperate with one another to share information and experiences about the delivery and types of information which have and have not worked. Furthermore, show cave managers and owners should not hesitate to ask local

universities, karst scientists, and caving organizations, amongst others, for assistance when developing tour content and for developing other educational opportunities. Not utilizing learning tools or providing erroneous data to visitors does a disservice to everybody living in karst environments, including the managers themselves.

Future Research and Projects

The results from this study and the insights drawn have generated a series of suggestions for where future research and projects should be directed to reduce instances of karst degradation. For instance, a web-based 'one stop shop' and forum for karst education should be developed as to provide outreach to show cave operators willing, but unable to increase the educational quality of existing tours and other educational resources. Simply put, conversations with managers revealed they simply do not fully understand the dynamics of karst, or the notion that caves are merely one component of larger, complex systems.

Owners and managers of multiple educational centers and show caves in both the United States and abroad feel providing both karst and cave science to visitors can be overwhelming if undertaken without outside assistance. To alleviate these concerns an online forum could be creased where karst science is provided and interpreted in accurate, layman terms, and suggestions are provided for the delivery of tour content and training of guides. An enjoyable, entertaining to read, relevant, and easily understood pamphlet that communicates the universal theme (Ham 1992) of karst environments (interconnected system, easily polluted, valuable resources, etc.) to specific behavioral guidelines and considerations (how to properly fertilize lawns, don't dump into sinkholes, cave ethics, etc.) should be developed and distributed to visitors of show caves. This tangible outcome of the tour experience, which will help to reinforce information provided during tours, could be developed and made available on the forum so only printing costs are accrued by facilities.

Ideally, a well informed populace will make informed decisions. Thus, interpretation is used to not only enhance visitor experience but also influence visitor behaviors that might mitigate negative environmental impacts (Tilden 1977; Sharpe 1982; Ham 1992; Ham and Krumpe 1996; Manning 1999; Lackey and Ham 2003). This study has successfully proven that improving the educational material at informal karst education settings can increase the knowledge of the general populace about the importance and sensitivity of karst terrains, which, with time, could lead to fewer occurrences of anthropogenic disturbance and increase public demand for the eventual implementation and enforcement of comprehensive policies to protect and conserve karst landscapes. Further investigations are needed to determine if visitors will actually change their behaviors as a result of the information they encounter during their tourist experiences. Providing show caves with data which proves facilities are directly influencing behavior, attitudes, and karst perceptions may also serve as encouragement for private and public karst attractions to develop stronger educational yet entertaining programs and tours. More research is also needed to investigate the role of show cave visitors who do not live in karst areas in reducing instances of karst degradation.

Educating adults through informal learning settings can help develop understanding and judgment on environmental policy issues, encourage discourse on these issues, and ultimately promote informed participation in decision-making (Lauber et al. 2002). Thus, the assumption of this project is that the lack of education revealed during this research may have significant environmental policy implications. However, only a longitudinal study can determine if the amount of quality education at show caves is increasing the pressure exerted by the public who visited these facilities to create new policies protecting karst. For instance, there may be an increased potential for karst policy to be enacted outside of the United States because of the focus on educating adults and not children at international show caves and parks. Although difficult to conclusively determine, future research may be able establish if enough of the population will be educated to exert the pressure required to force change or create scenarios where significant improvements to the regional degree of karst degradation are noted. Any of these changes will undoubtedly begin at a local level, but the policy and outreach approaches of local governments have historically served as the foundation for larger, national- and state-level policy and education strategy development.

Policy investigations can also determine if current cave and karst policies are perpetuating the focus of cave, not karst, education and protection. For instance, the United State Cave and Karst Resource Management Policy is primarily concerned with the guidelines for cave protection alone. This lack of focus on karst environments as interconnected systems with caves as a single component, sets the stage for other agencies, organizations, and karst attractions also supporting cave, not karst, science and conservation.

Furthermore, water resource issues stem from both spatial and societal disconnects, which are manifested in poor policy and karst resource management practices, and further complicate the understanding and management of complex karst environments throughout the world. Examining how karst perceptions and understanding differ both spatially and among representatives from the private, governmental, and academic fields should therefore be pursued. Correlating these findings with analyzed characteristics of implemented karst-related policies, management strategies, and policy needs and enforcement from around the world could lead to the creation of karst-specific legislative frameworks based on public perception and education.

Future investigations into informal karst education should investigate other common educational techniques utilized in informal learning environments, such as impacts of the use of film and interactive karst displays. For instance, the effects of show cave and museum visitors experiencing unique cave educational tools, such as a simulator equipped with real cave footage could be determined.

Visitor reactions observed through video footage, personal interviews, and exit outcomes assessments could be used to analyze the understanding of knowledge, attitude, and behavior changes spurred by the use of each educational strategy.

Lastly, geocognition research, such as that performed on learning how maps in geoscience courses are interpreted by students, could be applied to informal karst education. This research could be conducted using ArcGIS to digitize and analyze data from eye tracking devices, which can record the features of karst exhibits, maps, and interpretative signs that onlookers are most drawn to and in what order. Having a better understanding of these data will allow interpretation experts at venues with karst displays to develop these displays in a manner that maximizes visual literacy learning.

Research and development of an interpretation evaluation framework for use at show caves is also needed. Multiple individuals involved in various capacities at show caves who were interviewed or surveyed in the course of this study indicated they were unaware of the importance of conducting evaluations. They along with other participants indicated they were uncertain of what should be included in an evaluation and how to pursue such actions appropriately. Thus, researching current evaluation frameworks and the wide variety of existing evaluation techniques through application could help lead to the development of a process which could be provided to and utilized by show cave managers worldwide. This framework could be made available through the online forum discussed above.

Lastly, effective environmental education must encompass both formal and informal learning (Barney et al. 2005; Scott 2007). Yet, not only is informal karst education lacking, but formal education is also minimal compared to many other environmental topics. Reasons for this worldwide trend, means with which to overcome existing hurdles, and strategies for the successful incorporation of karst material into existing formal education must therefore be pursued.

Overall, this study adds significant new knowledge concerning the status of karst education in the United States and abroad and illustrates that we can improve communication of karst information to the public through informal education and interpretative programs at karst tourism attractions. Show caves will continually be faced with the ever growing demand for establishing scientific interpretation programs and methods for how to evaluate the outcomes of their efforts. This research helps these managers and interpretation personnel justify the need for improving interpretative material by revealing from conclusions of the survey data where shortfalls exist and offering suggestions for improvement.

Promoting education can be a powerful tool for conservation and management in any environment, but particularly for karst terrains where current education and management strategies are lacking or in their infancy. The data collected during this research suggest more educational efforts should in fact be pursued worldwide at show caves and through other outreach venues such as non-governmental and governmental agencies. Data indicate multiple potential misconceptions about the role of education at show caves exist worldwide and the spread of these messages to show cave managers, owners, and operators across the globe should be curbed through science and education. In the end, decreasing anthropogenic karst disturbance will require a combination of innovative approaches and the collaboration of all sectors of karst including tourist operators, scientists, policymakers, and outreach media (film, news reporters, museums, science centers, etc.). The United Nations Decade of Education for Sustainable Development discussed in Chapter 2 is a worldwide initiative to reorient education around the economic, social, and environmental pillars of sustainable development, extends from 2005 to 2014. The success of this program is contingent on the reform of all aspects of education including formal education, the role of media, teacher education, community involvement, and lifelong learning through informal education (Combes 2005). Thus, karst attractions must begin to participate in this endeavor and do all they can to encourage the protection of karst terrains and the valuable water resources contained within them. We all have something to gain from teaching about karst and promoting its protection and conservation…fresh drinking water, the most vital element of life. We are failing ourselves and the environment by not attempting to overcome the misconceptions and hurdles that were uncovered during this research to maximize opportunities for spreading karst knowledge.

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Appendices

APPENDIX A: Karst Education Efforts of the United States

Table A1: Karst Education Efforts of the United States (National-level).

Contributing Organization	Program(s)	Activities	Target Audience	Material Focus	Additional Comments	Source(s)
Project Underground		Classroom activities, workshops for teachers, resource library	*Children*	All aspects of cave and karst science	This program is adopted in multiple states	Project Underground 2010
United States Geological Survey	*Caverns and Caves* and *Groundwater* resource packets; Karst topography paper model	Lesson plans, data and maps, web resources, printable posters, educational resource packets (stories, discussion questions, paper model, writing assignments, and classroom activities)	*Children*	Cave formation, cave biota and adaptations, caring for caves, groundwater interaction with surface, sources of groundwater pollution, where groundwater located and usage		USGS Education Webpage 2010; Alpha et al. 1997; Davies and Morgan 1989; Dale and Jones 2003
National Wildlife Federation	Night Friends: American Bats	Free, downloadable activity guide (with step-by-step instructions, assessment guidelines	*Children*	Bat diversity, distribution, navigation, migration, diet, adaptations, reproduction, importance, and misconceptions; building a bat house	These activities are adaptable to different grade levels	National Wildlife Federation, undated
National Speleological Society	Fragile Underground brochure		*Adult Public*	Fragility and importance of caves/karst for water supplies and science, significance of caves as habitats, necessity for cave/karst management	This brochure is available free of charge from the NSS website or through the mail.	Dale and Jones 2003

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Watersheds.org	Karst: the Movie	Online, interactive karst model - karst word search puzzles, word matching exercises, vocabulary building worksheets	*Children*	Sinkhole formation, flow of water and contaminants through karst topography		Watersheds.org, undated website; Carden-Jessen, personal communication, 2010
Cave Research Foundation	Educational Resource Development Program	Audiovisual and multimedia educational materials; assisting in the creation of interactive karst displays and exhibits	*Adult Public and Children*	All aspects of cave and karst science		Cave Research Foundation 2010
American Geological Institute	64-page Living with Karst booklet		*Adult Public*	Characteristics of karst/groundwater behavior, anthropogenic disturbance, flooding, surface collapse, groundwater pollution, karst management strategies		Veni et al. 2001
Journey into Amazing Caves Movie			*Adult Public* and *Children*	Follows scientists through some of the world's most spectacular and unusual caves in search of cave microorganisms	The intent of the film was not to specifically teach about caves and karst	Journey into Amazing Caves 2001

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Discovery Channel	Planet Earth series segment on caves		*Adult Public and Children*	Cave formation; limestone erosion; importance of water in karst; cave biota; karst landscape and cave pollution; significance of pollution in karst	The term 'karst' is never specifically used in the video	Fothergill et al. 2007
Circle of Blue		Multiple media reports	*Adult Public*	Sensitivity and importance of karst terrains in relation to groundwater supply		Circle of Blue.org 2010; Ganter 2010; Robertshaw and Jaffe 2010; Groves 2010a, 2010b
New Mexico Tech Earth and Environmental Science		U-Tube videos	*Adult Public*	What is karst, importance of karst for health of environment and humans		New Mexico Tech Earth and Environmental Science 2008; Rylincoln 2008
Djuna Bewley and Dave Bunnell		Virtual cave tours	*Adults* and *Children*	Dynamics of cave development, growth of cave formations, importance of caves	The term 'karst' never specifically used; Multiple pictures accompany each of the 43 tour discussion points	Bewley and Bunnell 2009
United States Bureau of Land Management		Portable cave and interp video for use at the National Boy Scouts of America Jamborees	*Children*	Cave science and resource conservation, cave ethics	Similar interactive cave displays were created for use at Whiteman Park in Australia	Anderson 2000, Goodbar 1999

United States Bureau of Land Management	Welcome to the Underground	Resource packet and classroom activities (Karst and Nonkarst Watershed Models, Cave Creations, Bat Babies, Life in Dark)	*Children*	Cave types and US distribution, cave and karst formation, cave decorations, human use of cave, cave biota		Booth et al. 2009

Table A2: Karst Education Efforts of the United States (State-level).

State	Contributing Organization	Program	Activities	Target Audience	Material Focus	Additional Comments	Source(s)
Alabama	Legacy	Down Under in North Alabama	Trips to wild/show caves, classroom sessions and activities	*Schools* and *Adult Public*	Karst topography, cave formations, cave biodiversity	Designed for teachers and public - Teachers are primary participates	Legacy 2010
Alabama	AL Humanities Foundation, Auburn University	Encyclopedia of Alabama	Web-based encyclopedia	*Adult Public*	Cave biota and formation, caves in human history, karst and cave conservation	Karst and caves given entries in 2009	Encyclopedia of Alabama 2010; Kidd 2009; Schrenkel 2008
Alaska	Tongass National Forest	Karst and Caves of Southeast Alaska: A Teachers' Resource and Resource Trunks	For schools - Caves of Southeast Alaska and other videos, presentations For Public - Interp Trails, presentations	*School Groups* and *Adult Public*	Caves, aquifers, human impact	Unique groundwater model used to demonstrate potential for aquifer pollution	Schulte and Crocker-Bedford 2002; Kovarik 2010

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Arizona	State Geological Agency	Homeowner's Guide to Geologic Hazards and 28-page Layperson's Guide to AZ Water		*Adult Public*	Geologic Hazards (such as karst sinkholes), surface and subsurface water	"Karst" not in Water Guide, Minimal in Hazards Guide, Aquifer pollution and extraction not discussed	Harris and Pearthree 2002, Gelt and Eden 2007
Arkansas	Friends of North Fork and White Rivers	We (Watershed Education) Project	Brochures, videos, workshops, newspaper writings	*Adult Public*	Karst environments as a whole rather than individual features	Material from state agencies only narrowly focused on karst. Most info on cave/sinkhole clean-ups, groundwater quality, biota	DeVries, personal comm.., 2010; Friends of the River, undated website; Doerr, personal comm., 2010
California	Sequoia Natural History Association		Educational center, guided tours, interpretative signs	*Adults* and *Children*	Holistic karst systems, local flora and fauna		Sequoia Natural History Association 2010; Boiano, personal comm., 2010
California	Sierra Nevada Recreational Corporation		For Adults - Cave Training Courses For School Groups - Guided tours, teacher lesson plans	*Adult Public* and *School Groups*	Strictly Caves	Karst never discussed, nor is connection of caves to land surface	Sierra Nevada Recreation Corporation 2010

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Colorado	Colorado Western Slope Grotto		For Adults - 5 week speleology course For Children - Classroom talks, cave tours, scout trips	*Adult Public* and *Children*	Speleologenesis, geomorphology, biospeleology, cave cartography, cave etiquette	Non-credit course for non-scientist. Cave tours for scouts ceased because of White Nose	LeMoine, personal communication , 2011
Connecticut	Central Connecticut Grotto		Presentations and cave tours	*Children*	Strictly Caves		Central Connecticut Grotto 2010
Delaware	No Significant Karst Efforts Uncovered					Keyword search for 'karst' on Geological Society site had 0 results	
Florida	Southwest FL Water Management District	Linked Resources for Community Education in Hydrogeo.	Videos, brochures	*Public*	Karst as a whole, stormwater runoff and pollution, sinkholes, springs		SWFWMD, undated
Florida	Southwest FL Water Management District	Water Resources Education Week	Watershed Fieldtrip Guides and Teacher Resources	*Children*	Water resources, watersheds, protection of watersheds	Karst is only minimally discussed	Yarbrough 2000
Florida	Southwest FL Water Management District, Karst Productions, Inc.	Water's Journey: the Hidden Rivers of Florida	Video	*Adult Public* and *Children*	Connectedness of karst, groundwater pollution	Regularly aired on local PBS channels	Karst Productions Inc. 2004

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Florida	FL Dept. of Environmental Protection, collaboration from state parks	Learning in Florida's Environment (LIFE) Program	FDEP partners with schools to create field experiences and material pertinent to the local area	*School Groups*	Karst systems as a whole, springs, cave formation, sinkholes, human influences of karst water quality		Florida Department of Environmental Protection LIFE Program 2009
Florida	Florida Department of Environmental Protection and Spring Working Groups	Water and You Campaign	Various methods including interactive videos	*Adult Public* and *Children*	Sensitivity and importance of karst springs		FDEP 2005
Florida	Floridasprings.org (Division of FDEP)	Water's Journey Expedition	Activity guides *Reporting on Water's Journey Expedition* and *Examining Human Impact on the Aquifer and Springs*	*School Groups* Grade 6-8	Aquifers and springs, negative impact of sinkhole pollution on these features	Karst" not specifically used, but springs and aquifers extensively reviewed	Floridasprings.org, undated
Florida	Institute of Food and Agricultural Sciences		Solid and hazardous waste regulation handbook	*Public* (solid and hazardous waste handbook)	Proper storage and disposal techniques for select waste products	Connection of handbook content to karst minimal	Olexa et al. 2003
Florida	St. Petersburg Government among other city- and county-level governments		Downloadable activity and coloring books	*Children*	Stormwater pollution, water cycle, herbicide and pesticide pollution concerns	Connection to karst terrains, specifically, minimal	Pinellas County Government, undated

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Florida	Hernando County Citizens for Water Committee		Brochures, questionnaires in water bills, public talks and meetings, TV programming	*Adult Public*	Sensitivity and importance of karst, springs, and aquifers		Hernando County Public Works Dept, undated; Citizens for Water, undated
Florida	Florida Museum of Natural History	Northwest Florida: Waterways and Wildlife exhibit	Exhibit and public talks	*Adult Public* and *Children*	Local area habitats including cave minerals, hydrology, and biota	Only vaguely discusses karst terrains as a whole, instead focuses on caves/springs	
Florida	Marion County Government with sponsorship from local state parks and agencies	Springs Festival	Month-long Florida Springs Festival offering guiding trips near springs (boats and walking), presentations, and publications	*Adult Public* and *Children*	Karst geology, proper watering and fertilizing, sensitivity of karst features, local flora and fauna	Similarly activities hosted during Juniper Springs Recreational Area - Ocala National Forest Symposium	Springfest.org 2010; Aiken, personal communication , 2010
Georgia	No Significant Karst Efforts Uncovered					Even inquiry into GA Environ. Ed. Resource Database had no karst, caves, or sinkholes results	
Hawaii	No Significant Karst Efforts Uncovered						

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Idaho	Idaho Geological Survey		Summer field studies workshops	*Teachers*	Local geology and geologic hazards	Karst topography a topic discussed	Idaho Geological Survey, undated website
Illinois	Illinois Geological Survey	Geobits	Short, informative documents, free downloadable PDFs	*Adult Public*	Any aspect of caves and karst		Illinois State Geological Survey 2009
Illinois	Illinois Natural History Survey		Biospeleology publication	*Adult Public*	Cave biota		Illinois Natural History Survey 2009
Illinois	Illinois Department of Natural Resources		Website content	*Adult Public*	What is karst, how to protect soil and groundwater from pollution in karst		Illinois Department of Natural Resources 2010
Illinois	Karst Conservancy of Illinois		Guided tours to 2 preserves, local school presentations	*Children* and *Adults* (primarily children)	Karst as an interconnected ecosystem, cave science and biota	Unable to lead tours now due to cave closings (White Nose)	Sawyer, personal communication, 2011; Karst Conservancy of Illinois 2009
Indiana	Leonard Springs Nature Park	Caves Among Us Tour Quarterly Program	Specialized cave and karst tours	*Adult Public* and *Children*	Local cave geology, biota, and hydrology; connectedness of caves to groundwater resources	Approximately 25-30 attendees each session	Lindberg 2008

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Indiana	Spring Mill State Park	Annual Gone Caving Event	Wild cave tours, cave rescue demonstrations, science presentations, crafts	*Adult Public* and *Children*	Caves and cave science, cave biota	Karst environments as connected system is not the focus of activities	Ingle, personal communication, 2010; Spring Mill State Park Website 2010
Indiana	Indiana State University, Center for N. American Bat Research and Conservation	Annual Indiana Bat Festival	Inflatable cave for children, presentations on karst systems and cave conservation	*Adult Public* and *Children*	Cave biota and hydrology, White Nose Syndrome	More recent focus is White Nose, but being to incorporate entire karst landscapes	Ingle, personal communication, 2010; ISU Indiana Bat Festival 2010
Iowa	Iowa Geological Survey		Various scientific publication available through their website	*Adult Public*	Various geology topics, including karst	Highly technically written, no less technical material available	Iowa Department of Natural Resources Website 2010
Iowa	Department of Natural Resources		Caves in Iowa brochure	*Adult Public*	Development, use, and conservation of caves	Karst is not specifically discussed in this document	Iowa Department of Natural Resources Geological Survey 2005
Iowa	Local Grottos		Create maps for educational signs, cave tours	*Children*	Strictly cave science and biota		Klausner, personal communication, 2010
Kentucky	Rockcastle Karst Conservancy		Free downloadable activity and coloring books, bat videos	*Children*	Caves and Bats	Most Kentucky efforts not related to gov't agency	Otten, personal comm., 2010; Rockcastle Conservancy 2010

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Kentucky	Kentucky Geological Survey	Maps-to-Teachers Program, *Kentucky is Karst Country Booklet*	Develop and distribute geologic maps for classrooms and libraries free of charge, produce short educational reports	*Educators* (maps) and *Adult Public* (booklet)	Karst and its location, karst misconceptions, karst vulnerability and hazards, how karst hydrology differs from other environments	Developed a series of geologic maps for non-geologists, classrooms, and libraries for free	Kentucky Geological Survey 2010; Currens 2002
Kentucky	Kentucky Educational Television	*The Lay of the Land: Effects of Kentucky Geology on Culture and Karst Topography in KY* Youth Program	For Children - Professional development training for teachers, fieldtrip guides, lesson plans, videos For Public - 3 TV programs	*Children* and *Adult Public*	Caves; also water degradation from agricultural, recreational, and household activities, karst watersheds	Karst is not specifically discussed in the 3 TV programs - caves in the central focus	Kentucky Educational Television 2010
Kentucky	American Cave Association		School visits for a $75 fee, three educational programs offered in house, cave and karst workshops for educators	*Children*	Development of caves, karst rocks, how farming impacts caves/aquifers, BMPs to minimize agriculture-induced degradation		Nims, personal communication, 2010; American Cave Association 2010
Kentucky	Carter Caves State Park and Eastern States Speleological Organization	Annual Crawlathon Event	Geology fieldtrips, cave tours, educational workshops, hands-on activities	*Children* and *Adult Public*	Cave and karst science (cave science is traditionally emphasized)	Hundreds of participants come to weekend-long event annually	Gillespie, personal communication, 2010; Carter Caves State Park

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Louisiana	No Significant Karst Efforts Uncovered						
Maine	No Significant Karst Efforts Uncovered						
Maryland	Maryland Geological Survey		*Engineering and Hazards in Karst Terrains* handout, Caves of MD videos	*Adult Public*	Karst building hazards; cave distribution, formation, and biota	Due to budget cuts the Caves of MD series must be purchased for $13.20	Maryland Geological Survey 2009
Mass.	No Significant Karst Efforts Uncovered						
Michigan	Michigan Karst Conservancy		Interpretative trails at two managed properties, bi-annual *Michigan Karst* publication	*Adult Public*	Sinkhole features and Michigan karst specifically	Publication is primarily distributed to group members (200 copies)	Luckins 2008; Golden, personal communication, 2010
Michigan	Monroe Conservation District	Monroe-Lenawee Groundwater Stewardship Program	For Adults - dye trace demos, well water testing, posters at events For Children - EnviroScape groundwater model demos	*Adult Public* and *School Groups*	Karst water contamination from surface practices	14,000 people were targeted over the course of 3 years, but funding was recently terminated	Monroe Conservation District 2010; Acerboni, personal communication, 2010; Harper, personal communication, 2010

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Minnesota	Minnesota Pollution Control Agency	SEEK Karst Education Learning Trunk, free *Karst: A Complex Landscape Sculpted by Water* poster	Classroom activity sheets, and karst videos, books, posters, fact sheets, and slideshows	*School Children*	Interconnected karst terrains	SEEK trunks are developed for middle school students	SEEK, undated website
Minnesota	Minnesota Pollution Control Agency		4 two-day workshops	*Adult Public*	Karst groundwater pollution vulnerability		US EPA 2010; MN Pollution Control Agency 2010
Minnesota	Eagle Bluff Environmental Learning Center		Field and classroom activities	*School Children*	How pollution travels through karst, caves, sinkholes, ecology, history	Students and teachers stay for 3-5 days, participate in classes and activities	Eagle Bluff Environmental Learning Center 2006, 2008a, 2008b, 2008c
Minnesota	Twin Cities Public Television	Newton's Apple	A single program titled Spelunking	*Children*	Cave archaeology, features of caves	Info worksheets also provided on their website	Twin Cities Public Television, undated website
Minnesota	Minnesota Public Radio		A single, short program aired March 2010	*Adult Public*	Groundwater flow in Minnesota's karst areas	Researchers discussed studying groundwater flow in area	MPR News 2010
Missouri	Missouri Department of Conservation		*A Guide to MO's Cave Life* and monthly *Missouri Conservationist* publication	*Adult Public*	Cave biota, karst groundwater, springs, cave conservation		Elliot 2003; Missouri Conservationist 2010

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Missouri	Missouri Department of Conservation	Cave and Bat Discovery Trunks	Teacher workshops, videos, rock samples, picture guides, lesson plans	Children	Cave biota and cave science only		Carden-Jessen, personal comm., 2010; MO Depart. of Conservation 2010
Missouri	Missouri Department of Natural Resources		Website content, scientific publications, *Missouri Resources* Magazine	*Adult Public*	Karst features (caves, springs, sinkholes) and their distribution, cave biota	Magazine available for free to in-state subscribers (3 issues yr.), out-of-state charged $4.50 yr.	Missouri Department of Natural Resources 2010a, 2010b
Missouri	Missouri Speleological Survey		Website Content	*Adult Public*	Cave biota inventories, cave protection and restoration strategies, caving do's and don'ts, formations		Missouri Speleological Survey; Cooley, personal comm., 2011
Missouri	Ozark National Scenic Riverways	More Than Skin Deep: A Teacher's Guide to Caves and Groundwater	Teacher's guide to caves and groundwater, classroom activities	*Children*	Cave formation, water movement through karst, cave biology, cave formations, biota	modeling clay cave formations, comparing bats to birds, growing speleothems, and creating cave sounds	Ozark National Scenic Riverways 2010
Missouri	Missouri Cave and Karst Conservancy		Website Content	*Adult Public*	Humans contribution to pollution, conservation	Centered on caves, not karst	MO Cave/Karst Conservancy 2010

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Missouri	Springfield Plateau Grotto		Website content, 20-page Caring for Your Karst Landowner Guide	*Adult Public*	Minimzing karst groundwater pollution, cave biota and formations, cave management		Springfield Plateau Grotto, undated
Mississippi	No Significant Karst Efforts Uncovered					MS state parks contain no karst	Murphy, personal communication, 2010
Montana	No Significant Karst Efforts Uncovered						
Nebraska	No Significant Karst Efforts Uncovered						Fuller, personal comm.., 2010
New Jersey	Department of Environmental Protection, Geological Survey Division		Biannual *Unearthing New Jersey Newsletter*	*Adult Public*	Location of karst, karst policy and landforms, sensitivity of karst to pollution, research on karst groundwater flow	Free via internet, limited number of copies are printed upon request	Herman 2006; Nicholson 2006; Witte & Monteverde 2006; NJ DEP 2010
New Mexico	Bureau of Geology and Mineral Resources		All New Mexico residents can subscribe to any of 3 free geology journals produced by Bureau, an article has appeared in New Mexico Earth Matters on karst	*Adult Public*	Describes the caves and karst of New Mexico	Bureau offer multiple free workshops for teachers, a series of earth science podcasts, and downloadable educational activities, but not specific to karst	Hill 2003

Appendix A (Continued)

New York	Northeastern Cave Conservancy					Specifics of their efforts were inconclusive	
Nevada	No Significant Karst Efforts Uncovered						
North Carolina	No Significant Karst Efforts Uncovered						
North Dakota	No Significant Karst Efforts Uncovered						
Oklahoma	State Geological Survey	Earth Science and Mineral Resources in Oklahoma Series	Free, downloadable, educational reports and fieldtrip guides for families	*Children*	Karst terrains as interconnected system		Johnson and Luza 2008; Oklahoma Geological Survey 2010
Oklahoma	Oklahoma Fish and Wildlife Service		Brochures and Reports	*Adult Public*	Best management practices for minimizing human impacts to karst	Only available via the agency's webpage	Oklahoma Fish and Wildlife Service 2003
Ohio	Ohio Museum of Natural History and Science	Cavern: A World without Light exhibit	Exhibit features over 500 feet of replica cave passageways and interp signs	*Adults* and *Children*	Cave formations and biota (bats), karst development and water flow through caves		

Appendix A (Continued)

Ohio	Department of Natural Resources		4 free, 10-minute audio files titled Caves (2/07/02), Caverns (7/12/07), Cave Research (7/27/07), and Karst (Sink Holes) (12/17/01); a special issue of Ohio Geology publication	*Adult Public* and *Children*	Primarily caves/sinkholes; Special issue dedicated to karst locations, karst groundwater and development, considerations for people living on karst	Dep't maintains most extensive collection of educational resources encountered during research, yet none on karst - attributed to lack grant funding and PI ending	Ohio Department of Natural Resources 2010; Berg 2009; Hull 2009; Angle, 2010, personal communication
Oregon	No Significant Karst Efforts Uncovered						
PA	Pittsburg Grotto		Website Content - "no frills, no bells, no whistles - just links"	*Adult Public*	Links to hundreds of cave and karst webpages	Site was last undated in 2008 so many links no longer active, PA karst is primarily discussed in highly technical reports not readable by public	

Appendix A (Continued)

PA	Mid-Atlantic Karst Conservancy	Conserve Our Caving Heritage Project	Bob and Bev Danielson Library and Cave and Karst Education Center, interp karst signs	*Adult Public*	All aspects of caves and karst, must be seeking info to come to library	Opened in May 2010, so the success of the library is unknown	Damon, personal comm.., 2010; Mid-Atlantic Karst Conservancy, undated website
Rhode Island	No Significant Karst Efforts Uncovered					Rhode Island one of two states in US with no caves	
South Carolina	No Significant Karst Efforts Uncovered						
South Dakota	No Significant Karst Efforts Uncovered						
Tennessee	Clarksville, TN Online		*What is Karst Topography and Why Should We Care About It* article	*Adult Public*	Karst systems, role of sinkholes in karst, how sinkholes impact humans, protection		Piesky 2009
Tennessee	Department of Environment and Conservation		Website links, videos	*Adult Public*	Sources of water pollution, where TN water comes from, how to prevent water pollution, unique concerns of karst	Uniquely a selection of the Dep't videos offered in Spanish	TN Dep't of Env. Conservation, website; Clendening, personal comm., 2010

Appendix A (Continued)

Tennessee	City of Cookeville with assistance from Upper Cumberland Grotto		Interpretative signs, newspaper publications	*Adult Public*	Groundwater pollution and connectedness of karst features		Sutherland, personal comm.., 2011
Tennessee	Herald-Citizen Newspaper		Newspaper article	*Adult Public*	Local sinkhole cleanups, sensitivity of karst, karst hydrology		Trotter 2010
Tennessee	Middle Tennessee State University Biology Dep't Center for Environmental Education		BatBox for teachers - books, videos, instructional materials, and real bat skeletons	*Children*		Goal is to increase the ease with which bat science can be taught to students	Center for Environmental Education, undated website
Texas	Texas A&M University Aggie Speleological Society		Cave trips and lectures to school groups	*Children*	Cave specific topics		Aggie Speleological Society, undated website
Texas	Texas Cave Conservancy		Interp trails at karst preserves; Participation in *Cave Day* event	*Adult Public* and *Children*	Connection between caves and groundwater	Over 500 participants took part in 2010 activities	Texas Cave Conservancy 2010
Texas	Texas Cave Management Association		Cave trips for youth and scout groups	*Children*	Cave specific topics	Directed at 6th, 7th, and 8th grade students	TX Cave Man. Ass. 2006; Jenkins and Russell 2009; Jenkins 2008

Appendix A (Continued)

Texas	Texas Parks and Wildlife Department		Free webcast *Deep in the Karst of Texas,* accompanying activities; publications in monthly outdoor magazine	*Adult Public* and *Children*	Primarily cave science and biota, as opposed to karst terrains in their entirety	Sinkholes and aquifers have also been discussed in the magazine publication	Texas Parks and Wildlife 2010
Vermont	No Significant Karst Efforts Uncovered						
Virginia	Department of Conservation and Recreation	VA Natural Heritage Karst Program	Free informative presentations, content-rich website, downloadable watershed factsheets, karst brochures	*Adult Public*	WNS, all aspects of karst, karst landform sensitivity/connectedness, local watershed statistics, groundwater protection	Of the programs investigated, VA Natural Heritage Karst Program is most extensive	Zokaites, personal communication, 2010; VDOCR Karst Program Website 2010
Virginia	Virginia Cave Board - as part of the Department of Conservation and Recreation		Advice locals/ agencies; developed *Buried Treasures* exhibit; produce *Living with Sinkholes* brochure, cave conserve poster, Cave Owner Newsletter; sponsor VA Cave Week	*Adults* and *Children*	All aspects of karst environments, sinkhole formation, proper water drainage near sinkholes, ease with which karst groundwater is contaminated, cave biota and formation	Posters sent to 1,000 teachers, newsletters sent to 1,500 landowners with caves. Group also offers interp. guidance to area show cave owners upon request	Kastning, undated; The Recorder 2010a; Virginia Cave Week 2010; The Recorder 2010

Appendix A (Continued)

Virginia	Children Museum of Richmond and Virginia Living Museum		Interactive cave and karst exhibits (mock cave) and field-based tours (safaris)	*Children*	Cave ecology, development, and formations; adaptations of troglobites		Children's Museum of Richmond 2010, VA Living Museum 2010
Virginia	Nature Conservancy, Mountain Soil and Water District, and Dep't of Conservation/ Recreation		Workshops for geologists, engineers, land managers, developers, farmers; exhibits; dye tracing demos	*Adult Public* and *Gov't*	Importance of karst, connectedness of karst, karst degradation, cave biology		
Virginia	Nature Center at the Homestead Preserve Old Dairy		Work sessions for planning/zoning	*Govern ment*	Geology, cave life, and water conservation	Work sessions to provide educ. material about karst and question and answer sessions	Bollinger 2009
Virginia	The Recorder newspaper		*Beneath Our Feet* series (Karst Formed by Water; Farmers, landowners learn about protecting karst; World of water under soil; Cave Biology: What lies below?)	*Adult Public*	Karst formation, karst groundwater protection from pollution, cave biology		The Recorder 2010b; Jones 2010; Cooper 2009; Adams 2009; Smith 2009

Appendix A (Continued)

Virginia	Conservancy of the Virginias (with collaboration from Natural Heritage Program)		Development and distribution of *Living of Karst* reference guide for landowners in karst - available for free via Conservancy website	*Adult Public*	Impacting karst groundwater and ecosystems; sinkhole management; erosion control	Cave Conservancy of the VA recognized as both WV and VA projects since members of both in the organization	Cave Conservancy of the Virginias Website 2010
Virginia	Virginia Naturally Program		Fund outdoor education experiences, teacher resource guides, professional development workshops	*Children* and *Teachers*	All aspects of karst, interactions between groundwater and surface, protecting aquifers, karst formations (caves, springs, sinkholes)	$538,000 in grants given for outdoor experiences, 1,200 copies of teacher resources are downloaded	VA Naturally Website 2010; VA Department of Environmental Quality Website 2010; Zokaites 2007
Washington	No Significant Karst Efforts Uncovered						
West Virginia	West Virginia Speleological Society		Cave tours	*Children*	Strictly Cave Science		West Virginia Speleological Survey, undated website
West Virginia	Greenbrier Watershed Association of West Virginia		3-part series *What's the Fuss about Karst*; weblinks	*Adult Public* and *Children*	Sinkhole formation and function, Greenbrier River karst watershed		

Appendix A (Continued)

Wisconsin	Rock River Coalition, Inc. in collaboration with University of Wisconsin		Education pamphlet - *Karst: Avoid that Sinking Feeling*	*Local Adult Homeowner's*	Why and how karst groundwater susceptible to pollution, BMPs for groundwater pollution		Rock River Coalition, 2010; Santry, personal communication, 2010
Wisconsin	Wisconsin Water Conservation Department		Workshops, site visits, well testing	*Local Farmers* and *Homeowners*	Applying fertilizers, identifying karst, regulatory and non-regulatory karst setback policies, vulnerability of karst		Santry, personal communication, 2010
Wisconsin	Ledge View Nature Center		Exhibits, interpretative signs, guided karst tour	*Children*	Biology, geology, and human use history of local caves		Ledge View Nature Center Website 2010
Wyoming	No Significant Karst Efforts Uncovered						

APPENDIX B: International Karst Education Efforts

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Table A3: International Karst Education Efforts

Country	Contributing Organization	Activities	Target Audience	Material Foucs	Additional Comments	Source(s)
England	Natural England	Website content, interp signs in natural areas, public talks, brochures, guided tours, publication of 8-volume *Countryside Character*	*Adult Public*	All aspects of karst science and geology of England, human impacts in region's natural areas	Educational resources also available for visitors to the countries, farmers, land managers, researchers, teachers, and students	Natural England 2010; Natural England Countryside Commission 2003
England	British Geological Survey	Guidebooks for local karst areas, website content	*Adult Public*	Biodiversity, minerals, human impacts, solution cave formation, sinkhole formation and importance, karst hydrogeology, sinkhole and aquifer pollution prevention		Cooper 2006; Cooper, personal communication, 2010; British Geological Survey Foundations of the Mendips
England	Limestone Pavement Conservation	Brochures, website content, scientific reports	*Adult Public*	Ecology, karst policy, BMPs, threats to karst, lime pavement	UK Biodiversity Action Plan for Limestone Pavements	Limestone Pavement Conservation 2009

Appendix B (Continued)

England	British Caving Association (formerly the British Cave Research Association)	30-40 page booklets	*Adult Public*	All aspects of cave and karst science	Many publications are highly technical and therefore not useful the general public. Some reports now used as field guides by persons seeking karst exploration	Simms, personal communication, 2010
Ireland	Geological Survey of Ireland	Free downloadable karst booklet	*Adult Public*	What karst is, how karst formed, karst locations, importance of karst for drinking water and tourism, karst disturbances		Ireland Karst Working Group 2007; Préteseille, personal communication, 2010; Simms, personal communication, 2010
Ireland	Speleological Union of Ireland	*Dump It, Drink It* booklet	*Adult Public*	Connectedness of karst terrains, sensitivity of karst to aquifer pollution		Speleological Union of Ireland 1996
Ireland	Burren Outdoor Education Center	Interp signs, exhibits, hands-on activities	*Children*	Caves primarily		Wilton-Jones, personal communication, 2010
Germany	German Speleological Federation	Website content, quarterly publication of *Mitteilugen*	*Adult Public*	All aspects of cave and karst science, importance of caves	Educational material abundant in Germany, but is not karst-specific	German Speleological Federation 2010

Appendix B (Continued)

France	French Speleology Federation	Website content, cave tours and presentations - presentations available for download from their website	*Adult Public*	Cave and karst formation, sensitivity and importance of karst to groundwater	Educational material abundant, but only vaguely discusses karst. Env. and Energy Management Agency and Water Pollution Control Program info too jargon-filled for the general public	French Speleology Federation, 2010
Switzerland	No Significant Karst Efforts Uncovered				Swiss Speleological Society, Geological Survey, and EPA all have no efforts. Any uncovered focus on water supply and only minimally karst	
Belgium	No Significant Karst Efforts Uncovered					
Netherlands	No Significant Karst Efforts Uncovered					
Austria	Austria Environmental Agency and Geological Agency	Website content	*Adult Public*	Minimal inclusion of karst science in educational materials	Results solely based on archival research, personal communications not successful	Schubert, personal communication, 2010

Appendix B (Continued)

Austria	Austrian Speleological Association (VÖH) and Grottos	Multiple-day seminars for cavers, workshops, wild cave tours, bi-annual publication peridoically directed to public	*Adult Public*	All aspects of cave and karst science	Austrian grottos highly active in these pursuits	Austrian Speleological Association 2010; Plan, personal communication, 2010
Austria	Vienna Natural History Museum	Monthly presentations on caves and karst, 28-series cave video collection, interp signs/displays, spelogical trail with cave samples	*Adult Public*	All aspects of cave and karst science (aquifer sensitivity, cave biota, and cave/karst formation)	The 3-room cave and karst exhibit (*Caves:Landscapes without Light*) will remain in the museum for 2 yrs	Plan, personal communication, 2010; Pavuza, personal communication, 2010
European Community	European Landscape Convention (Museum of National History and Arch. of Montebelluna, research centers and schools in France/Slovenia	Web-based exercises, teacher lesson plans, field-based exercises, cultural dialogue at international level on karst phenomena	*Children*	Evolution of karst, relationship with human settlements, morphological structures, good karst practices	Part of Education on *Landscape for Children - 3KL – Karstic Cultural Landscape project* - Assumption of program is children will spread learned info to adults	Castiglioni 2009
N. Europe (Iceland, Norway, Sweden, Finland)	No Significant Karst Efforts Uncovered					

Appendix B (Continued)

Spain	Geological and Mineral Institute and Ministry of Environment and Marine Affairs	Website content, brochures, scientific publications	*Adult Public*	All aspects of cave and karst science, connectedness of karst systems		CENEAM 2008
Spain	National Center for Env. Educ. of the Ministry of Env. and Marine Affairs	Newsletters, environmental interpretation material, educational courses, seminars, exhibitions	*Adult Public*	All aspects of cave and karst science, connectedness of karst systems	Source of the most noteworthy karst education pursuits	
Portugal	No Significant Karst Efforts Uncovered					
Greece	Institute of Geology/Mineral Exploration's Mineralogical Museum	Karst rocks museum exhibit	*Adult Public* and *Children*	Interp. of evolution of karst ecosystem and of their relationship with human		
Greece	Caving Clubs	Cave tours, free photo exhibitions, comic pages for local publications, free activity books	*Adult Public* and *Children*	Caves primarily	Members from 14 clubs participate in these activities	Despiniadis, personal communication, 2010
Macedonia	Caving Clubs with local teachers and media	Cave tours, news reports, free presentations at local venues	*Adult Public* and *Children*	Caves primarily	Many caving clubs newly developing so budgets for creating karst education materials are limited	Temovski, personal communication, 2010

Appendix B (Continued)

Malta	No Significant Karst Efforts Uncovered				Innovative content available in country, but not for karst/caves	
Italy	Gruppo Speleo-Alpinistico Cinghiali and Gruppo Speleologico Piemontese caving clubs	Classroom lectures, hikes, wild cave tours, free bi-annual educational newsletter on their website	*Children*	Karst science, speleothems, cave biota, karst distribution, vulnerability of caves and aquifer in karst	Part of *Caving in School Project* - Caving clubs are the primary source of karst-specific educational material in Italy	Gruppo Speleologico Piemontese 2010
Italy	Gruppo Speleologico Guidonia Montecelio caving club	Learning modules on their website	*Adult Public* and *Children*	All aspects of cave and karst science	2 modules related to karst while 2 solely focus on caving techniques and safety	Gruppo Speleologico Guidonia Montecelio 2010
Cyprus	No Significant Karst Efforts Uncovered					
Eastern Europe (Estonia, Latvia, Lithuania, Poland)	No Significant Karst Efforts Uncovered					
Slovenia	Inconclusive				Research into karst ed. deemed inconclusive since inability to investigate speleological clubs and associations	

Appendix B (Continued)

Albania	Inconclusive	Ministry of Env. and Spatial Planning report an "insufficient capacity" to promote cave/karst education		Reported a newsletter that commonly features caves/karst is sent to residents	Inconclusive because of inability to investigate the speleological clubs and associations	Bajraktari, personal communication, 2010
Bulgaria	Hinko.org	Wbsite Content "promote a wide cultural dialogue at international level on karst phenomena"	*Adult Public*	Surface and subsurface karst landforms, karst evolution, sensitivity of karst water to degradation, karst/cave conservation, cave laws, biota	Efforts by Federation of Speleology, Ministry of Env. and Water, or Geological Survey. Similar resources by area grottos, but contact unsuccessful	Hinko.org 2010
Slovakia	Slovak Caves Administration and Slovak Museum of Nature Protection and Caving	Video productions, expos, exhibitions, interpretative signs, *Aragonit* magazine, *Speleological Evenings lectures,* brochures; For Children - free activity/color books	*Adult Public* and *Children*	All aspects of caves and karst	This group is responsible for developing caves/karst landscapes for public use (education trails and publications for 7 show caves)	Slovak Caves Administration 2010
Czech Republic	Czech Speleological Society	Lectures, exhibitions, workshops, articles in local newspaper	*Adult Public*	All aspects of caves and karst		Czech Speleological Society 2010
Czech Republic	Czech Geological Survey	Virtual museum, online geological encyclopedia	*Adult Public*	All aspects of caves and karst		Czech Geological Survey 2010

Appendix B (Continued)

Czech Republic	Czech Caves Administration	Video productions, expositions, exhibitions, interpretative signs, brochures; For Children - free activity/color books	*Adult Public* and *Children*	All aspects of caves and karst	Responsible for developing caves/karst landscapes for public use (education trails and publications for 7 show caves)	Czech Caves Administration 2010
Romania	Grupul de Explorari Subacvatice si Speologice	Production of a wide variety of films, books, photo exhibitions, and presentations	*Adult Public*	Caves primarily		GESS 2010
Romania	Alba County`s Department for Youth	Presentations at local venues	*Adult Public* and *Children*	All aspects of caves and karst	Also work with caving club near Scarisoara Ice Cave	Ciubotarescu, personal communication, 2010
Romania	Arad Regional Environmental Center (CZEA)	Presentations at local schools	*Children*	All aspects of caves and karst - how human impacts karst and minimizing this		Arad Regional Environmental Center 2010
Romania	Oradea Crystal Caving Club of Romania, Cave Club of Cluj, and Asociatia Speologica Exploratorii Resita	Presentations at local venues (museums) and environmental activities and area schools	*Adult Public* and *Children*	Sustainable development and environmental protection in karst areas	Many of same functions as the CZEA but also promote the need for sustainable development and environmental protection in karst	Asociatia Speologica Exploratorii Resita 2010; Cave Club of Cluj 2007; Oradea Crystal Caving Club of Romania 2010

Appendix B (Continued)

Romania	Center for Protected Areas and Sustainable Development	For Adults - Interp panels, exhibits, seminars, workshops, nature hikes to karst gorges and plateaus For Children – Teacher lesson plans/training	*Adult Public* and *Children*	Settlements, in order to highlight value of cultural heritage at European level. Cave biodiversity recently added into goals	*Part of Nature for People* - Project Karst is one of two "thematic tracks" pursued under this project	Center for Protected Areas and Sustainable Development 2010; Lucaciu, personal communication, 2010
Hungary					Karst reports rather technical in nature and not easily interpreted by members of public	
Bosnia and Herz.	No Significant Karst Efforts Uncovered				Despite presence of cave groups, speleological federations, and geological surveys/water ministries	
Africa (Morocco, Nigeria, Algeria)	No Significant Karst Efforts Uncovered				Educational efforts specifically deal with cave archaeology, rather than geology	
Tanzania	*Inconclusive*				Tanzania Speleology Association and other geology/env. organizations unsuccessful	
Namibia	National Museum of Namibia	Small cave/karst exhibit	*Adult Public*	Karst rocks, use of caves and karst, cave biota		Darnall, personal communication, 2010

Appendix B (Continued)

Zimbabwe	National Reserves	Educational brochures, signs, exhibits at national reserves	*Adult Public* and *Children*	All aspects of cave and karst geology		Zimbabwe National Parks and Wildlife Website 2010
Madagascar	Ankarana Special Reserve and Tsingy de Bemaraha Strict Nature Reserve	Educational brochures, signs, exhibits at national reserves	*Adult Public* and *Children*	All aspects of cave and karst geology		Immeuble Madagascar National Parks Website 2010
South Africa	Cave Research Organization of South Africa	Open access education blog	*Adult Public*	Science of caves/karst, human threats to karst, preventing and correcting pollution, karst importance	Overall, contact information to multiple organizations lacking, so definitive results are inconclusive	
South Africa	Karst Working Group (Collaboration of Cave Research Organization of South Africa, International Union of Conservation Nations)	School lesson plans and in-class activities	*Children*	Cave biota, cave and karst resource management education		Buchanan, personal communication, 2010
Tunisia	Zaghouan-Tunisia Caving Club	For Adults - Cave trips, presentations at local env functions, brochures (in collaboration with Ministry of Env.) For Children - Posters in Tunisia classrooms	*Adult Public* and *Children*	Cave formation, equipment and techniques used by cavers, cave protection and biota, history, archeology		Meher, personal communication, 2010

Appendix B (Continued)

Asian Region	*Inconclusive*					
Australia	New South Wales Dept of Environment, Climate Change, and Water - Karst Geodiversity Unit	Education boards and brochures, free downloadable cave and karst booklet *Guide to New South Wales Karst and Caves*, posters, free *geoLogic* resources	*Adult Public*	All aspects of caves and karst and pollution prevention	GeoLogic titles include "Karst Env.: The Treasure Chests of Time," "Karst Env.: More than caves and rocks," "Karst form. and develop. processes,"	NSW 2008
Australia	Geoscience Australia	Brochures	*Adult Public*	All aspects of karst, location, karst hazards (pollution and sinkhole collapse)	Part of Resources, Energy and Tourism Department of the Australian National Government	Geoscience Australia, undated
Australia	Newcastle and Hunter Valley Speleological Society	Caving courses	*Adult Public* and *Children*	Caving and rock climbing technique, basic cave and karst science, cave conservation	Courses in sequence. Badly degraded karst area in Timor used to teach about karst degradation and limestone	Smith, personal communication, 2010
Australia	Western Australia Speleological Group	Website content, offer science for establishing conservation areas	*Adult Public*	Cave biota		Lichon, personal communication, 2010
Australia	Australian Cave and Karst Management Association	Website content, offer science for establishing conservation areas	*Adult Public*	Cave biota		

Appendix B (Continued)

Australia	Mole Creek Caving Club of Tasmania	For Adults - Wild cave tours, website content, attend env. activities, karst articles in tourism pubs, newspapers pubs, Jackeys Marsh Forest Festival; For Children - School talks, wild cave tours for youth groups	*Adult Public* and *Children*	Cave science primarily, connectedness of karst		Lichon, personal communication, 2010; Hunter, personal communication, 2010
Australia	CaveWorks Eco Center and Research Laboratory	Displays and poster boards, interactive cave models, replicas of cave formations, cave crawl tunnel	*Children*	All aspects of caves and karst		CaveWorks Eco Center and Research Laboratory 2010
Australia	Hastings State Reserve in Tasmania	Pre-visit activities, lesson plans, onsite guided activities, post-visit activities, coloring, word-searches, pH testing, permeability, karst evolution modeling	*Children*	All aspects of cave and karst science, caves and sinkholes are emphasized	Designed to complement the Australian School Curriculum	Liddell, personal communication, 2010
New Zealand	Department of Conservation (support from Canterbury Caving Club)			All aspects of karst and connectedness and sensitivity to degradation		New Zealand Dept of Conservation 2010; Alice Shanks, personal comm., 2010

Appendix B (Continued)

New Zealand	Waitomo Caves Discovery Centre	Exhibits on caves and karst, collections of items/fossils found in caves, brochures, collections of thesis available for review	*Adult Public*	Caves and biota primary focus, sensitivity and connectedness also reviewed		Yapp, personal communication, 2010
Canada	Alberta Speleological Society	For Adults - Website content For Children - Guided wild cave tours	*Adult Public* and *Children*	Karst and distribution, features, cave formation and decorations, WNS		Alberta Speleological Society 2010
Canada	Speleological Society of Manitoba	For Adults - Website content For Children - Guided wild cave tours	*Adult Public* and *Children*	Karst and distribution, features, cave formation and decorations, WNS	To instill a sense of respect for caves and prevent careless people from entering	Speleological Society of Manitoba 2010
Canada	Quebec Speleological Society	Public presentations at local venues, wild cave tours	*Adult Public*	All aspects of caves and karst		Coubertin, personal communication, 2010
Canada	Canadian Cave Conservancy	Public presentations, cave tours for scouts/youth, karst class materials)	*Adult Public* and *Children*	All aspects of caves and karst		Coubertin, personal comm., 2010; Coles, personal comm., 2010
Canada	Canadian Cave and Karst Information Server	Weblinks to conservancies, grottos, and for karst management, conservation, and exploration	*Adult Public*	List of karst terms, descriptions karst and functionality, karst laws, human influence, karst science articles/reports		Canadian Cave and Karst Information Server 2009

Appendix B (Continued)

Canada	Geological Survey of Canada	Virtual fieldtrips; downloadable kid activities; lectures, videos, classroom posters; assist local museums with exhibits	*Adult Public* and *Children*	Geological processes and formations other than karst, such as volcanoes and earthquakes primary focus, yet karst minimally discussed	Innovators in the Schools, Rent a Scientist, and Calgary Science Hotline Programs, geology expert scheduled to speak about geology topics (including karst) in Nova Scotia, British Columbia, Ottawa	Viau, personal communication, 2010; Geological Survey of Canada 2010
Canada	Friends of the Eramosa Karst and Hamilton Conservation Authority	UTube videos, created and distributed maps of Ontario karst, science reports in journals/newspapers, karst fact sheets	*Adult Public*	karst and importance, why vulnerable to degradation, cave/karsr misconceptions		Friends of the Eramosa Karst 2010
Canada	Manitoba Speleological Society	Wild cave tours	*Children*	karst locations, speleothems, cave biota, cave/karst formation, karst importance and sensitivity		Falkingham, personal communication, 2010
Puerto Rico	North Study Speleological Society	Public talks; brochures to schools, libraries, and museums; cave trips	*Children*	Cave science, development, care		Carrión, personal communication, 2011
Puerto Rico	Federación Espeleológica de Puerto Rico	Participation in government meetings and area events	*Government Offical* and *Cavers*	Cave and karst sensitivity and importance	Education for general public (adult or children) is lacking	Federación Espeleológica de Puerto Rico 2010

Appendix B (Continued)

Dominican Republic	Dominican Republic Speleological Society	<u>For Adults</u> - Participation at all area env. events, contracted space in newspaper, TV programs; <u>For Children</u> - cave tours	*Adult Public* and *Children*	Cave formation and care, importance of protecting karst groundwater, preventing pollution	Group unable to formally schedule public or gov't talks, but are planning to	Dominican Republic Speleological Society 2010; Pittaro, personal communication, 2010
Jamaica	Jamaican Caves Organization	Monthly "outreach" sessions	*Adult Public*	Cave science, caves and springs pollution, role bats in nature	One of the most unique approaches for increasing public knowledge	Stefan, personal communication, 2010
Central America	No Significant Karst Efforts Uncovered				This finding is rather inconclusive in that contact with multiple organizations not made	
Brazil	Brazilian Society of Speleology	Free electronic bulletin, wild cave tours	*Adult Public*	Latest news and science related to speleology and karst	Brazil only country with educational efforts	Brazilian Society of Speleology 2010
Middle East - Oman, UAE, Egypt, Yemen, Saudi Arabia, Iran, Iraq, Jordan, Afghanistan, Pakistan	No Significant Karst Efforts Uncovered					Durrani, personal communication, 2010
Israel	Cave Research Unit of Hebrew University of Jerusalem	Guided tours and community lectures	*Adult Public*	Basic science of karst and env. problems		CRU Hebrew University of Jerusalem 2010

Appendix B (Continued)

Turkey	*Inconclusive*				No cave grottos pursue public education	Yamac, personal communication, 2010
Lebanon	Speleo Club du Liban	Free museum - displays, books, exhibits, interpretative signs	*Adult Public*	Local karst terrain, caves, cave memorabilia		Speleo Club du Liban 2010
Lebanon	Lebanese Association of Speleological Studies	Local media (newspapers, television, radio) productions, exhibitions, train public authorities, cave trips for tourists	*Adult Public*	Cave formation, karst geology, cave decor, exploration, cave science technique, human influence, importance of cave biota, cave protection	The "Say, what's a cave" Initiative under development to introduce children aged 5 to 13 to the importance and wonder of cave environments	Stephan, Lebanese Association of Speleological Studies, personal communication, 2010
Russia and Near Abroad - Kazakhstan, Uzbekistan, Russian Fed., Turkmenistan, Kyrgyzstan, Tajikistan, Georgia, Belarus	No Significant Karst Efforts Uncovered					
Armenia	National Academy of Sciences and Speleological Center	Coursework and publications	*Directed at college students and academic professionals*	All aspects of cave and karst science		

Appendix B (Continued)

Ukraine	*Inconclusive*			Unable to confirm/refute efforts by speleological clubs/associations	Clear that no karst education pursued through Association of Ukrainian Geologists	

APPENDIX C: Contacted Show Caves

Table A4: Contacted Show Caves.

Facility	Public or Private	Email	Location
Buffalo National River	Public		Arkansas
Carlsbad Caverns National Park	National Park	Marie_Marek@nps.gov	New Mexico
Cumberland Gap National Historic Park	Public		Kentucky
Jewel Cave National Monument	Public	Bradley_Block@nps.gov	South Dakota
Mammoth Cave National Park	National Park	joy_lyons@nps.gov	Kentucky
Oregon Caves National Monument	Public		Oregon
Ozark National Scenic Riverways	Public		Missouri
Russell Cave National Monument	Public		Alabama
Sequoia, Kings Caverns National Parks	National Park		California
Timpanogos Cave National Monument	Public	Michael_Gosse@nps.gov	Utah
Lehman Caves - Great Basin Nat'l Park	National Park	grba_interpretation@nps.gov	Nevada
Wind Cave National Park	National Park		South Dakota
Cloudland Canyon State Park	State Park	Robert.Wilson@dnr.state.ga.us	Georgia
Cathedral Caverns	State Park	ccaverns@nehp.net	Alabama
Blue Springs State Park	State Park	BlueSprings.StPk@dcnr.alabama.gov	Alabama

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Rickwood Caverns State Park	State Park	RickwoodCaverns.StPk@dcnr.alabama.gov	Alabama
Blanchard Springs Caverns	State Park		Arkansas
Edward Ball Wakulla Springs State Park	State Park	jeffrey.hugo@dep.state.fl.us	Florida
Falling Waters State Park	State Park	scott.sweeny@dep.state.fl.us	Florida
Florida Caverns State Park	State Park	kelly.banta@dep.state.fl.us	Florida
Ponce de Leon Springs State Park	State Park	aaron.d.miller@dep.state.fl.us	Florida
Crystal River Preserve State Park	State Park	jacklin.steege@dep.state.fl.us	Florida
Devil's Millhopper Geological State Park	State Park		Florida
Ellie Schiller Homosassa Springs State Park	State Park	ken.torres@dep.state.fl.us	Florida
Fanning Springs State Park	State Park	stephen.davenport@dep.state.fl.us	Florida
Ichetucknee Springs State Park	State Park	sam.cole@dep.state.fl.us	Florida
Lafayette Blue Spring State Park	State Park	myra.carter@dep.state.fl.us	Florida
Madison Blue Spring State Park	State Park		Florida
Manatee Springs State Park	State Park	Joleen.Dudley@dep.state.fl.us	Florida
O'Leno State Park	State Park		Florida
Paynes Prairie Preserve State Park	State Park	andrea.christman@dep.state.fl.us	Florida
Peacock Springs State Park	State Park	richard.west@dep.state.fl.us	Florida

Rainbow Springs State Park	State Park	nicky.aiken@dep.state.fl.us	Florida
Blue Spring State Park	State Park		Florida
De Leon Springs State Park	State Park		Florida
Silver River State Park	State Park	scott.mitchell@marion.k12.fl.us	Florida
Wekiwa Springs State Park	State Park		Florida
Weeki Wachee Springs State Park	State Park		Florida
Spring Mill State Park			Indiana
Alabaster Caverns State Park	State Park	alabastercaverns@oklahomaparks.com	Oklahoma
Gardner Cave - Mt. Spokane State Park	State Park	mount.spokane@parks.wa.gov	Washington
Colorado Bend State Park	State Park		Texas
Devil's Sinkhole State Natural Area	State Park		Texas
Kickapoo Caverns State Park	State Park	mike.knezek@tpwd.state.tx.us	Texas
Longhorn Cavern State Park	State Park	henryh@vtrc.com	Texas
Castlewood Canynon State Park	State Park	castlewood.canyon@state.co.us	Colorado
Sylvan Lake State Park	State Park	sylvan.lake.park@state.co.us	Colorado
Lewis and Clark Caverns State Park	State Park		Montana
Minnetonka Cave	State Park	dduehren@fs.fed.us ,	Idaho

Kartchner Caverns State Park	State Park	mbuchmann@azstateparks.gov	Arizona
Providence Mountains SRA - 3 caves		info@parks.ca.gov	California
Lost River Gorge and Boulder Caves		info@lostrivergorge.com	New Hampshire
Polar Caves Park		online inquiry	New Hampshire
Crystal Grottoes Caverns		online inquiry	Maryland
Howe Caverns		online inquiry	New York
Natural Stone Bridge and Caves Park		info@stonebridgeandcaves.com	New York
Secret Caverns		secretcaverns@localnet.com	New York
Lockport Cave and Underground Boat Tour		online inquiry	New York
Coral Caverns			Pennsylvania
Crystal Cave			Pennsylvania
Indian Caverns		info@indiancaverns.com	Pennsylvania
Indian Echo Caverns			Pennsylvania
Laurel Caverns			Pennsylvania
Lincoln Caverns		online inquiry	Pennsylvania
Lost River Caverns		info@lostcave.com	Pennsylvania

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Penn's Cave	online inquiry	Pennsylvania
Woodward Cave and Campground	info@woodwardcave.com	Pennsylvania
Crystal Cave	info@heinemanswinery.com	Ohio
Ohio Caverns	Info@ohiocaverns.com	Ohio
Olentangy Indian Caverns	oic@olentangyindiancaverns.com	Ohio
Perry's Cave	fun@perryscave.com	Ohio
Seneca Caverns	senecacaverns@hmcltd.net	Ohio
Indian Trail Caverns	info@indiantrailcaverns.com	Ohio
Lost World Caverns	online inquiry	West Virginia
Organ Cave	janie@organcave.com	West Virginia
Seneca Caverns	randrews@senecacaverns.com	West Virginia
Smoke Hole Caverns	online inquiry	West Virginia
Caverns of Natural Bridge Village	cavemonstero@yahoo.com	Virginia
Crystal Caverns at Hupp's Hill	online inquiry	Virginia
Dixie Caverns		Virginia
Endless Caverns	info@endlesscaverns.com	Virginia
Grand Caverns	cavernsinfo@ci.grottoes.va.us	Virginia

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Luray Caverns	online inquiry	Virginia
Shenandoah Caverns	adugan@shentel.net	Virginia
Skyline Caverns	info1@skylinecaverns.com	Virginia
Linville Caverns	info@linvillecaverns.com	North Carolina
Desoto Caverns Park	info@DeSotoCavernsPark.com	Alabama
Sequoyah Caverns	roy@sequoyahcaverns.com	Alabama
Appalachian Caverns	appalachiancaverns@appacaverns.com	Tennessee
Bell Witch Cave		Tennessee
Bristol Caverns	BristolCaverns@aol.com	Tennessee
Cumberland Caverns	teddyj@cumberlandcaverns.com	Tennessee
Forbidden Caverns		Tennessee
Lost Sea Caverns	thelostsea@gmail.com	Tennessee
Raccoon Mountain Caverns	raccoon1@raccoonmountain.com	Tennessee
Ruby Falls		Tennessee
Tuckaleechee Caverns	info@tuckaleecheecaverns.com	Tennessee
Cherokee Caverns	cherokeecaverns@aol.com	Tennessee
Crystal Onyz Cave	crystalo@scrtc.com	Kentucky

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Diamond Caverns		Kentucky
Hidden River Cave	pnims@cavern.org	Kentucky
Cub Run Cave	info@cubruncave.net	Kentucky
Kentucky Caverns - KY Down Under	info@kdu.com	Kentucky
Kentucky Down Under		Kentucky
Lost River Cave	annie@lostrivercave.com	Kentucky
Outlaw Cave	online inquiry	Kentucky
Bull Shoals Caverns	joates@coba.usf.edu	Arkansas
Cosmic Cavern		Arkansas
Hurricane River	cave@hurricanerivercave.com	Arkansas
Mystic Caverns	online inquiry	Arkansas
Old Spanish Treasure Cave	caveman@spanish-treasure-cave.com	Arkansas
War Eagle Cavern	wareaglecavern@hughes.net	Arkansas
Bluff Dwellers Cave	bluffd@netins.net	Missouri
Bridal Cave	info@bridalcave.com	Missouri
Fantastic Caverns	online inquiry	Missouri
Jacob's Cave	jacobscave@earthlink.net	Missouri

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Marvel Cave	online inquiry	Missouri
Meramec Caverns	info@americascave.com	Missouri
Talking Rocks Cavern	chris@talkingrockscavern.com	Missouri
Bluespring Caverns	info@bluespringcaverns.com	Indiana
Marengo Cave	carol.groves@gmail.com	Indiana
Squire Boone Caverns	spelunk@squireboone.com	Indiana
Crystal Cave	info@acoolcave.com	Wisconsin
Cave of the Mounds	online inquiry	Wisconsin
Kickapoo Indian Caverns		Wisconsin
Niagara Cave	niagara@harmonytel.net	Minnesota
Spook Cave	spookcave@spookcave.com	Iowa
Crystal Lake Cave	info@crystallakecave.com	Iowa
Beautiful Rushmore Cave	info@beautifulrushmorecave.com	South Dakota
Black Hills Caverns	info@blackhillscaverns.com	South Dakota
Crystal Cave Park	info@southdakotacave.com	South Dakota
Sitting Bull Crystal Cave	sbcc@enetis.net	South Dakota
Wonderland Cave	info@southdakotacave.com	South Dakota

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John Brown's Cave		Nebraska
Cascade Caverns	downunder@cascadecaverns.com	Texas
Caverns of Sonora	cavernsofsonora@cavernsofsonora.com	Texas
Cave-Without-A-Name	cwan@boernenet.com	Texas
Inner Space Cavern	shirree@myinnerspacecavern.com	Texas
Natural Bridge Caverns	tickets@naturalbridgecaverns.com	Texas
Colossal Cave Mountain Park	info@colossalcave.com	Arizona
Minnetonka Cave		Idaho
Black Chasm, California, and Boyden Caverns	caverns@caverntours.com	California
Lake Shasta Caverns	online inquiry	California
Mercer and Moaning Caverns	info@mercercarverns.com	California
Horne Lake Caverns and Riverbend Caves	info@hornelake.com	Canada
Glacier National Park	marie.lefaivre@pc.gc.ca,	Canada
Bonnechere Caves		Canada
Tyendinaga Cave		Canada

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Laflèche Caves	info@aventurelafleche.ca	Canada

La Grotte de Saint-Elzéar	info@lagrotte.ca	Canada
Fairy Cave	info@cavernetroudelafee.ca	Canada
Harrison's Cave		Barbados
Animal Flower Cave		Barbados
Crystal and Fantasy Cave	info@caves.bm	Bermuda
Hato Caves		Curacao
El Choco National Park - Cave of Cabarete		Dominican
Los Tres Ojos National Park		Dominican
Cave of Miracles	direcgeneral@tropicaltoursromana.com.do	Dominican
Conch Bar Caves National Park	online inquiry	Turks & Caicos
Rio Camuy Cave Nature Park	sugerencias@cpnpr.gobierno.pr	Puerto Rico
Barton Creek Cave	info@greendragonbelize.com	Belize
Actun Tunichil Muknal	pacztours@btl.net & mayawalktours@yahoo.com	Belize
Gruta de Botuverá	botuvera@botuvera.sc.gov.br	Brazil
Cueva del Milodón	jromero@conaf.cl	Chile
Venado Caves	info@anywherecostarica.com	Costa Rica

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Rey Marcos Cave	online inquiry	Guatemala

El Boquerón Cave	yaraguatour@hotmail.com	Hondoras
Grutas de Coyame	online inquiry	Mexico
Grutas de la Estrella		Mexico
Grutas de Cacahuamilpa National Park	online inquiry	Mexico
Jeita Grotto	info@jeitagrotto.com	Lebanon
Stalactite Cave Nature Reserve	moked@npa.org.il	Israel
Arnhem Cave	arnhem@mweb.com.na	Namibia
Amboni Caves	kisonipm@hotmail.com	Tanzania
Hiraodai Countryside Park	sato@hiraodai.jp	Japan
Abukuma-do Cave	takine-abukumadou@city.tamura.lg.jp	Japan
Shizushi Limestone Cave Park	sangyo@town.mizuho.kyoto.jp	Japan
Okinawa World - Gyokusendo Cave	info@gyokusendo.co.jp	Japan
Ryugashi Cave	ryugashi@doukutu.co.jp	Japan
Nippara Limestone Cave	info@nippara.com	Japan
Abercrombie Caves	abercrombie.caves@environment.nsw.gov.	Australia
Carey's Cave	information@weejaspercaves.com	Australia

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Jenolan Caves Trust	reception@jenolancaves.org.au	Australia

Wombeyan Karst Conservation Preserve	Wombeyan.Caves@environment.nsw.gov.	Australia
Kosciuszko National Park	srvc@environment.nsw.gov.au	Australia
Cutta Cutta Nature Park		Australia
Camooweal Caves National Park	james.newman@derm.qld.gov.au, tracey.schwilk@derm.qld.gov.au	Australia
Capricorn Caves	admin@capricorncaves.com.au	Australia
Kelly Hill Conservation Park	kellyhill@sa.gov.au	Australia
Naracoorte Caves National Park	naracoortecaves@saugov.sa.gov.au	Australia
Gunns Plains Cave State Reserve	online inquiry	Australia
Mole Creek Karst National Park	mccaves@parks.tas.gov.au	Australia
Hastings Caves State Reserve		Australia
Princess Margaret Rose Cave		Australia
Yanchep National Park		Australia
Buchan Caves Reserve	online inquiry	Australia
Margaret River Caves	caveworks@margaretriver.com	Australia
Leeuwin-Naturaliste National Park	info@dec.wa.gov.au	Australia

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Kawiti Glow worm Caves	kawitiwhanau@gmail.com	New Zealand

Nikau Cave	info@nikaucave.co.nz	New Zealand
Orakei Korako Cave & Thermal Park	online inquiry	New Zealand
Waitomo Glowworm Cave, Ruakuri Cave	online inquiry	New Zealand
Ngarua Caves	ngaruacaves@paradise.net.nz	New Zealand
Mangapu Cave	online inquiry	New Zealand
Spellbound Glowworm Cave	info@glowworm.co.nz	New Zealand
Te Anaroa Cave	waitomocavesfloatthru@xtra.co.nz	New Zealand
Paparoa National Park	paparoavc@doc.govt.nz, rreid@doc.govt.nz	New Zealand
Oparara Kahurangi National Park	info@oparara.co.nz	New Zealand
Għar Dalam Cave & Museum	online inquiry	Malta
Dictaean Cave	online inquiry	Crete
Melidoni cave	online inquiry	Crete
Sfentoni Cave	info@zoniana.gr	Crete
Alistrati Cave	alscav@otenet.gr	Greece
Cave of Aggitis	mail@1lyk-dramas.dra.sch.gr	Greece

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Cave of Petralona		Greece

Cave of Pramanta	info@pramanta.gr	Greece
Caves of Perama	online inquiry	Greece
Koutouki Cave	eben@mani.org.gr	Greece
Caves of Diros, Glifada Cave	eben@mani.org.gr, epsne@culture.gr	Greece
Cave of Kastria	kastcave@otenet.gr	Greece
Snejanka Cave		Bulgaria
Yagodina cave	online inquiry	Bulgaria
Stopica Cave		Yugoslavia
Vjetrenica Cavern	ivo.lucic@zg.htnet.hr	Bosnia/Herzeg.
Špilja Modrić	marijan@zara-adventure.hr	Croatia
Škarin Samograd	arheoloski-muzej-st@st.tel.hr	Croatia
Špilja Vranjača	gpunda@inet.hr	Croatia
Špilja Biserujka	siloturist@ri.t-com.hr	Croatia
Jama Baredine	jama-baredine@pu.tel.hr	Croatia
Feštin Kingdom Cave	sige@pu.t-com.hr	Croatia
Mramornica Cave	agroturizam.sterle@pu.t-com.hr	Croatia

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Romuald's Cave	info@sdi.hr	Croatia

Baraceve Cave	info@baraceve-spilje.hr	Croatia
Samograd Cave	tzg-gospic@gs.htnet.hr	Croatia
Veternica Cave	park.prirode.medvednica@zg.htnet.hr	Croatia
Jama pod Babjim zobom	dzrjbled@gmail.com	Slovenia
Smoke Cave	Franc.Maleckar@guest.arnes.si	Slovenia
Kostanjevica Jama	podkapnikom@email.si	Slovenia
Snow Cave	igor.ocvirk@h-rc.si,	Slovenia
Pivka Jama and Crna Jama	online inquiry	Slovenia
Postojna Cave	mnenja@postojnska-jama.si	Slovenia
Park Škocjanske Jame	psj@psj.gov.si	Slovenia
Vilenica Caves	vilenica@siol.net	Slovenia
Železna jama	irena.strazar@helios.si	Slovenia
Cave of Abaliget	online inquiry	Hungary
Mészégető Spring Cave	dunadrava@ddnp.kvvm.hu	Hungary
Tettye Travertine Cave	info@barlangpecs.hu	Hungary
Trio Cave	szkbe@szkbe.hu	Hungary

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Pond Cave of Tapolca	knauer@bfnp.kvvm.hu	Hungary

Aggtelek National Park	info.anp@axelero.hu	Hungary
Mátyáshegy Cave	info@barlangaszat.hu	Hungary
Duna-Ipoly National Park	palvolgy@axelero.hu	Hungary
Spannagelhöhle	info@spannagelhaus.at	Austria
Eisriesenwelt - The World of the Ice Giants	info@eisriesenwelt.at	Austria
Koppenbrüllerhöhle	info@dachsteinwelterbe.at	Austria
Gassel-Tropfsteinhöhle	gerhard.zeppetzauer@oebb.at	Austria
Griffen Dripstone Cave	griffen@tropfsteinhoehle.at	Austria
Katerloch	info@katerloch.at	Austria
Kraus Cave	gde@gams-hieflau.steiermark.at	Austria
Lurgrotte Peggau	lurgrotte@aon.at	Austria
Lurgrotte Semriach	info@lurgrotte-semriach.at	Austria
Allander Tropfsteinhöhle	gemeindeamt@alland.at	Austria
Einhornhöhle	hohewand@netway.at	Austria
Hermannshöhle	info@hermannshoehle.at	Austria
Belianska Cave	caves@ssj.sk	Slovak Republic

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Bystrianska Cave	caves@ssj.sk	Slovak Republic

Demänovská Cave of Liberty	caves@ssj.sk	Slovak Republic
Domica Cave	caves@ssj.sk	Slovak Republic
Dobšinská Ice Cave	caves@ssj.sk	Slovak Republic
Demänovská Ice Cave	caves@ssj.sk	Slovak Republic
Driny Cave	caves@ssj.sk	Slovak Republic
Gombasecká Cave	caves@ssj.sk	Slovak Republic
Harmanecká Cave	caves@ssj.sk	Slovak Republic
Jasovská Cave	caves@ssj.sk	Slovak Republic
Ochtinská Aragonite Cave	caves@ssj.sk	Slovak Republic
Važecká Cave	caves@ssj.sk	Slovak Republic
Bozkov Dolomite Caves	bozkov@caves.cz	Czech Republic
Javoricko Cave	javoricko@caves.cz	Czech Republic
Mladec Caves	mladec@caves.cz	Czech Republic
Na Spicaku Cave	spicak@caves.cz	Czech Republic
Na Pomezi Cave	pomezi@caves.cz	Czech Republic
Zbrasov Aragonite Caves	zbrasov@caves.cz	Czech Republic

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Koneprusy Caves	koneprusy@caves.cz	Czech Republic

Cave of Chynov	chynov@caves.cz	Czech Republic
Turold Cave	turold@caves.cz	Czech Republic
Balcarka Cave	balcarka@caves.cz	Czech Republic
Kateřina's Cave	katerinska@caves.cz	Czech Republic
Sloup-Sosuvka Caves	sloupskososuvske@caves.cz	Czech Republic
Cave Výpustek	vypustek@caves.cz	Czech Republic
Jaskinia Niedźwiedzia	rezerwacja@jaskinia.pl , biuro@jaskinia.pl	Poland
Lummelunda Cave	info@lummelundagrottan.se	Sweden
Segeberger Kalkberghöhle	online inquiry	Germany
Schillathöhle	online inquiry	Germany
Hermannshöhle		Germany
Dripstone Cave of Iberg	info@hoehlen-erlebnis-zentrum.de	Germany
Heimkehle	online inquiry	Germany
Aggertalhöhle - Agger Valley Cave	info@aggertalhoehle.de	Germany
Attahöhle - Dripstone Cave of Attendorn	info@atta-hoehle.de	Germany
Bilsteinhöhlen	online inquiry	Germany

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Dechen Cave	Dechenhoehle@t-online.de	Germany

Kluterthöhle	info@kluterthoehle.de	Germany
Kubacher Kristallhöhle	online inquiry	Germany
Teufelshöhle - Devil's Cave	info@teufelshoehle.de	Germany
Altensteiner Höhle - Cave of Altenstein	info-altensteiner_hoehle@onlinehome.de	Germany
Syrauer Drachenhöhle - Dragon's Cave Syrau	syrau@t-online.de	Germany
Maximilian's Grotto	info@grottenhof.de	Germany
Großes Schulerloch	kontakt@schulerloch.de	Germany
Sontheimer Höhle	info@sontheimer-hoehle.de	Germany
Wimsener Höhle	wimsen@tress-gastronomie.de	Germany
Charlottenhöhle	online inquiry	Germany
Schellenberger Eishöhle	info@eishoehle.net	Germany
Sturmannshöhle	info@obermaiselstein.de	Germany
Parc National de Furfooz	info@parcdefurfooz.be	Belgium
Grotte et Abime de Comblain-au-Pont	info@comblainaupont.be	Belgium
Grottes de Han and Grotte de Lorette	grotte-de-han@grotte-de-han.be	Belgium
Grottes de Hotton	info@grottesdehotton.be	Belgium

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Grottes de Neptune	infos@grottesneptune.be	Belgium

St. Beatushöhlen	info@beatushoehlen.ch	Switzerland
Grottes de Réclère	prehisto@bluewin.ch	Switzerland
Grottes de Vallorbe	contact@vallorbe.ch	Switzerland
Nidlenloch	info@nidlenloch.ch	Switzerland
Grotte aux Fées	grotteauxfees@bluemail.ch	Switzerland
The Underground Lake of Saint Léonard	lac.souterrain@bluewin.ch	Switzerland
Höllgrotten Baar	info@hoellgrotten.ch	Switzerland
Poole's Cavern	info@poolescavern.co.uk	Britain
Blue John Cavern	online inquiry	Britain
Peak Cavern	info@peakcavern.co.uk	Britain
Speedwell Mine	info@speedwellcavern.co.uk	Britain
Treak Cliff Cavern	treakcliff@bluejohnstone.com	Britain
Great Masson Cavern, Great Rutland Cavern	office@h-of-a.co.uk	Britain
Kents Cavern	caves@kents-cavern.co.uk	Britain
St. Michael's Caves		Britain
Cheddar Caves & Gorge	caves@cheddarcaves.co.uk	Britain

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Wookey Hole	staff@wookey.co.uk	Britain

Ingleborough Cave	info@ingleboroughcave.co.uk	Britain
White Scar Cave	info@whitescarcave.co.uk	Britain
Mother Shipton's Cave	info@mothershipton.co.uk	Britain
Stump Cross Caverns	enquiries@stumpcrosscaverns.co.uk	Britain
Dan-yr-Ogof, Cathedral, Bone, and Caves	info@dan-yr-ogof-showcaves.co.uk	Wales
Marble Arch Caves Global Geopark	info@marblearchcavesgeopark.com	Ireland
Aillwee Cave	info@aillweecave.ie	Ireland
Doolin Cave	tours@doolincave.ie	Ireland
Dunmore Caves	dunmorecaves@opw.ie	Ireland
Mitchelstown Cave	visit@mitchelstowncave.com	Ireland
Crag Cave	cragcave@tinet.ie	Ireland
Grottes de Cougnac	contact@grottesdecougnac.com	France
Grottes de Maxange	contact@lesgrottesdemaxange.com	France
Gouffre de Proumeyssac	Proumeyssac@perigord.com	France
Grotte de Rouffignac	grottederouffignac@wanadoo.fr	France
Grotte Prehistorique de Villars	contact@grotte-villars.com	France

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Grotte de Bara-Bahau	info@grotte-bara-bahau.com	France

Grotte de Lascaux	contact@semitour.com	France
Les Grottes de Presque	grottesdepresque@yahoo.fr	France
Gouffre de Padirac	gouffre.padirac@padirac.com	France
Grotte Prehistorique des Merveilles		France
Grottes d'Arcy-sur-Cure	grottes-arcy@orange.fr	France
Les grottes de Blanot	blanot-grottes@wanadoo.fr	France
Grottes de Savonnières	infos@grottes-savonnieres.com	France
Grotte de la Glacière	grotteglaciere@wanadoo.fr	France
Grottes de Beaume les Messieurs	online inquiry	France
Grotte des Moidons	online inquiry	France
Grottes des Planches	online inquiry	France
Les grottes de l'Aguzou	grotte.aguzou@wanadoo.fr	France
Aven Armand	contact@aven-armand.com	France
Gouffre Géant de Cabrespine	contactsite@wanadoo.fr	France
Grotte des Canalettes	contact@grotte-grandes-canalettes.com	France
Grotte de Clamouse	grotte@clamouse.com	France

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Grotte de Dargilan	contact@dargilan.com	France

Grotte des Demoiselles	online inquiry	France
Grotte de Labeil	labeil@aol.com	France
Abîme de Bramabiau	bramabiau@aol.com	France
Grotte de la Cocalière	grotte-cocaliere@wanadoo.fr	France
Gouffre d'Esparros	online inquiry	France
Les Grottes Isturitz et Oxocelhaya	grotte.isturitz@hol.fr	France
Grotte de Pech Merle	online inquiry	France
La Grotte de la Vache	contactgrotte@club-internet.fr	France
Grotte de la Noré	online inquiry	France
Grotte et Canyon de Saulges	info@grottes-de-saulges.com	France
Grottes de Saint-Cézaire	online inquiry	France
Grotte de Beaume Obscure	baumeobscure@orange.fr	France
Grotte et cascade de Seythenex	info@cascade.fr	France
Grotte de Thouzon	grottesdethouzon@wanadoo.fr	France
L'Aven Grotte de la Forestière	contact@laforestiere.net	France
Grotte de la Madelaine	grottemadeleine@wanadoo.fr	France

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Aven de Marzal	avenmarzal@soleos-pro.com	France

Aven d'Orgnac	info@orgnac.com	France
Grottes de St-Marcel d'Ardèche	contact@grottesaintmarcel.com	France
Grottes de Choranche	info@choranche.com	France
Grotte de la Draye Blanche	grotte.drayeblanche@wanadoo.fr	France
Grotte de la Luire	grotte-luire@orange.fr	France
Grottes de Thaïs	grotte-thais@wanadoo.fr	France
Les Grottes de la Balme	info@grotteslabalme.com	France
Grotta di Castelcivita	info@grottodicastelcivita.it	Italy
Grotta dell'Angelo		Italy
Grotta Gigante	info@grottagigante.it	Italy
Grotta Nuova di Villanova	info@grottedivillanova.it	Italy
Grotta di Collepardo and di Pastena	info@grottecollepardo.it	Italy
Grotte Di Borgio Verezzi	grotte@comuneborgioverezzi.it	Italy
Grotte di Toirano	info@toiranogrotte.it	Italy
Grotte di Frasassi	online inquiry	Italy
Grotta di Bossea	nifargus@libero.it	Italy

Appendix C (Continued)

Grotta di Castellana	presidente@grottedicastellana.it	Italy

Grotta del Trullo	info@grottadeltrullo.com	Italy
Grotta del Fico	grottadelfico@tiscali.it	Italy
Grotte Is Zuddas	iszuddas@iszuddas.com	Italy
Riserva Naturale Grotta di Carburangeli	carburangeli@neomedia.it	Italy
Grotta del Genovese	info@grottadelgenovese.it	Italy
Antro del Corchia	info@antrocorchia.it	Italy
Grotta del Vento	info@grottadelvento.com	Italy
Grotte di Oliero	info@valbrenta.net	Italy
Grutas de Alvados	geral@grutasalvados.com	Portugal
Grutas de Mira de Aire	online inquiry	Portugal
Grutas da Moeda	info@grutasmoeda.com	Portugal
Peştera Ungurului		Romania
Bears' Cave		Romania
Peştera de la Vadu-Crisului		Romania
Peştera Dambovicioara		Romania
Peştera Ialomita		Romania

Appendix C (Continued)

Peştera Muierilor		Romania

Peştera Polovragi		Romania
Cuevas de El Castillo y Las Monedas	reservascuevas@culturadecantabria.es	Spain
Cueva de El Pendo	online inquiry	Spain
Cueva de Ekain	info@ekainberri.com	Spain
Arrikrutz-Oñatiko Kobak	arrikrutz@oinati.org	Spain
Cueva de Mendukilo	mendukilo@mendukilo.com	Spain
Cueva de Los Enebralejos	online inquiry	Spain
Cueva De Valporquero	dlvalporquero@argored.com	Spain
Cova de la Font Major	fontmajor@covesdelespluga.info	Spain
Cueva de las Calaveras		Spain
Cuevas del Canelobre	canelobre.busot@tsc.es	Spain
Gruta de San José	riosubterraneo@vallduixo.infoville.net	Spain
Grutas de las Maravillas	online inquiry	Spain
Cueva de los Murciélagos	informacion@cuevadelosmurcielagos.com	Spain
La Cueva de Nerja	admon@cuevanerja.com	Spain
Cuevas de Sorbas	reservas@cuevasdesorbas.com	Spain

Appendix C (Continued)

Cueva de las Ventanas	info@cuevadelasventanas.com	Spain

Cuevas de Artá	info@cuevasdearta.com	Spain
Cuevas del Drach	cuevasdeldrach@cuevasdeldrach.com	Spain

APPENDIX D: Tour Guides SurveyMonkey® Survey Instrument Questions

1. Are you employed at a privately or publicly owned facility?

- Private
- Public

If you answered 'public' please specify if your facility is at the state or federal level.

2. The educational information provided on tours at your facility is factually correct and incorporates the latest science about karst terrains.

- I don't know if it is accurate or up-to-date
- Strongly Disagree
- Disagree
- Neither Agree or Disagree
- Agree
- Strongly Agree

Please explain your choice.

3. On average, what percentage of the tour material provided to the general public at your representative facility is concentrated on science education? If more than one tour is provided at your facility you may specify any differences in the box below. Please explain your choice.

- 0%
- between 25% and 50%
- approximately 50%
- between 50% and 75%
- more than 75%

4. Are there any differences between the amount of science information provided during tours for the general public and school groups? Please be as specific as possible.

5. From where does your facility receive the material used to develop tours?

6. Are guides allowed any freedom to determine the information they provide the public during tours they lead? Please explain.

7. Do you believe show cave and spring facilities should increase their focus on karst education? Why or why not?

☐ Yes

☐ No

Please explain.

8. Do you feel increasing education at show cave and spring facilities would discourage people from visiting these facilities? Why or why not?

☐ Yes

☐ No

Please explain.

9. Do you believe it would be feasible for all cave and spring tours in your country to have some of the same educational material incorporated into their tour material? Why or why not? Please explain.

10. Aside from leading tours, please describe any background expertise and experiences you have in karst environments.

11. How long have you been leading cave and/or spring tours?

- less than one year
- one to three years
- three to five years
- five to ten years
- more than ten years

12. What process was involved in getting you ready to lead tours at your facility? Please be as specific as possible.

13. What do you feel would most help you improve your tours? Do you feel your tour can be improved?

14. Is the content of the tours you lead ever evaluated?

- Yes
- No

15. If you responded 'Yes' to question 14, what criteria is used during this evaluation process and how is the evaluation conducted?

16. Please use this space to provide any additional comments, suggestions, and experiences you can have had with visitors. Do you feel this survey should be addressing another question?

APPENDIX E: Managers, Owners, Interpretation Staff SurveyMonkey® Survey Instrument Questions

1. What position do you hold that ties you to karst and/or karst education?

- Show Cave/Spring Manager
- Interpretation
- Show Cave/Spring Owner
- Tour Guide

Other (please specify)

2. Is your position held at a publicly- or privately-held karst facility?

- Private
- Public

If you answered "Public" please specify whether your facility is owned at the state or federal level.

3. On a scale of 1 to 5 (five being the best) how would you rank the educational quality of tours provided at your representative facility?

- 1
- 2
- 3
- 4
- 5

Please explain your choice.

4. Your facility provides the general public with adequate information related to karst environments as a whole (not just cave science).

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neither Agree or Disagree
- ☐ Agree
- ☐ Strongly Agree

Please explain your choice.

5. Your facility provides school groups with adequate information related to karst environments as a whole (not just cave science).

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neither Agree or Disagree
- ☐ Agree
- ☐ Strongly Agree

Please explain your choice.

6. What educational opportunities do you provide to visitors to your facility (signs, displays, videos, brochures, tour content, etc.)? Please be as specific as possible.

7. From where does your facility receive its tour material?

8. If educational programs are present at your facility, have measures been taken to assess and/or evaluate these programs? What criteria is used in this evaluation process? Please expand.

9. In your opinion, do you feel the general public is adequately educated on karst science in your country?

- ☐ Yes
- ☐ No

Please explain your selection.

10. In your opinion, do you feel school children are adequately educated on karst science in your country?

- ☐ Yes
- ☐ No

Please explain your choice.

11. Overall, do you feel privately-owned show caves and springs have a role to play in educating the general public about karst environments?

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neither Agree or Disagree
- ☐ Agree
- ☐ Strongly Agree

Please explain your choice.

12. Overall, do you feel publicly-owned show caves and springs have a role to play in educating the general public about karst environments?

- ☐ Strongly Disagree
- ☐ Disagree
- ☐ Neither Agree or Disagree
- ☐ Agree
- ☐ Strongly Agree

Please explain your choice.

13. Karst show caves and springs should be required by law to have a greater focus of karst education.

- Strongly Disagree
- Disagree
- Neither Agree or Disagree
- Agree
- Strongly Agree

Please explain your choice.

14. What constraints, if any, do you feel hinders the ability of show cave and spring facilities from pursuing karst education?

15. Please provide any additional comments or suggestions you have regarding karst education and show cave and spring tourism.

APPENDIX F: Guided Tour Outcome Assessment Karst Survey

Please give us your feedback concerning your tour experience by completing the following voluntary survey as accurately and honestly as possible and return once completed.

If you don't know the answer or have an educated guess to a question please leave it blank.

1) Please define the word *karst* or describe a *karst landscape*. ______________________

____

____

2) How is *karst* and *caves* formed? ____

____

____

3) Please indicate whether the following statements are true or false.

	True	False	Don't Know
a) Limestone rock acts as a good filter for water.			
b) Water can rapidly travel from the surface to subsurface in karst areas.			
c) Caves serve as a pathway for water to travel through karst terrains.			
d) Cutting down trees is good for karst.			

4) Please describe how humans may impact karst terrains through the following practices:

Fertilizing lawns ____

Filling in/closing sinkholes____

Dumping trash in sinkholes ____

5) Living organisms that are beneficial to humans are found caves?

True or False

6) Name one way pollution on the surface can make its way underground in karst areas?

____

____

7) Generally speaking, how large might the area above ground be that affects a cave? Please circle one.

a) only the land directly above the cave   b) the entire state the cave is located in

c) the land above and nearby the cave   d) no land above the ground affects the cave

---

1) What is your Age? 18-30 31-40 41-50 51-60 61-70 71-80 81-90 > 90

2) What is your Highest Level of Education?

Nursery school to 5th grade	6th to 8th grade	9th to 11th grade
High school or equivalent	Some college, no degree	Associate's degree

Bachelor's ________________________ (MAJOR)   Graduate degree _________________________ (MAJOR)

3) What is your primary state/country of residence? ________________________________

4) Which of the following best describes your reason for visiting this show cave today? Check all that apply.

- ☐ Purely entertainment
- ☐ Wanted to see a cave firsthand
- ☐ Really wanted to learn about caves/karst
- ☐ Saw a sign, thought interesting
- ☐ Other_____________________________________

5) Had you heard about karst landscapes before today? YES or NO
If you answered, *yes*, please indicate where you heard about karst prior to today by checking all that apply.

- ☐ Televised news report
- ☐ Public Workshop
- ☐ Work Related
- ☐ Newspaper
- ☐ Friend or Family
- ☐ Child
- ☐ Classroom
- ☐ Show Cave or Park
- ☐ Other___________

6) On a scale of 1 to 5 (5 representing the most satisfaction) please rate your *overall satisfaction* with your tour today.

1 2 3 4 5

7) On a scale of 1 to 5 (5 representing the greatest) how would you rate your tour in terms of *education*?

1 2 3 4 5

8) On a scale of 1 to 5 (5 representing the greatest) how would you rate your tour in terms of *enjoyment*?

1 2 3 4 5

9) On a scale of 1 to 5 (5 representing the greatest) how would you rate the *quality of your tour guide*?

1 2 3 4 5

10) What can be changed to make the tour more beneficial/interesting to you? __________

____

____

11) Had you taken a show cave or spring tour before today? YES or NO

If **yes**, what facilities have you visited? ____

____

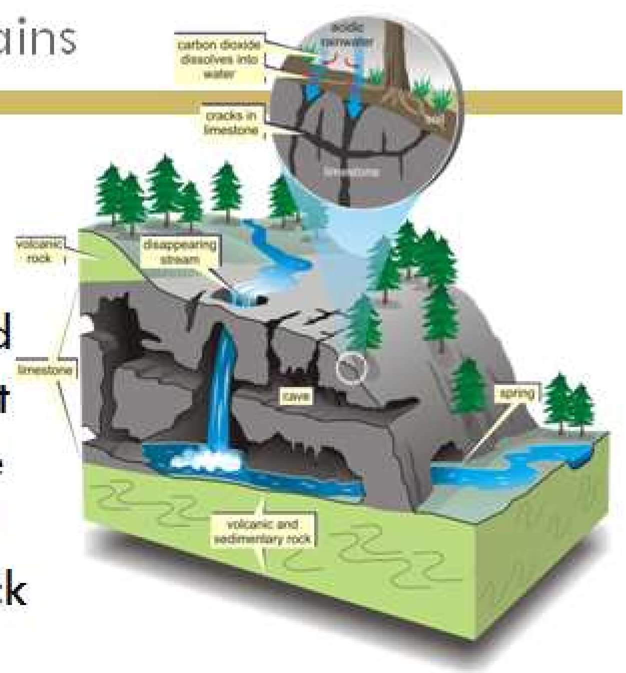
12) Were your tours at other facilities more or less educational than your tour today?

____

The Basics of Karst Environments

Karst Terrains

Landscape with distinctive hydrology and landforms that arise from the dissolution of soluble bedrock



What is Karst?

For the purposes of cave tours we are trying to get visitors to understand that Karst is a very interconnected **landscape (**not just a cave**)**

Formal Definitions of Karst...

Soluble rock, such as limestone, gypsum, or dolomite- characterized by solutional features….

Another definition of karst is: “A terrain with distinctive landforms and drainage arising from greater rock solubility in natural water that is found elsewhere”

Karst Features

- Karst landforms (sinkholes, caves, aquifer, springs, etc. (pictures on next slide) are very connected
- You can use the “Your Watershed” diagram on to see how they are connected.
  - You will need an internet connection in order to operate the diagram or if the link doesn’t work, you can do an internet search for “Your Karst Watershed”
- We want visitors to leave understanding that what happens in a cave can impact the entire karst landscape and/or what happens in a sinkhole (for example) can impact the cave

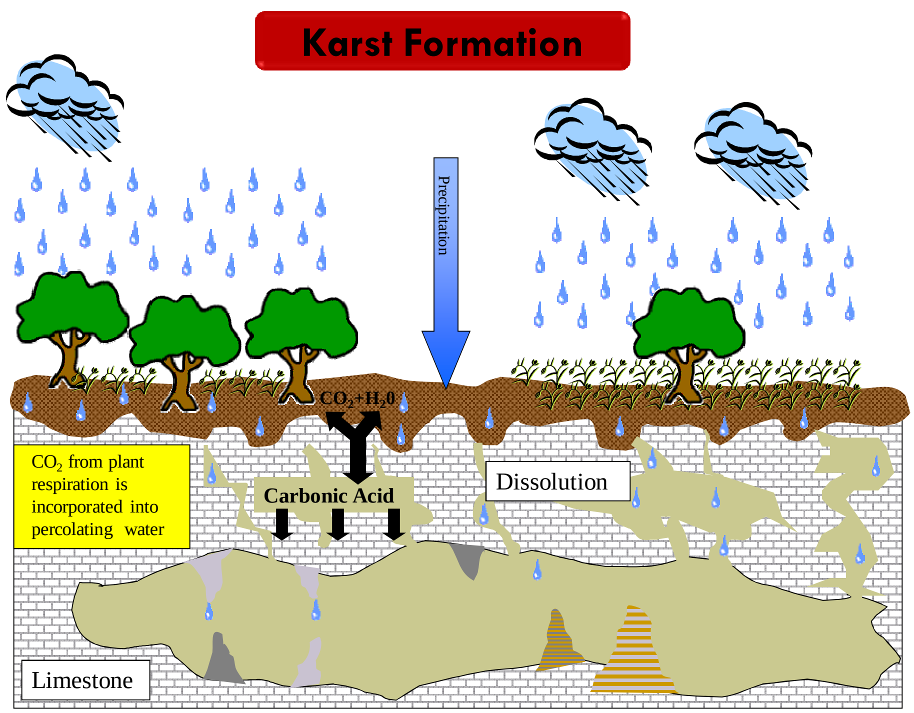

CAVES
SINKHOLES
UNDERGROUND CONDUIT
SPRINGS


Karst Features
YOUR WATERSHED
GO BACK TO THE ATLAS
KARST FEATURES
NON POINT SOURCE POLLUTION

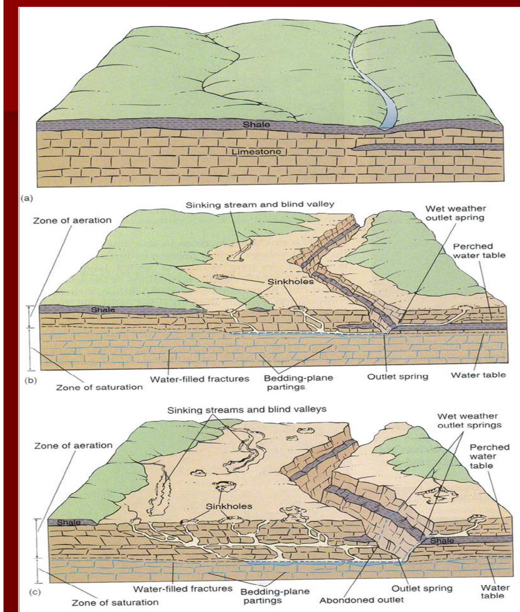
Most commonly formed in limestone, but can include other types of rocks

The Development of Karst

- Development of a classic karst landscape requires:
  - Typically a warm, humid climate
  - Soluble rock (limestone is the most common)
    - This means that it is rock that can be easily eroded away by slightly acidic water
  - Active movement of water below the surface
  - A source of CO_2, which typically comes from tree respiration into the soil on top of rocks (trees are very important)
- Karst Formation
  1. Karst forms as rainwater picks on CO_2 (Carbon Dioxide) in the atmosphere and in the soil overlying karst rocks (because of the trees)
  2. This makes the rainwater slightly acidic (forms carbonic acid – water plus CO_2)
  3. The Carbonic acid will slowly begin to eat away the very soluble rock
  4. As the rock gets eaten away holes are left in the ground that will eventually become springs, aquifers, caves, and sinkholes



Another Diagram of Karst Formation



Step 1: Water hasn't eroded much of the landscape

Step 2: Water slowly begin to eroded the landscape so the river begins to cut down and formations begin to form

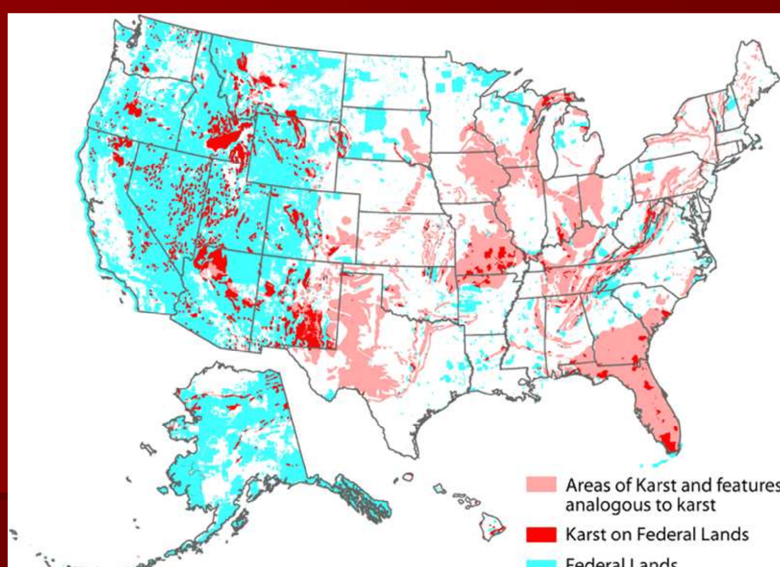
Step 3: Water continues to erode the landscape so the formations become connected by tunnels (conduits) the water is creating

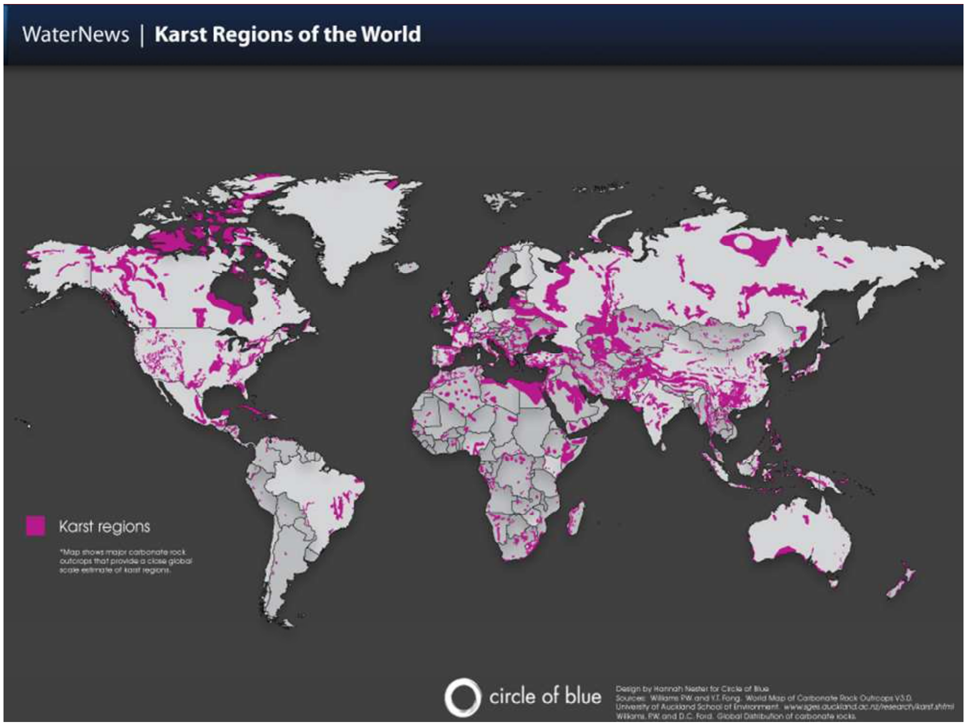
Worldwide importance of karst terrains

Why is Karst Important – Why do we want visitors to understand karst?

- Karst environments are very unique
- Karst is easily disturbed due to connectedness
- Over 25% of world's population lives on karst
- 40% of U.S. drinking water supplies come from Karst aquifers
- Karst contains scientific information on climate, hydrology, human impacts, land use, Biota
- Few Laws Protecting Karst
  - So we need to use education as a way to stop bad things from happening to karst landscapes
  - Show caves are a great place to educate
- The following slides will help illustrate some of these points

U.S. Karst





Importance of Karst Terrains

- Cover _15%_ of land surface
- Provide habit for over _25%_ of population
- Supply _25%_ of worldwide drinking water resources
- _40%_ of U.S. drinking water supplies obtained from karst aquifers

Karst Holds Valuable Scientific Information

Karst Caves Commonly House Cultural Artifacts

Karst Caves Hold Valuable Cave Life

- Bats can eat up to 50% of their weight in insects each night, helping to protect humans from disease from things like mosquitoes

Karst terrains are highly susceptible to human impacts

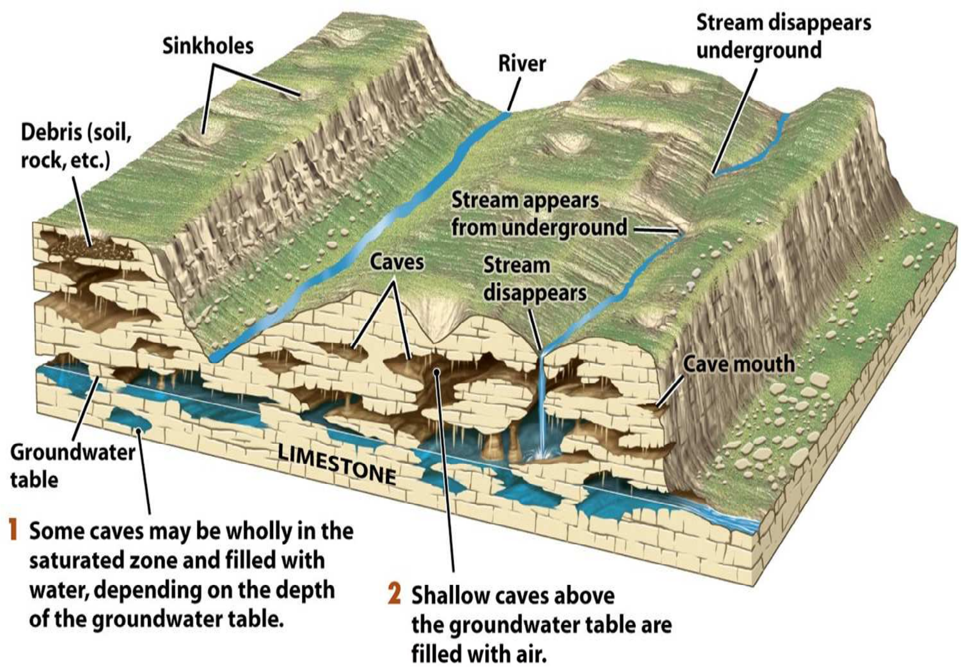
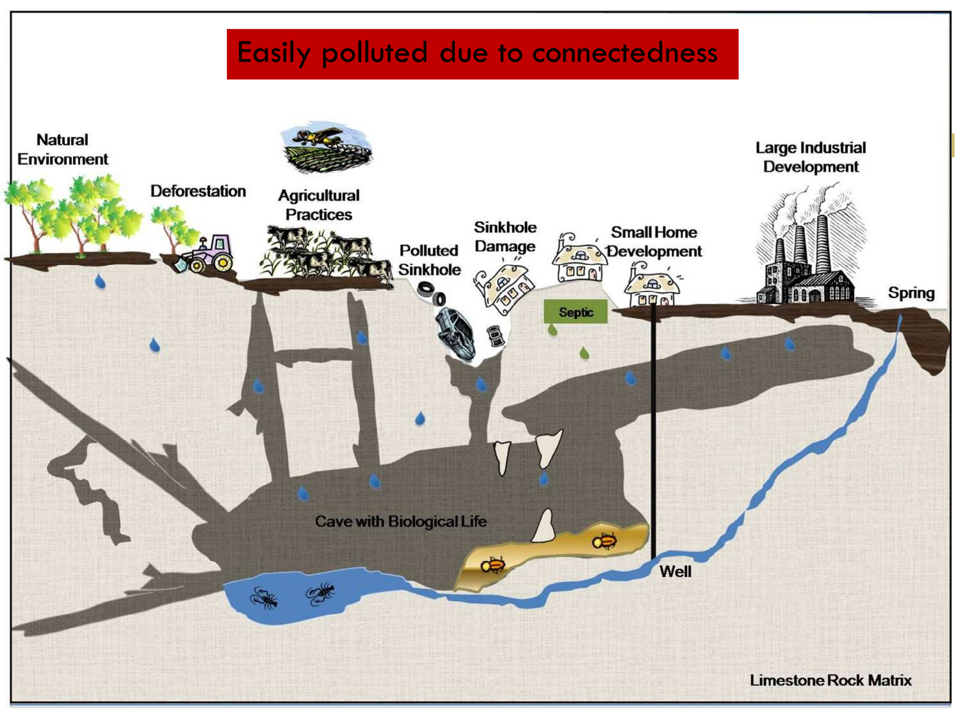


Figure 17-19
Understanding Earth, Fifth Edition



Thin Soils Common in Karst Areas, so there is a Lack Filtration of Pollutants

Rapid flow of groundwater through karst leads to rapid and widespread contamination

----

Because limestone has so many holes in it and it so soluble to water, **LIMESTONE IS A VERY POOR FILTER OF WATER,** once pollution gets into karst water it usually stays there and spreads for a very long time

Little Filtration of Groundwater Recharge (water coming from surface or through the rock on top of the cave = Water Pollution

So….

clear and cold water

does not equal

Pure water!

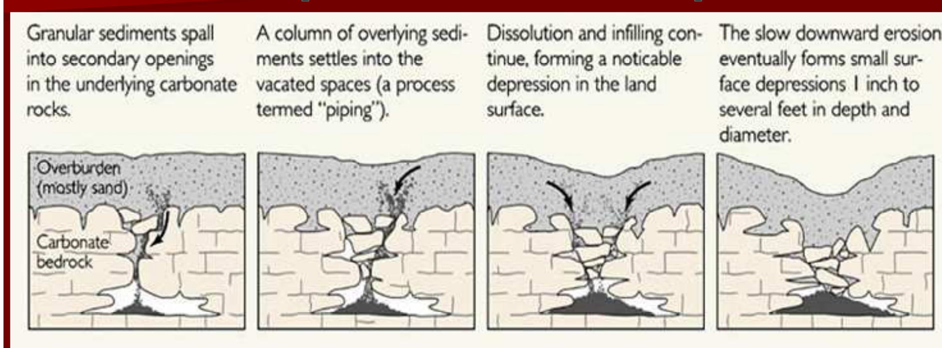
Water quality also impacts subsurface biota

Infilling sinkholes/caves can stop groundwater recharge

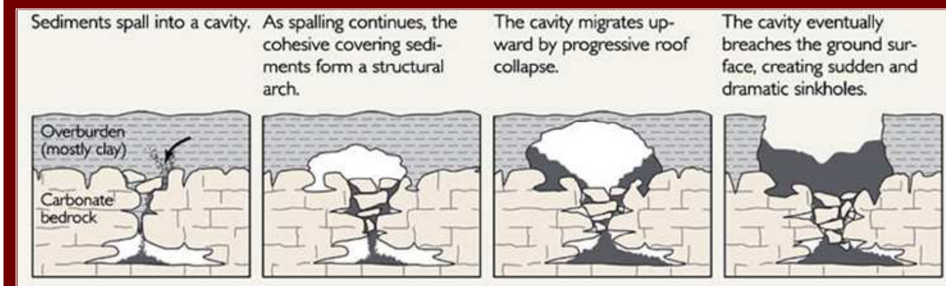
Bloodblister Cave Entrance in Florida (filled), so water can enter the karst underground as it should be able too

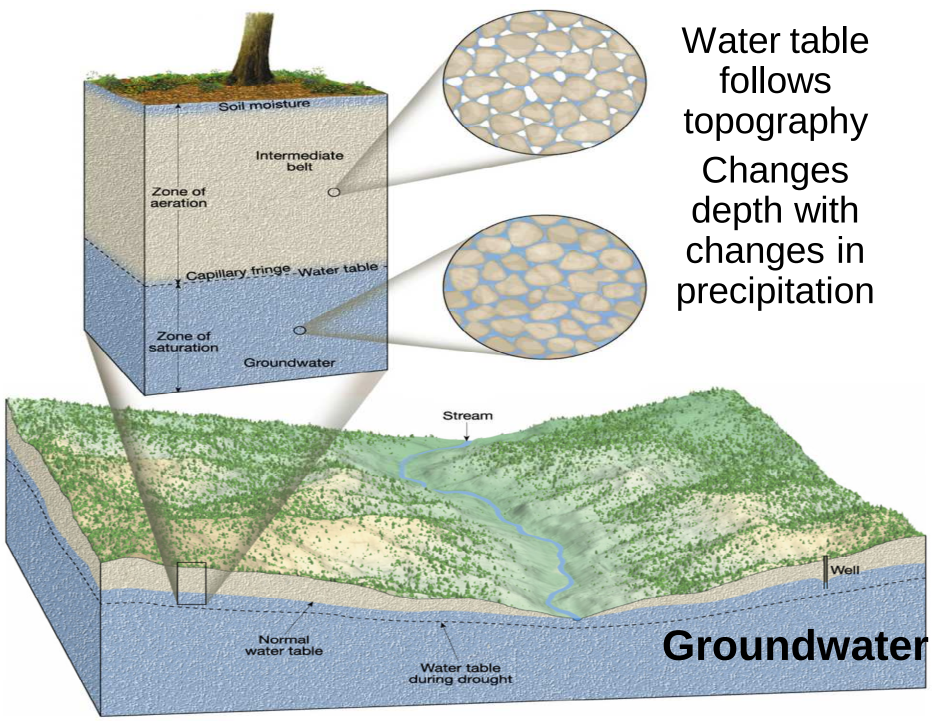
The following slides are for your reference only…

How Subsidence Sinkholes Form… These are the sinkholes that appear are dips in the landscape



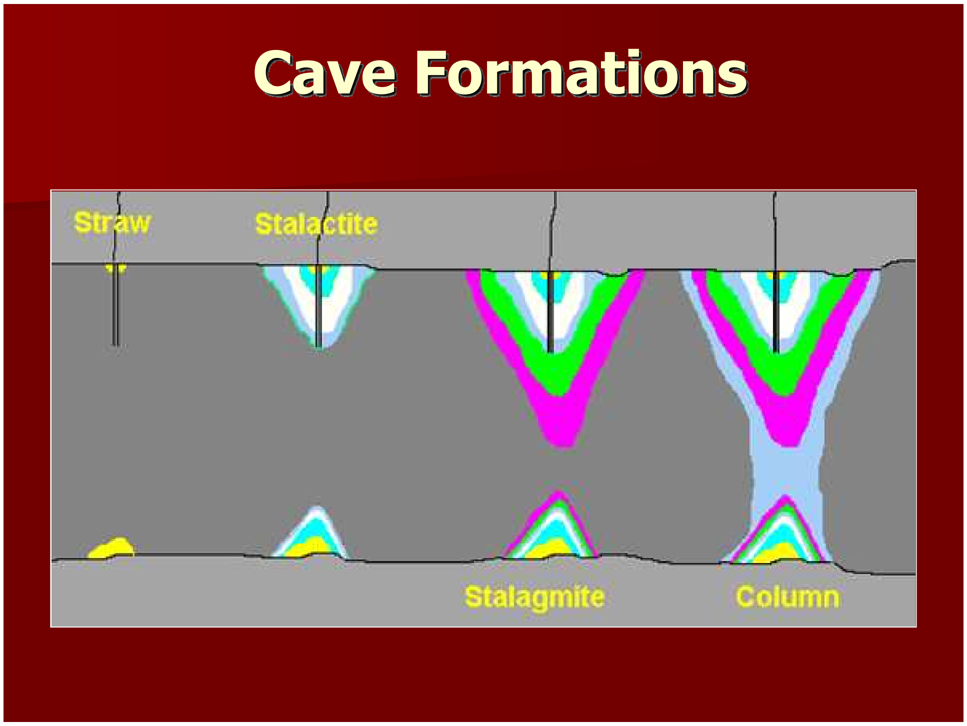
How Collapse Sinkholes Form… These are the sinkholes that suddenly form and look like the ground just fell straight done (because it did!)





Water table follows topography

Changes depth with changes in precipitation


Cave Formations
Straw
Stalactite
Stalagmite
Column

APPENDIX H: Pre-tour, Pre-training Survey Assessments

Table A5: Pre-tour, Pre-training Survey Assessments (Mammoth).

Facility	Q 1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid.
Mammoth	2	2	2	2	2	2	2	1	2	1	2	2	41-50	F	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Associates	KY
Mammoth	2	2	2	2	1	1	2	1	2	1	2	1	41-50	M	High School	KY
Mammoth	2	2	2	2	2	2	2	1	2	2	2	2	18-30	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	18-30	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	41-50	F	Bachelors	FL
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	18-30	M	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	Associates	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	51-60	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	18-30	M	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	41-50	F	Masters	KY
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	51-60	F	High School	KY
Mammoth	2	2	2	2	2	2	2	1	2	2	2	2	41-50	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Bachelors	KY
Mammoth	2	2	1	1	2	1	2	2	2	1	1	2	51-60	F	High School	KY
Mammoth	1	1	2	2	2	2	2	2	2	2	2	2	51-60	F	Bachelors	FL
Mammoth	2	2	2	2	2	2	1	2	2	1	2	2	41-50	M	Associates	FL
Mammoth	2	2	2	2	2	1	2	2	2	2	1	2	31-40	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	18-30	M	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	1	41-50	M	Associates	AR
Mammoth	2	2	2	2	2	2	2	2	1	2	2	2	41-50	M	High School	KY

Appendix H (Continued)

Mammoth	2	2	2	2	2	2	2	2	2	2	2	1	51-60	M	High School	TN
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Associates	MO
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	31-40	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	18-30	F	Associates	TN
Mammoth	2	2	2	2	2	1	2	2	2	2	2	1	18-30	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	1	1	31-40	F	Masters	KY
Mammoth	2	2	1	2	2	2	2	2	1	2	2	2	18-30	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	1	2	61-70	F	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	F	Bachelors	KY
Mammoth	1	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Masters	AR
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	MO
Mammoth	2	2	2	2	2	2	2	2	2	1	1	2	31-40	M	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	31-40	M	Some C	TN
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	High School	TN
Mammoth	2	2	2	2	2	2	2	2	2	2	2	1	41-50	M	Some C	KY
Mammoth	2	2	2	2	1	2	2	2	2	2	1	2	31-40	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	High School	FL
Mammoth	2	2	2	2	2	2	2	2	2	2	2	1	18-30	M	High School	TN
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Associates	TN
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	18-30	F	Associates	TN
Mammoth	2	2	2	2	1	2	2	2	1	2	2	2	41-50	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	2	2	41-50	F	Masters	TN
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	61-70	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Bachelors	KY

Mammoth	2	2	2	1	2	2	2	2	2	2	2	1	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	1	2	2	2	2	2	2	2	31-40	F	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	High School	KY
Mammoth	2	2	1	2	1	2	2	2	2	2	2	2	31-40	F	Bachelors	KY
Mammoth	1	1	1	2	2	1	2	1	2	1	1	1	18-30	F	Some C	KY
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	18-30	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	18-30	M	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	41-50	F	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	41-50	F	Some C	KY
Mammoth	2	2	2	2	2	2	1	2	1	2	1	1	18-30	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	41-50	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	51-60	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	1	18-30	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	1	2	2	1	2	2	41-50	F	High School	KY
Mammoth	2	2	2	2	2	1	2	2	1	1	1	1	41-50	F	Doctorate	KY
Mammoth	2	2	2	2	2	1	1	2	2	1	2	1	41-50	F	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	2	1	18-30	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	Doctorate	TN
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Masters	KY
Mammoth	2	2	2	1	2	2	2	1	2	2	2	2	41-50	M	Associates	KY
Mammoth	1	2	2	2	2	1	2	2	2	2	2	2	18-30	M	Some C	KY
Mammoth	2	2	2	1	2	1	2	2	2	2	2	2	61-70	F	High School	KY
Mammoth	2	2	2	2	1	2	2	2	2	2	2	2	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Some C	TN

Appendix H (Continued)

Mammoth	2	2	2	2	2	2	2	2	1	2	2	2	41-50	F	Associates	TN
Mammoth	2	1	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	GA
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Bachelors	KY
Mammoth	1	2	2	2	2	2	2	2	2	2	2	2	18-30	F	Associates	KY
Mammoth	1	2	2	1	2	1	1	2	1	2	2	2	51-60	M	Masters	GA
Mammoth	1	2	2	2	2	2	1	2	2	2	2	2	31-40	F	Some C	TN
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	Associates	KY
Mammoth	2	1	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	KY
Mammoth	2	2	2	1	2	2	2	2	2	1	2	2	31-40	F	Bachelors	KY
Mammoth	2	2	2	2	1	2	2	1	2	2	2	2	18-30	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	51-60	F	Associates	KY
Mammoth	1	1	2	2	1	1	2	1	1	1	2	1	31-40	M	High School	KY
Mammoth	2	1	2	2	2	2	2	2	2	2	2	2	41-50	M	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	18-30	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	Bachelors	MO
Mammoth	2	2	2	2	2	2	2	1	2	1	2	2	18-30	M	Some C	KY
Mammoth	2	2	2	2	2	2	2	1	2	1	2	2	31-40	M	High School	AL
Mammoth	2	1	2	2	2	2	2	2	2	2	2	2	51-60	M	High School	SD
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	18-30	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	High School	KY
Mammoth	2	2	2	2	2	1	2	1	2	2	2	2	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Some C	FL
Mammoth	2	2	2	2	2	2	2	1	1	2	2	2	31-40	F	Masters	KY
Mammoth	2	2	2	2	2	2	2	1	2	2	2	2	51-60	M	Bachelors	KY
Mammoth	2	1	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	KY

Appendix H (Continued)

Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	18-30	F	Some C	KY
Mammoth	2	2	2	2	2	2	1	1	1	2	1	2	31-40	M	Bachelors	KY
Mammoth	2	1	2	2	2	2	2	2	2	1	2	2	18-30	F	Associates	CA
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	61-70	M	High School	KY
Mammoth	2	1	2	2	2	2	2	2	2	2	2	2	31-40	F	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	31-40	M	High School	FL
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	High School	TN
Mammoth	2	1	2	2	2	2	2	2	2	2	1	2	18-30	F	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	61-70	F	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	High School	MO
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	Some C	AL

Table A6: Pre-tour, Pre-training Survey Assessments (Florida Caverns).

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid.
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	31-40	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Associates	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	21-30	M	Masters	GA
Florida Caverns	2	2	2	2	2	2	2	1	2	1	2	2	41-50	M	Bachelor	AL
Florida Caverns	2	1	2	2	2	2	2	2	2	1	2	2	61-70	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-21	F	Some C	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	1	2	61-70	F	High School	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	1	2	2	18-21	M	High School	FL
Florida Caverns	1	2	2	1	2	2	2	2	2	2	2	2	41-50	M	High School	GA
Florida Caverns	2	2	2	2	2	2	2	1	1	2	2	2	18-21	F	Some C	NC
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	Masters	AL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	31-40	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	61-70	F	Some C	GA
Florida Caverns	2	1	2	2	2	2	1	2	2	2	2	2	31-40	F	Some C	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	Masters	GA

Florida Caverns	2	2	2	2	2	1	2	2	1	2	2	2	21-30	M	Associates	FL
Florida Caverns	2	2	1	2	1	2	2	2	1	1	2	1	41-50	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	18-21	F	High School	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	31-40	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelors	GA
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	High School	FL
Florida Caverns	1	2	1	2	2	2	2	1	2	1	1	2	18-21	F	Some C	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	2	2	1	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	2	2	1	18-21	F	Some C	GA
Florida Caverns	2	2	2	2	1	2	1	2	2	2	2	2	31-40	F	Bachelors	LA
Florida Caverns	2	2	2	2	1	2	2	2	1	2	2	2	61-70	F	Masters	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Associates	AL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Masters	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	18-21	M	High School	FL

Appendix H (Continued)

Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	FL
Florida Caverns	2	2	1	2	1	2	2	2	2	2	2	2	31-40	F	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	AL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	High School	FL
Florida Caverns	2	2	1	2	1	2	1	2	1	1	1	2	18-21	F	High School	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	1	2	2	31-40	M	High School	FL
Florida Caverns	2	1	2	1	2	2	2	2	2	2	2	2	31-40	F	Bachelors	GA
Florida Caverns	2	1	1	2	1	2	1	2	2	1	2	1	41-50	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Associates	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	51-60	M	High School	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	41-50	F	High School	GA
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	Associates	FL
Florida Caverns	1	2	2	2	2	2	2	2	1	1	2	2	31-40	F	High School	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	41-50	M	High School	FL
Florida Caverns	2	1	2	1	2	1	2	2	2	2	1	1	21-30	M	Bachelors	GA
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	2	61-70	F	Doctorate	GA
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	41-50	M	Masters	FL

Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	Some C	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	31-40	F	Associates	FL
Florida Caverns	2	2	1	1	2	2	1	2	1	1	2	1	21-30	M	Bachelors	FL
Florida Caverns	2	2	2	1	2	1	2	1	2	1	2	1	31-40	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-21	F	High School	AL
Florida Caverns	2	2	1	2	2	1	2	2	2	1	1	1	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	51-60	F	Associates	GA
Florida Caverns	2	2	2	2	2	1	2	2	2	2	1	2	18-21	M	High School	FL
Florida Caverns	2	2	2	2	1	2	2	2	1	2	2	2	31-40	M	Some C	GA
Florida Caverns	2	2	1	2	2	2	2	2	2	1	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	1	1	1	2	2	2	2	2	1	1	2	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	2	1	2	21-30	F	Bachelors	LA
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	21-30	M	Masters	FL

Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	41-50	M	Bachelor	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	High School	FL
Florida Caverns	2	2	1	2	1	2	2	2	2	2	2	2	31-40	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	1	2	2	18-21	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Bachelor	GA
Florida Caverns	1	2	2	2	2	2	2	2	1	2	2	2	31-40	F	Associates	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	21-30	F	High School	FL
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	1	2	1	2	2	31-40	M	Masters	FL
Florida Caverns	2	2	1	2	2	2	1	2	1	1	1	1	21-30	F	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	41-50	F	High School	LA
Florida Caverns	2	2	2	2	2	2	2	1	2	1	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	High School	FL
Florida Caverns	2	2	1	1	2	2	1	1	2	1	2	1	21-30	M	Bachelors	AL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Associates	FL

Appendix H (Continued)

Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Some C	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	2	1	2	61-70	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	FL
Florida Caverns	2	2	2	1	1	2	2	2	2	2	2	2	41-50	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	18-21	F	Some C	GA
Florida Caverns	2	2	2	1	2	2	2	1	1	1	1	1	41-50	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	51-60	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	1	2	2	2	2	18-21	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	1	2	31-40	F	Associates	FL
Florida Caverns	2	2	2	1	1	1	1	2	2	1	2	1	41-50	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	18-21	F	High School	FL
Florida Caverns	2	2	1	2	1	2	2	1	2	1	1	2	21-30	F	Associates	FL
Florida Caverns	1	1	2	1	1	2	2	2	2	1	2	1	51-60	M	High School	FL

Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	41-50	F	High School	SC
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	2	1	2	31-40	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	1	2	18-21	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	1	2	2	2	2	18-21	F	Some C	FL
Florida Caverns	1	1	2	2	2	2	2	2	2	2	2	2	31-40	M	Masters	FL
Florida Caverns	1	2	2	2	2	2	2	2	1	2	2	2	51-60	M	Bachelors	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	31-40	F	High School	FL
Florida Caverns	2	2	1	2	1	1	1	2	1	1	1	2	18-21	F	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	1	2	41-50	F	High School	TX
Florida Caverns	2	2	2	2	2	2	2	2	1	2	1	2	41-50	F	High School	FL

Appendix H (Continued)

Florida Caverns	1	2	2	2	2	2	2	2	1	2	2	2	21-30	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	18-21	M	Associates	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	31-40	F	High School	FL
Florida Caverns	2	1	2	1	1	1	2	2	1	2	2	1	31-40	M	Bachelors	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	18-21	F	High School	GA
Florida Caverns	2	2	2	2	1	2	2	2	1	2	2	2	41-50	F	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	18-21	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	51-60	F	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	2	1	31-40	M	Bachelors	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	21-30	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	41-50	M	Some C	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	21-30	M	Some C	FL
Florida Caverns	2	2	1	1	2	1	1	1	1	1	1	2	31-40	F	Associates	FL
Florida Caverns	2	1	1	1	2	2	1	2	1	1	1	1	31-40	F	Bachelors	FL

Table A7: Pre-tour, Pre-training Survey Assessments (Lost River).

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Lost River	1	1	2	2	2	2	2	2	2	2	2	2	21-30	F	Associates	FL
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	CA
Lost River	2	2	2	2	2	2	2	2	2	2	1	2	41-50	M	Bachelors	TN
Lost River	1	1	2	2	2	2	2	2	2	2	2	2	21-30	M	Associates	KY
Lost River	2	2	2	2	2	2	1	2	2	2	2	2	18-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Bachelors	KY
Lost River	2	2	2	2	2	2	1	2	2	2	2	2	21-30	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Masters	KY
Lost River	2	2	1	2	2	2	2	2	2	2	2	2	41-50	F	Associates	KY
Lost River	1	1	2	2	2	2	2	2	2	2	2	2	18-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Some C	KY
Lost River	2	1	2	1	1	2	2	1	1	1	2	1	21-30	F	High School	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	41-50	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	41-50	F	Bachelors	KY
Lost River	2	2	2	2	2	1	2	2	2	2	2	2	18-30	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	Associates	KY

Appendix H (Continued)

Lost River	2	2	2	2	1	2	2	1	1	1	1	2	51-60	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Bachelors	KY
Lost River	2	2	1	2	2	2	2	2	2	2	2	2	41-50	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	Associates	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	18-20	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Some C, no degree	KY
Lost River	1	1	1	1	2	2	2	1	2	2	2	2	41-50	M	Masters	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	31-40	F	Some C, no degree	KY
Lost River	2	2	1	2	2	2	2	2	2	2	2	2	41-50	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Masters	KY
Lost River	2	2	1	2	1	2	2	2	2	2	2	2	21-30	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	High School	CA
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	KY
Lost River	2	2	2	1	2	2	2	2	1	2	2	2	31-40	M	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelors	MO
Lost River	2	2	2	2	1	2	2	2	1	2	2	2	31-40	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Associates	CA
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	High School	SC
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	Masters	KY

Appendix H (Continued)

Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	High School	KY
Lost River	1	1	2	2	2	2	2	2	2	2	2	2	21-30	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	1	2	18-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	1	2	21-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	61-70	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	41-50	F	Some C	KY
Lost River	2	2	1	2	2	2	2	2	2	2	1	2	31-40	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	41-50	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	1	1	2	21-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	61-70	M	High School	TN
Lost River	2	2	2	2	1	2	1	2	2	2	1	1	31-40	F	Bachelor's	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	31-40	M	Some C	OH
Lost River	2	2	2	2	1	2	2	2	2	2	2	1	18-20	M	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	Bachelors	OH
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	31-40	M	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	21-30	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Some C	KY
Lost River	2	1	2	2	2	2	2	2	2	2	1	2	21-30	M	Bachelors	KY
Lost River	1	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	21-30	F	Masters	KY
Lost River	2	2	2	2	2	2	2	1	2	2	2	2	31-40	F	High School	KY

Appendix H (Continued)

Lost River	2	2	2	2	2	1	2	2	2	1	2	2	41-50	M	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelors	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	51-60	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	High School	KY
Lost River	2	2	2	1	2	2	2	2	2	2	1	2	31-40	F	High School	MO
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	51-60	M	High School	OH
Lost River	2	2	1	2	2	1	2	2	2	2	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Some C	KY
Lost River	2	1	2	2	2	2	2	2	2	2	1	2	31-40	M	Bachelors	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	18-20	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	Bachelors	KY
Lost River	2	2	2	1	2	2	1	2	2	1	1	2	21-30	M	Associates	KY
Lost River	2	1	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	FL
Lost River	2	2	2	1	2	2	2	2	2	1	2	2	31-40	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Bachelors	TN
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	KY
Lost River	2	1	2	2	2	2	2	2	2	1	2	2	41-50	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Associates	OH
Lost River	1	2	2	2	2	2	2	2	2	1	2	2	41-50	F	Masters	KY
Lost River	2	2	2	2	2	2	2	2	1	2	2	2	41-50	F	High School	KY
Lost River	2	2	2	1	2	2	2	1	2	2	2	2	41-50	M	Masters	KY

Lost River	2	1	2	2	2	2	2	2	2	2	2	2	41-50	M	Bachelors	KY
Lost River	2	2	2	2	2	1	1	2	1	2	2	1	41-50	M	Some C	MO
Lost River	1	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Some C	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	18-30	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Bachelors	FL
Lost River	1	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Associates	MI
Lost River	2	2	2	2	2	1	2	2	2	2	2	2	31-40	M	High School	KY
Lost River	2	1	2	1	2	2	1	1	1	2	1	2	51-60	F	Associates	TN
Lost River	2	2	2	2	2	2	1	2	2	2	2	2	18-30	F	Associates	FL
Lost River	2	2	2	2	2	2	2	1	2	2	2	2	51-60	F	Associates	TN
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	High School	TN
Lost River	2	2	2	1	2	2	2	2	2	1	2	2	41-50	F	Masters	TN
Lost River	2	2	2	1	2	2	2	1	2	1	1	2	51-60	M	Masters	TN
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Masters	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	Some C	KY
Lost River	1	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Bachelors	KY
Lost River	2	2	2	2	2	2	1	1	1	1	2	2	21-30	F	Bachelors	KY
Lost River	1	1	2	1	1	2	2	1	2	2	2	1	31-40	F	Bachelors	FL

Table A8: Pre-tour, Pre-training Survey Assessments (Cumberland).

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Cumberland	2	2	2	1	2	2	2	2	2	2	2	2	61-70	F	PhD	Canada
Cumberland	2	1	2	2	2	2	2	2	2	1	2	2	31-40	F	Master's	TN
Cumberland	2	2	2	2	2	2	2	1	2	2	2	2	71-80	F	Master's	MI
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Nursing	TN
Cumberland	2	1	2	2	2	2	2	2	2	2	2	2	21-30	M	High School	AK
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	IL
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	High School	Canada
Cumberland	2	2	2	2	2	1	2	2	2	1	2	2	21-30	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	FL
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	High School	FL
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	51-60	F	Master's	IN
Cumberland	2	2	2	2	2	1	2	2	2	2	2	2	41-50	M	Law degree	SC
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	31-40	M	Some C	SC
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	21-30	F	Bachelor's	FL
Cumberland	2	1	2	2	2	2	2	2	2	1	2	2	61-70	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	IN
Cumberland	2	1	2	2	2	2	2	1	2	2	2	2	31-40	M	Some C	SC
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	LA
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	21-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelor's	LA
Cumberland	2	1	2	2	2	2	2	2	2	1	2	1	21-30	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	F	Some C	MO
Cumberland	2	2	2	2	2	2	2	1	2	1	2	2	61-70	M	High School	FL
Cumberland	2	1	2	1	1	2	2	2	1	2	2	1	18-21	F	High School	KY

Appendix H (Continued)

Cumberland	2	1	1	1	2	2	2	2	1	1	2	2	51-60	M	Bachelor's	IL
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelor's	LA
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	41-50	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	1	2	21-30	F	Some C	MO
Cumberland	1	2	2	2	2	2	2	2	2	1	2	2	31-40	F	High School	FL
Cumberland	1	1	2	2	2	2	2	1	2	1	2	2	31-40	F	Bachelor's	IN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	1	2	51-60	M	Law Degree	KY
Cumberland	1	1	2	2	1	2	2	2	1	1	2	1	18-20	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Master's	GA
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Bachelor's	TN
Cumberland	2	1	2	2	2	2	2	2	2	1	2	2	18-21	F	High School	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	18-20	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelor's	VA
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	18-21	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	High School	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	21-30	F	Bachelor's	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	18-20	M	Some C	GA
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Some C	TN
Cumberland	2	2	1	2	2	1	2	2	2	1	2	2	21-30	F	High School	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Bachelor's	TN
Cumberland	1	1	2	2	2	2	1	2	1	1	1	2	51-60	M	Some C	TN

Appendix H (Continued)

Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	Bachelor's	TN
Cumberland	2	2	2	2	1	2	2	2	2	2	1	2	31-40	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Master's	VA
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	18-20	M	High School	MO
Cumberland	2	2	2	2	2	1	2	2	2	1	2	1	31-40	M	High School	GA
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	18-21	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	61-70	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	High School	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	High School	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	51-60	F	Bachelor's	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	21-30	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	High School	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	61-70	M	High School	TN
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	21-30	F	Some C	GA
Cumberland	2	2	2	2	2	2	2	1	2	1	2	2	41-50	M	Bachelor's	TN
Cumberland	2	2	1	2	2	2	2	2	2	2	2	2	21-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	Master's	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	31-40	F	Master's	TN
Cumberland	2	2	2	2	2	1	2	2	2	1	2	1	51-60	M	Some C	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	1	2	31-40	M	Bachelor's	KY
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	18-20	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Some C	TN
Cumberland	2	2	2	2	2	1	2	2	2	1	2	2	31-40	F	Bachelor's	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	18-21	M	High School	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelor's	TN

Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	21-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	F	Master's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	Bachelor's	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	41-50	M	Some C	MO
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	21-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	High School	GA
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Bachelor's	TN
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	21-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	High School	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	1	2	31-40	M	Bachelor's	TN
Cumberland	2	1	2	1	2	2	2	1	1	1	1	1	51-60	F	Some C	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	61-70	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	2	18-21	M	High School	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	31-40	M	Bachelor's	KY
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	18-20	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	1	2	2	2	2	51-60	M	Some C	TN
Cumberland	1	1	2	2	1	2	1	1	1	1	1	1	31-40	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	1	1	1	2	1	21-30	F	High School	TN

APPENDIX I: Post-tour, Pre-training Survey Assessments

Table A9: Post-tour, Pre-training Survey Assessments (Mammoth)

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q 5	Q 6	Q7	Age	Sex	Education	Resid
Mammoth	2	2	2	2	2	2	2	1	2	1	2	1	41-50	F	Some C	KY
Mammoth	2	1	2	2	2	2	2	2	2	2	2	2	31-40	F	Associates	KY
Mammoth	2	2	2	2	1	1	2	1	2	1	2	1	41-50	M	High School	KY
Mammoth	2	1	2	2	2	2	2	1	2	2	2	2	18-30	M	Bachelors	KY
Mammoth	1	2	1	2	2	2	2	2	2	1	2	1	18-30	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	18-30	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	1	2	1	2	1	41-50	F	Bachelors	FL
Mammoth	2	1	1	2	2	1	2	2	2	1	2	2	18-30	M	Some C	KY
Mammoth	2	2	2	1	2	2	2	2	2	1	2	2	41-50	F	Associates	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	51-60	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	18-30	M	Masters	KY
Mammoth	2	2	2	2	2	2	2	1	2	2	1	2	41-50	F	Masters	KY
Mammoth	2	2	1	2	2	1	2	2	2	1	2	1	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	51-60	F	High School	KY
Mammoth	2	1	2	2	2	2	2	1	2	1	2	2	41-50	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Bachelors	KY
Mammoth	2	2	1	1	1	1	2	2	2	1	1	2	51-60	F	High School	KY
Mammoth	1	1	2	2	2	2	2	2	2	2	2	2	51-60	F	Bachelors	FL
Mammoth	2	2	2	1	2	2	1	2	2	1	2	2	41-50	M	Associates	FL
Mammoth	2	1	2	1	2	1	2	2	2	2	1	2	31-40	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Masters	KY

Appendix I (Continued)

Mammoth	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**51-60**	**F**	**Bachelors**	**KY**
Mammoth	2	2	1	2	2	2	2	2	1	1	2	2	18-30	M	Masters	KY
Mammoth	2	1	2	2	2	2	2	2	1	1	2	1	41-50	M	Associates	AR
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	41-50	M	High School	KY
Mammoth	2	1	2	2	2	2	2	2	2	1	2	1	51-60	M	High School	TN
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Associates	MO
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	31-40	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	18-30	F	Associates	TN
Mammoth	2	2	2	2	2	1	2	2	2	2	2	1	18-30	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	1	1	31-40	F	Masters	KY
Mammoth	1	2	1	2	2	2	2	2	1	2	2	2	18-30	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	1	2	61-70	F	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Associates	KY
Mammoth	2	2	1	2	2	2	2	2	2	1	2	1	18-30	F	Bachelors	KY
Mammoth	1	1	2	2	2	2	2	2	2	1	2	2	51-60	F	Masters	AR
Mammoth	2	1	2	2	2	2	2	2	2	1	2	2	18-30	F	High School	MO
Mammoth	2	1	2	2	2	2	2	2	1	1	1	2	31-40	M	Some C	KY
Mammoth	2	2	2	2	2	1	1	2	2	1	2	1	31-40	M	Some C	TN
Mammoth	2	1	2	2	1	1	2	2	2	1	2	2	31-40	F	High School	TN
Mammoth	2	2	2	2	2	2	2	2	2	2	2	1	41-50	M	Some C	KY
Mammoth	1	1	2	1	1	2	2	2	1	2	1	2	31-40	M	Associates	KY
Mammoth	2	1	2	2	2	2	2	2	2	1	2	1	41-50	M	High School	FL

Appendix I (Continued)

Mammoth	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**18-30**	**M**	**High School**	**TN**
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Associates	TN
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	18-30	F	Associates	TN
Mammoth	2	1	2	2	1	2	2	2	1	2	2	2	41-50	F	Bachelors	KY
Mammoth	2	2	2	2	2	1	2	2	1	2	2	2	41-50	F	Masters	TN
Mammoth	2	2	2	2	2	2	2	1	2	1	1	2	18-30	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	1	2	2	1	2	1	61-70	F	High School	KY
Mammoth	2	1	2	2	2	1	2	2	2	2	2	2	41-50	F	Bachelors	KY
Mammoth	1	2	2	1	2	2	2	1	2	1	2	1	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	1	2	1	2	2	2	2	2	31-40	F	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	High School	KY
Mammoth	2	2	1	2	1	2	2	2	2	1	2	2	31-40	F	Bachelors	KY
Mammoth	1	1	1	2	2	1	2	1	2	1	1	1	18-30	F	Some C	KY
Mammoth	2	2	2	2	1	2	2	2	1	1	2	2	18-30	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	18-30	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	18-30	M	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	41-50	F	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	41-50	F	Some C	KY
Mammoth	2	2	2	2	2	2	1	2	1	2	1	1	18-30	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	41-50	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	51-60	M	Associates	KY

Appendix I (Continued)

Mammoth	**2**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**1**	**18-30**	**M**	**Bachelors**	**KY**
Mammoth	2	2	2	2	2	2	1	2	2	1	2	2	41-50	F	High School	KY
Mammoth	2	2	2	2	2	1	2	2	1	1	1	1	41-50	F	Doctorate	KY
Mammoth	2	2	2	2	2	1	1	2	2	1	2	1	41-50	F	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	2	1	18-30	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	Doctorate	TN
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Masters	KY
Mammoth	2	2	2	1	2	2	2	1	2	2	2	2	41-50	M	Associates	KY
Mammoth	1	2	2	2	2	1	2	2	2	2	2	2	18-30	M	Some C	KY
Mammoth	2	2	2	1	2	1	2	2	2	2	2	2	61-70	F	High School	KY
Mammoth	2	2	2	2	1	2	2	2	2	2	2	2	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Some C	TN
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	18-30	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	2	2	41-50	F	Associates	TN
Mammoth	2	1	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	GA
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Bachelors	KY
Mammoth	1	2	2	2	2	2	2	2	2	2	2	2	18-30	F	Associates	KY
Mammoth	1	1	2	1	2	1	1	2	1	2	2	2	51-60	M	Masters	GA
Mammoth	1	2	2	2	2	2	1	2	2	2	2	2	31-40	F	Some C	TN
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	Bachelors	KY
Mammoth	2	2	2	2	2	1	2	2	2	1	2	1	31-40	F	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	KY
Mammoth	2	2	2	1	2	2	2	2	2	1	2	2	31-40	F	Bachelors	KY
Mammoth	2	2	2	2	1	2	2	1	2	2	2	2	18-30	M	High School	KY
Mammoth	2	2	2	1	2	2	2	1	2	1	1	1	51-60	F	Associates	KY

Appendix I (Continued)

Mammoth	**1**	**1**	**2**	**2**	**1**	**1**	**2**	**1**	**1**	**1**	**2**	**1**	**31-40**	**M**	**High School**	**KY**
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	18-30	F	High School	KY
Mammoth	2	2	2	2	1	2	2	2	2	1	2	1	18-30	F	High School	KY
Mammoth	2	1	2	2	2	1	2	2	2	1	2	1	31-40	F	Bachelors	MO
Mammoth	2	2	2	2	2	1	2	1	1	1	2	2	18-30	M	Some C	KY
Mammoth	2	1	2	2	2	2	2	1	2	1	2	2	31-40	M	High School	AL
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	High School	SD
Mammoth	2	1	2	2	2	1	2	2	2	1	2	2	18-30	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	High School	KY
Mammoth	2	2	2	2	2	1	2	1	2	2	2	2	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Some C	FL
Mammoth	2	1	1	2	2	2	1	1	1	2	2	2	31-40	F	Masters	KY
Mammoth	2	2	2	2	2	2	2	1	2	2	2	2	51-60	M	Bachelors	KY
Mammoth	1	1	2	2	2	1	2	2	2	1	2	2	31-40	F	Some C	KY
Mammoth	2	1	2	2	2	2	2	1	1	1	2	2	18-30	F	Some C	KY
Mammoth	2	2	2	2	1	2	1	1	1	2	1	2	31-40	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	1	2	18-30	F	Associates	CA
Mammoth	2	1	2	2	2	2	1	2	2	2	1	2	61-70	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	1	31-40	M	High School	FL
Mammoth	2	2	2	2	1	1	2	1	2	2	2	2	41-50	F	High School	TN

Appendix I (Continued)

Mammoth	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**1**	**18-30**	**F**	**Some C**	**KY**
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	61-70	F	Associates	KY
Mammoth	2	1	2	2	2	2	2	2	1	2	2	2	31-40	F	High School	MO
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Some C	KY
Mammoth	2	1	2	1	2	2	2	2	2	1	2	2	31-40	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Some C	AL

Appendix I (Continued)

Table A10: Post-tour, Pre-training Survey Assessments (Florida Caverns)

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Florida Caverns	1	2	2	2	2	2	1	2	2	1	2	2	18-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	Masters	FL
Florida Caverns	2	1	1	2	2	2	2	1	2	1	2	2	61-70	F	Bachelor	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	1	2	2	31-40	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	1	1	18-30	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	31-40	F	High School	FL
Florida Caverns	1	2	2	1	2	2	2	2	2	1	2	2	31-40	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	High School	FL
Florida Caverns	2	2	2	1	2	1	2	2	2	2	2	2	18-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Masters	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	1	2	2	18-30	M	Bachelors	FL
Florida Caverns	1	1	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	GA
Florida Caverns	2	2	2	2	2	2	1	1	2	1	2	2	61-70	M	Some C	FL
Florida Caverns	2	2	1	2	1	2	2	2	2	1	1	2	41-50	F	Masters	GA

Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	18-30	F	Associates	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	41-50	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-30	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	1	2	31-40	F	Bachelors	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	1	2	2	51-60	F	High School	FL
Florida Caverns	1	1	1	2	2	2	2	1	2	1	2	2	31-40	F	Some C	FL
Florida Caverns	2	2	2	1	1	2	2	2	2	2	2	1	18-30	M	Some C	FL
Florida Caverns	1	2	1	2	2	2	2	2	2	1	2	1	31-40	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	Bachelors	FL
Florida Caverns	2	1	2	2	1	2	2	2	1	2	2	2	18-30	M	Masters	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Associates	AL
Florida Caverns	2	2	2	2	2	1	2	2	2	2	2	2	51-60	M	High School	FL
Florida Caverns	1	1	1	2	1	2	2	2	2	1	2	2	18-30	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelors	FL
Florida Caverns	1	1	2	2	2	2	2	2	2	1	2	2	31-40	M	Masters	GA
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	18-30	F	High School	FL

Florida Caverns	2	1	2	1	1	2	2	2	2	1	2	2	18-30	F	Some C	AR
Florida Caverns	2	2	2	2	2	2	2	2	1	2	1	1	18-30	F	Associates	FL
Florida Caverns	1	2	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	AR
Florida Caverns	2	1	2	2	2	2	2	2	2	2	2	2	41-50	F	High School	FL
Florida Caverns	1	2	2	2	2	2	1	2	1	2	1	2	18-30	F	High School	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	2	2	2	18-30	F	High School	FL
Florida Caverns	1	1	2	1	2	2	2	1	2	1	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	1	2	2	2	2	1	2	2	1	2	1	31-40	M	Bachelors	FL
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	1	18-30	F	Associates	FL
Florida Caverns	2	2	2	2	1	2	2	1	2	1	2	2	41-50	F	High School	FL
Florida Caverns	2	1	2	2	2	1	2	2	1	1	2	2	18-30	M	High School	FL
Florida Caverns	2	1	2	2	2	2	2	2	2	1	2	2	51-60	M	Associates	FL
Florida Caverns	1	1	2	1	2	1	2	2	1	1	2	2	31-40	F	High School	FL
Florida Caverns	1	1	2	2	2	2	1	1	2	1	2	2	18-30	F	High School	FL
Florida Caverns	1	1	1	2	2	1	2	2	2	1	1	2	41-50	M	Bachelors	AR
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	21-30	M	Doctorate	KY
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	2	18-30	F	Masters	FL

Appendix I (Continued)

Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	FL
Florida Caverns	2	2	1	2	1	2	2	1	2	1	2	2	18-30	M	Some C	FL
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	1	18-30	M	Associates	FL
Florida Caverns	2	2	1	2	2	2	1	2	1	1	2	2	18-30	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	18-30	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	61-70	F	High School	FL
Florida Caverns	1	2	2	2	2	2	2	2	2	1	1	1	31-40	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	High School	FL
Florida Caverns	2	2	2	2	1	2	2	2	1	2	2	2	31-40	M	Some C	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	2	2	18-30	M	Bachelors	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	2	2	41-50	M	Some C	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	2	2	41-50	M	Some C	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	1	2	18-30	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	18-30	F	Masters	FL

Appendix I (Continued)

Florida Caverns	1	2	2	2	2	2	2	2	1	2	2	2	41-50	F	Bachelor	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	FL
Florida Caverns	2	2	1	2	1	2	2	2	2	2	2	2	31-40	F	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	2	2	31-40	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	31-40	F	Bachelor	AL
Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	31-40	F	Associates	FL
Florida Caverns	2	1	1	2	2	2	2	2	2	2	2	2	18-30	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Some C	MO
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	Masters	KY
Florida Caverns	2	2	2	2	2	2	2	2	1	1	1	1	31-40	F	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	High School	KY
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	High School	FL
Florida Caverns	2	1	2	2	2	2	1	1	2	1	2	1	51-60	M	Bachelors	AL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Some C	TN

Florida Caverns	2	2	2	2	2	2	2	2	2	2	1	2	18-30	F	High School	FL
Florida Caverns	2	1	2	2	2	2	2	2	2	1	2	2	18-30	M	High School	FL
Florida Caverns	2	2	2	1	2	2	2	1	2	1	2	2	18-30	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	18-30	F	Some C	FL
Florida Caverns	2	2	2	1	2	1	2	2	1	1	2	1	31-40	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	31-40	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	1	2	1	2	2	31-40	F	Some C	FL
Florida Caverns	1	1	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	TN
Florida Caverns	1	1	2	2	2	2	2	2	2	1	1	2	41-50	F	Associates	FL
Florida Caverns	2	2	2	2	2	1	1	2	2	2	2	2	18-30	M	High School	FL
Florida Caverns	2	1	2	2	1	2	2	2	2	2	2	2	51-60	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	2	2	2	41-50	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	1	2	2	1	1	41-50	M	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	High School	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	41-50	F	High School	FL
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Bachelors	FL
Florida Caverns	2	1	1	2	1	1	2	2	2	1	1	1	18-30	M	Some C	FL

Appendix I (Continued)

Florida Caverns	2	1	2	2	2	2	2	1	2	1	2	2	41-50	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-30	F	Some C	FL
Florida Caverns	2	1	2	2	2	2	2	2	2	1	2	1	51-60	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Bachelors	GA
Florida Caverns	1	2	2	2	2	2	2	2	2	2	2	2	18-30	M	High School	AL
Florida Caverns	2	2	1	2	2	2	2	1	2	2	1	2	41-50	F	Some C	MO
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Masters	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	31-40	F	High School	FL
Florida Caverns	1	2	2	2	1	1	2	2	1	1	1	2	41-50	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	1	2	41-50	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	1	2	41-50	F	High School	FL
Florida Caverns	1	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Bachelors	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	1	2	2	18-30	M	High School	FL

Appendix I (Continued)

Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	41-50	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	31-40	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	51-60	F	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	1	1	31-40	M	Bachelors	KY
Florida Caverns	1	2	1	2	1	2	2	1	1	2	2	2	61-70	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-30	F	Some C	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	31-40	M	Some C	FL
Florida Caverns	1	2	2	1	2	1	2	2	1	1	2	2	31-40	M	Associates	FL
Florida Caverns	1	1	1	2	2	2	2	1	2	1	1	2	61-70	M	Bachelors	AR

Table A11: Post-tour, Pre-training Survey Assessments (Lost River)

Facility	Q 1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Lost River	1	1	2	2	2	2	2	2	2	1	1	2	21-30	F	Associates	FL
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	F	High School	CA
Lost River	2	2	2	2	2	2	2	2	2	1	1	2	41-50	M	Bachelors	TN
Lost River	1	1	2	2	2	2	2	2	2	1	2	2	21-30	M	Associates	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	18-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	31-40	M	Bachelors	KY
Lost River	2	2	2	2	1	2	1	2	2	1	2	2	21-30	F	High School	KY
Lost River	2	2	2	1	2	2	1	2	2	1	2	1	21-30	F	Bachelors	KY
Lost River	2	1	2	2	2	2	2	2	2	1	2	2	18-30	M	Associates	KY
Lost River	2	1	2	2	2	2	2	2	2	1	1	2	51-60	M	Some C	KY
Lost River	1	2	2	1	2	1	2	1	2	1	2	2	21-30	F	High School	KY
Lost River	2	1	2	2	1	2	2	2	2	2	2	2	18-30	F	Associates	KY
Lost River	2	2	2	2	2	1	2	2	1	2	2	1	41-50	M	Masters	KY
Lost River	2	2	1	2	2	2	1	2	2	2	2	2	41-50	F	Associates	KY
Lost River	1	1	2	2	2	2	2	2	2	2	2	2	18-30	F	Bachelors	KY
Lost River	2	1	2	2	1	2	1	2	2	2	2	2	18-30	F	Some C	KY
Lost River	2	2	2	2	1	2	2	1	2	1	2	2	21-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	High School	KY
Lost River	2	1	2	2	1	2	2	1	1	2	2	2	31-40	M	High School	KY
Lost River	2	2	2	2	2	1	1	1	2	1	1	2	41-50	M	Some C	KY
Lost River	1	1	2	1	1	2	2	1	1	1	2	1	21-30	F	High School	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	41-50	F	Some C	KY
Lost River	2	2	1	2	2	2	2	1	2	2	2	1	41-50	F	Bachelors	KY
Lost River	2	2	1	2	1	1	2	2	1	2	2	2	18-30	F	Associates	KY

Appendix I (Continued)

Lost River	1	1	2	2	2	2	2	1	2	1	1	1	31-40	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	Associates	KY
Lost River	2	2	2	2	1	2	2	1	1	1	1	2	51-60	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	Bachelors	KY
Lost River	2	2	1	2	2	2	2	2	2	2	2	2	41-50	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	Associates	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	18-20	M	High School	KY
Lost River	2	2	2	2	2	2	1	2	2	2	2	2	41-50	F	Some C	KY
Lost River	1	1	1	1	2	2	2	1	2	2	2	2	41-50	M	Masters	KY
Lost River	2	2	2	1	2	1	2	2	2	2	2	2	31-40	F	Some C	KY
Lost River	2	2	1	2	2	2	2	2	2	2	2	1	41-50	M	Bachelors	KY
Lost River	2	1	2	2	2	2	2	2	2	2	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	1	2	2	2	2	1	31-40	F	Masters	KY
Lost River	2	2	1	2	1	2	2	1	2	2	2	2	21-30	M	Bachelors	KY
Lost River	1	2	2	2	2	2	2	2	1	2	2	2	21-30	M	Some C	KY
Lost River	2	2	2	2	2	1	2	2	2	2	2	2	21-30	F	Some C	KY
Lost River	2	1	2	2	2	1	2	2	2	2	2	1	41-50	F	High School	CA
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Some C	KY
Lost River	1	2	2	2	1	2	2	2	2	1	2	2	18-30	F	High School	KY
Lost River	2	1	1	1	2	2	2	2	1	2	1	2	31-40	M	Associates	KY
Lost River	1	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelors	MO
Lost River	2	1	2	2	1	2	1	2	1	2	2	1	31-40	F	Bachelors	KY
Lost River	1	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Associates	CA
Lost River	2	1	2	2	2	2	2	2	2	2	2	2	31-40	F	High School	SC
Lost River	2	2	1	2	2	2	1	2	2	1	2	2	21-30	M	Associates	KY
Lost River	1	1	2	2	2	2	2	2	2	2	2	2	18-30	F	Masters	KY

Appendix I (Continued)

Lost River	2	2	2	2	1	2	2	2	2	1	2	1	21-30	M	Bachelors	KY
Lost River	2	2	1	2	2	2	2	1	2	1	2	2	61-70	F	Some C	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	41-50	F	High School	KY
Lost River	1	1	2	2	1	2	2	1	2	2	2	1	21-30	F	High School	KY
Lost River	1	1	2	2	2	2	2	2	2	1	1	2	18-30	M	Some C	KY
Lost River	2	1	2	2	2	2	2	1	2	1	1	2	21-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Bachelors	KY
Lost River	2	1	2	2	2	2	2	2	2	1	2	1	61-70	F	Bachelors	KY
Lost River	2	2	1	2	1	2	2	2	1	2	2	2	21-30	M	High School	KY
Lost River	2	1	2	2	2	2	2	2	2	1	2	1	41-50	F	Some C	KY
Lost River	2	2	1	2	2	2	2	2	2	2	1	2	31-40	F	High School	KY
Lost River	2	2	2	2	2	1	1	2	2	2	2	2	41-50	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	1	2	41-50	M	Masters	KY
Lost River	2	1	2	2	2	1	2	2	2	1	2	1	41-50	F	Associates	KY
Lost River	1	2	1	2	2	1	2	2	2	1	1	2	21-30	M	Some C	KY
Lost River	1	1	2	2	1	2	2	2	2	2	2	2	61-70	M	High School	TN
Lost River	2	2	2	1	1	2	1	2	2	2	1	1	31-40	F	Bachelor's	KY
Lost River	1	1	2	2	2	1	1	2	2	2	2	1	31-40	M	Some C	OH
Lost River	2	1	1	2	1	2	2	2	1	2	2	1	18-20	M	Associates	KY
Lost River	2	2	2	2	1	2	2	2	2	1	1	1	31-40	F	Bachelors	OH
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	31-40	M	Associates	KY
Lost River	2	2	2	2	2	2	1	2	2	2	2	1	21-30	M	Bachelors	KY
Lost River	2	1	2	1	2	1	2	2	2	1	1	2	21-30	M	Masters	KY
Lost River	2	2	2	1	2	2	1	2	2	1	2	1	51-60	M	Some C	KY
Lost River	2	1	2	2	2	1	2	2	2	2	1	2	21-30	M	Bachelors	KY
Lost River	1	2	2	1	1	1	2	2	2	1	2	1	21-30	F	Some C	KY
Lost River	2	1	2	2	2	1	2	2	2	1	2	1	21-30	F	Masters	KY
Lost River	2	2	2	1	2	2	2	1	2	2	2	2	31-40	F	High School	KY

Appendix I (Continued)

Lost River	1	1	2	1	2	1	2	1	2	1	2	1	41-50	M	Masters	KY
Lost River	1	2	2	2	2	2	1	2	2	2	2	2	31-40	F	Bachelors	KY
Lost River	1	2	2	1	2	2	1	2	2	1	1	2	51-60	F	Some C	KY
Lost River	2	1	2	2	2	2	2	1	2	2	2	2	21-30	F	High School	KY
Lost River	2	1	2	1	2	2	2	2	2	1	1	2	31-40	F	High School	MO
Lost River	2	2	2	1	2	1	2	2	2	1	2	2	51-60	M	High School	OH
Lost River	2	2	1	1	2	1	1	2	2	2	2	1	21-30	F	Bachelors	KY
Lost River	2	2	2	2	1	2	2	2	2	2	2	2	31-40	M	Some C	KY
Lost River	1	1	2	2	2	2	2	2	2	2	1	2	31-40	M	Bachelors	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	18-20	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	KY
Lost River	1	2	2	2	2	2	2	1	2	1	2	2	41-50	F	Bachelors	KY
Lost River	2	2	2	1	2	2	1	2	2	1	1	2	21-30	M	Associates	KY
Lost River	1	1	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	FL
Lost River	2	2	2	1	2	2	2	1	2	1	2	2	31-40	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	1	1	2	2	18-30	F	Associates	KY
Lost River	2	1	2	2	2	2	2	1	2	1	2	2	18-30	F	Bachelors	KY
Lost River	1	2	1	2	2	2	2	1	2	1	2	2	31-40	M	Bachelors	KY
Lost River	1	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Bachelors	TN
Lost River	1	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Bachelors	KY
Lost River	1	2	2	2	2	2	2	2	1	1	2	2	51-60	F	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	KY
Lost River	2	2	2	2	2	2	2	1	2	1	2	1	31-40	M	Some C	KY
Lost River	2	1	2	2	2	2	2	2	2	1	2	2	41-50	F	Bachelors	KY
Lost River	2	2	2	1	1	2	2	2	2	1	2	2	41-50	M	Associates	OH
Lost River	1	1	2	2	2	2	2	2	2	1	1	1	41-50	F	Masters	KY
Lost River	2	2	2	2	2	2	2	2	1	2	2	1	41-50	F	High School	KY
Lost River	1	2	2	1	1	2	2	1	1	2	2	2	41-50	M	Masters	KY

Appendix I (Continued)

Lost River																
Lost River	1	2	1	2	2	1	1	2	1	2	2	1	41-50	M	Some C	MO
Lost River	1	2	2	2	1	2	2	2	1	2	2	2	31-40	M	Some C	KY
Lost River	1	2	2	2	1	2	2	2	2	2	2	2	18-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	1	2	31-40	F	Some C	KY
Lost River	2	2	2	1	2	2	2	1	2	2	2	1	18-30	F	Some C	KY
Lost River	1	1	1	1	1	2	2	2	2	1	2	2	31-40	M	Bachelors	FL
Lost River	1	2	2	2	2	2	2	2	2	2	1	2	41-50	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Associates	MI
Lost River	2	2	1	2	2	1	2	2	2	2	2	2	31-40	M	High School	KY
Lost River	1	1	2	1	2	2	1	1	1	2	1	2	51-60	F	Associates	TN
Lost River	2	2	2	1	2	2	1	2	1	2	2	2	18-30	F	Associates	FL
Lost River	2	2	2	2	1	2	2	1	2	1	1	2	51-60	F	Associates	TN
Lost River	2	1	2	1	2	2	2	2	2	1	2	2	31-40	F	High School	TN
Lost River	1	2	1	1	2	2	2	2	1	1	1	2	41-50	F	Masters	TN
Lost River	2	1	2	1	2	2	2	1	2	1	1	2	51-60	M	Masters	TN
Lost River	1	2	2	1	2	2	2	2	2	1	2	1	51-60	M	Masters	KY
Lost River	2	2	2	1	2	2	1	1	2	1	2	2	21-30	F	Bachelors	KY
Lost River	2	1	1	2	2	1	2	2	1	1	1	2	31-40	M	Some C	KY
Lost River	1	1	2	2	1	2	2	2	1	1	2	2	51-60	F	Bachelors	KY
Lost River	2	1	1	1	1	1	1	1	1	1	2	2	21-30	F	Bachelors	KY
Lost River	1	1	2	1	1	2	2	1	2	2	2	1	31-40	F	Bachelors	FL

Table A12: Post-tour, Pre-training Survey Assessments (Cumberland)

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Cumberland	1	1	2	2	2	2	2	2	2	2	1	1	31-40	F	PhD	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	1	1	31-40	F	Master's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	1	2	18-30	F	Master's	KY
Cumberland	2	2	2	2	1	2	2	2	1	2	1	2	18-30	M	Bachelor's	TN
Cumberland	2	1	2	2	2	2	2	2	2	1	1	2	51-60	M	Nursing	TN
Cumberland	2	1	2	2	2	2	2	2	2	1	2	2	41-50	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Some C	TN
Cumberland	1	2	2	2	2	2	1	2	2	2	2	1	31-40	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	High School	TN
Cumberland	2	2	2	1	1	2	2	2	2	1	2	2	18-30	M	Some C	TN
Cumberland	2	1	2	2	2	2	2	1	2	2	2	2	31-40	F	High School	FL
Cumberland	1	2	2	2	2	2	2	2	2	1	1	2	18-30	F	Master's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	61-70	M	Law degree	KY
Cumberland	1	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Some C	SC
Cumberland	2	2	2	2	1	2	1	2	2	1	2	2	31-40	M	Bachelor's	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-30	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	High School	KY
Cumberland	2	2	2	1	2	2	2	2	2	2	1	2	31-40	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Some C	TN
Cumberland	2	2	2	2	2	1	1	2	2	1	2	2	51-60	F	Some C	TN
Cumberland	2	1	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelor's	TN

Appendix I (Continued)

Cumberland	2	2	2	2	2	2	2	2	1	1	1	2	51-60	F	Bachelor's	TN
Cumberland	1	1	2	2	2	2	2	2	2	2	2	2	18-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	1	2	18-30	F	Some C	TN
Cumberland	2	2	1	2	2	2	2	1	2	1	2	2	31-40	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	High School	GA
Cumberland	2	1	2	1	1	2	2	2	1	2	2	1	18-30	M	High School	KY
Cumberland	1	1	1	1	2	2	2	2	1	2	2	2	61-70	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	1	2	2	2	2	2	18-30	M	High School	TN
Cumberland	2	1	2	2	2	2	2	2	2	2	2	2	61-70	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Some C	KY
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	18-30	M	High School	FL
Cumberland	2	1	2	2	2	2	2	1	2	2	2	2	31-40	F	Bachelor's	FL
Cumberland	2	2	2	2	2	2	1	2	2	2	2	2	18-30	M	Some C	FL
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Law Degree	KY
Cumberland	2	2	2	2	1	2	2	2	1	2	1	2	51-60	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	18-30	F	Master's	TN
Cumberland	1	2	1	2	2	2	2	2	2	2	2	2	41-50	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	1	2	18-30	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	1	2	2	2	2	2	51-60	F	High School	TN
Cumberland	2	1	2	1	2	2	2	2	2	2	2	2	41-50	F	Some C	TN
Cumberland	1	1	1	2	2	2	2	2	2	2	2	2	31-40	F	Bachelor's	TN

Appendix I (Continued)

Cumberland	2	2	2	1	2	2	1	2	2	1	2	2	41-50	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	High School	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	1	18-30	F	Bachelor's	KY
Cumberland	2	2	2	2	2	2	2	2	2	2	1	1	31-40	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	2	51-60	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	1	2	31-40	M	Some C	TN
Cumberland	2	2	1	2	2	1	2	2	2	1	2	2	18-30	M	High School	CA
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	Bachelor's	TN
Cumberland	1	1	2	2	2	2	1	2	1	1	1	2	61-70	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Master's	KY
Cumberland	1	2	2	2	2	2	2	2	2	1	2	2	18-30	M	Bachelor's	TN
Cumberland	2	2	2	2	1	2	2	2	2	2	1	2	51-60	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	Master's	CA
Cumberland	2	1	1	2	2	2	2	2	2	1	2	2	41-50	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	1	61-70	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	1	41-50	M	Bachelor's	TN
Cumberland	1	1	2	2	2	2	1	2	1	2	2	2	18-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	1	2	18-30	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	1	18-30	F	High School	TN
Cumberland	2	2	2	2	1	2	2	2	2	2	1	2	31-40	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	61-70	M	Some C	TN

Appendix I (Continued)

Cumberland	2	2	2	2	2	2	2	2	2	1	1	1	41-50	M	High School	AL
Cumberland	1	1	2	2	1	2	2	2	2	1	2	2	61-70	M	High School	TN
Cumberland	2	1	1	2	1	2	2	2	2	1	2	1	31-40	M	Some C	AL
Cumberland	2	2	2	2	1	2	2	1	2	1	2	2	41-50	M	Bachelor's	TN
Cumberland	1	1	1	2	1	2	2	2	2	2	1	2	31-40	M	Some C	TN
Cumberland	1	2	2	2	2	2	2	2	2	2	1	2	41-50	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Some C	TN
Cumberland	1	1	2	2	2	2	2	2	1	2	2	2	31-40	M	Master's	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	31-40	F	Master's	TN
Cumberland	2	2	2	2	2	1	2	2	2	1	2	1	51-60	F	Some C	AL
Cumberland	2	2	2	2	2	2	2	2	2	1	1	2	61-70	M	Bachelor's	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	1	51-60	F	Some C	TN
Cumberland	1	1	2	2	2	2	2	2	2	1	2	2	31-40	F	Bachelor's	TN
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	31-40	M	High School	KY
Cumberland	2	2	2	2	2	2	2	1	2	1	2	2	18-30	M	Bachelor's	KY
Cumberland	1	1	1	2	2	2	2	2	2	2	2	2	51-60	M	Some C	KY
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	31-40	M	Master's	KY
Cumberland	2	2	2	2	2	2	2	2	2	2	1	1	18-30	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Some C	TN
Cumberland	2	1	1	2	2	2	2	2	2	1	1	2	18-30	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	1	2	31-40	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	1	1	18-30	M	Bachelor's	TN
Cumberland	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	Some C	TN
Cumberland	2	1	2	2	2	2	2	2	2	1	1	1	41-50	M	Some C	TN

Appendix I (Continued)

Cumberland	2	2	2	1	2	1	2	2	2	2	1	2	18-30	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	1	2	31-40	F	Bachelor's	TN
Cumberland	1	1	2	2	2	1	2	1	1	2	1	2	18-30	F	Some C	TN
Cumberland	2	1	2	2	2	2	2	1	2	1	1	1	51-60	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	2	2	2	1	2	2	2	1	1	2	2	18-30	F	High School	KY
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Bachelor's	FL
Cumberland	2	2	1	2	2	1	2	1	2	2	2	2	18-30	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	1	2	1	2	2	51-60	M	Some C	TN
Cumberland	1	1	1	2	2	1	1	1	1	1	1	1	51-60	F	Bachelor's	AL
Cumberland	2	2	2	2	2	2	2	1	1	1	2	1	18-30	F	High School	TN

Table A13: Post-training, Pre-tour Survey Assessments (Mammoth)

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Mammoth	2	2	2	2	2	2	2	1	2	1	2	2	18-30	M	Some C	KY
Mammoth	2	2	2	1	2	2	2	2	2	2	2	2	41-50	F	High School	KY
Mammoth	2	2	1	2	1	1	2	1	2	1	1	1	51-60	F	High School	TN
Mammoth	2	2	2	2	2	2	2	1	2	2	1	2	18-30	F	Bachelors	IN
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	F	Associates	FL
Mammoth	2	2	2	2	2	1	2	1	2	2	2	2	61-70	F	Some C	KY
Mammoth	2	2	2	2	2	2	2	1	2	1	1	1	41-50	M	Some C	KY
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	High School	CA
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	2	1	31-40	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	18-30	M	Some C	FL
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	18-30	F	High School	NV
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	51-60	M	Doctorate	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	31-40	F	Bachelors	IN
Mammoth	2	2	2	2	2	2	2	1	2	2	2	1	51-60	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	31-40	M	Associates	KY
Mammoth	2	2	1	1	2	1	2	1	2	1	1	2	18-30	F	Some C	KY
Mammoth	2	1	2	2	2	2	2	1	2	2	2	2	18-30	M	High School	TN
Mammoth	2	2	2	1	2	2	1	2	2	1	2	2	18-30	F	High School	TN
Mammoth	2	1	2	1	2	1	2	1	1	2	1	1	31-40	F	Some C	MO
Mammoth	2	2	2	2	2	2	2	1	2	2	1	2	41-50	F	Masters	TN
Mammoth	2	2	2	2	2	2	2	2	1	2	2	1	31-40	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	51-60	M	Masters	KY
Mammoth	2	2	2	2	1	2	2	2	2	2	2	1	41-50	F	Bachelors	KY
Mammoth	2	2	2	2	1	2	2	2	1	2	2	2	31-40	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	1	51-60	M	High School	TN

Appendix J (Continued)

Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Some C	MO
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	18-30	F	Associates	FL
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	31-40	F	Associates	TN
Mammoth	2	2	2	2	2	1	2	2	2	2	2	1	51-60	M	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	1	1	31-40	F	Doctorate	KY
Mammoth	2	2	1	2	2	2	2	2	1	2	2	2	51-60	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	1	2	61-70	F	High School	AR
Mammoth	2	2	2	2	2	2	1	2	2	2	1	2	51-60	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	F	Some C	KY
Mammoth	2	2	2	2	2	2	2	1	2	1	2	2	31-40	M	Bachelors	AR
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	Some C	IL
Mammoth	2	2	2	2	2	2	2	2	2	1	1	2	41-50	M	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Associates	MO
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	Bachelors	NV
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	61-70	M	Masters	KY
Mammoth	1	1	2	1	1	2	2	1	2	1	1	2	18-30	F	Masters	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	31-40	M	Bachelors	FL
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	51-60	M	High School	TN
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	51-60	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	18-30	F	Some C	CA
Mammoth	2	2	2	2	1	2	2	1	1	2	1	2	31-40	M	High School	KY
Mammoth	2	2	2	2	2	1	2	1	1	1	2	2	51-60	M	High School	AL
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Masters	KY
Mammoth	2	2	2	2	2	2	2	1	2	1	2	2	31-40	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Bachelors	KY
Mammoth	2	2	2	1	2	2	2	2	2	2	2	1	18-30	M	Some C	GA
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	41-50	F	High School	KY

Appendix J (Continued)

Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	51-60	F	Masters	FL
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	31-40	F	Bachelors	GA
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	51-60	F	High School	TN
Mammoth	2	2	2	2	2	2	2	2	1	1	2	2	51-60	F	High School	FL
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Some C	KY
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	Associates	KY
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	Associates	TN
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	31-40	F	Some C	KY
Mammoth	2	2	2	2	2	1	2	2	2	1	1	1	41-50	F	Bachelors	KY
Mammoth	2	2	2	2	1	1	1	1	1	2	1	1	31-40	F	Some C	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	1	2	41-50	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	High School	TN
Mammoth	2	2	2	2	2	1	2	2	1	2	1	1	18-30	M	Bachelors	WI
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	18-30	F	High School	TX
Mammoth	2	2	2	2	2	1	2	2	1	1	1	1	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	1	2	2	2	2	2	1	41-50	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	31-40	M	Associates	CA
Mammoth	2	2	2	2	2	2	2	2	2	2	1	2	18-30	M	High School	AL
Mammoth	1	2	2	2	2	2	2	2	1	2	2	2	31-40	M	Masters	KY
Mammoth	2	2	2	1	1	2	1	1	1	2	1	2	18-30	M	Associates	FL
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	18-30	M	Some C	GA
Mammoth	2	2	2	1	2	1	2	1	1	2	2	1	31-40	M	High School	KY
Mammoth	2	2	2	2	1	2	2	2	2	2	2	1	18-30	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	31-40	M	Associates	TN
Mammoth	2	2	2	2	2	1	2	2	2	2	2	2	31-40	M	Bachelors	FL
Mammoth	2	2	2	2	2	2	2	2	1	2	2	1	41-50	F	Masters	TN
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Doctorate	KY

Appendix J (Continued)

Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	51-60	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	KY
Mammoth	2	2	2	2	2	1	1	2	1	2	1	1	18-30	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	2	18-30	F	Some C	TN
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	M	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	61-70	F	High School	VA
Mammoth	2	1	2	2	1	2	2	1	2	1	1	2	41-50	F	Bachelors	OH
Mammoth	2	2	2	1	2	2	2	2	2	1	2	2	51-60	F	Associates	KY
Mammoth	2	2	2	2	1	2	2	1	2	2	2	2	41-50	M	High School	KY
Mammoth	2	2	2	1	2	2	2	1	2	1	1	1	41-50	M	Bachelors	TN
Mammoth	1	1	2	2	1	2	2	1	1	1	2	1	18-30	M	Some C	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	2	2	61-70	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	1	2	1	2	41-50	M	Associates	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	41-50	F	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	41-50	F	High School	GA
Mammoth	2	2	2	2	2	1	2	1	2	1	2	2	31-40	M	High School	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	18-30	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	18-30	M	High School	FL
Mammoth	2	2	2	2	2	1	2	2	2	1	2	1	31-40	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	1	1	2	18-30	M	Associates	KY
Mammoth	2	2	2	2	2	1	2	1	2	2	1	1	41-50	M	High School	KY
Mammoth	2	2	2	2	2	1	2	2	2	1	2	2	61-70	F	High School	VA
Mammoth	2	2	2	2	2	1	1	1	1	2	1	1	31-40	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	1	2	2	2	1	41-50	M	Associates	KY
Mammoth	2	2	2	1	2	2	1	2	2	1	1	2	51-60	F	High School	TN
Mammoth	2	2	1	2	1	1	2	1	1	1	1	1	18-30	F	Some C	KY
Mammoth	2	2	2	1	2	2	1	1	1	2	1	2	41-50	M	High School	KY
Mammoth	2	2	2	1	2	2	2	2	2	1	2	2	41-50	M	Bachelors	AL

Appendix J (Continued)

Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	61-70	M	Some C	OH
Mammoth	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	Bachelors	KY
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	41-50	F	High School	KY
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	18-30	F	High School	TX
Mammoth	2	2	2	2	2	2	2	2	2	2	1	1	41-50	M	Bachelors	KY
Mammoth	2	2	2	2	2	2	1	2	2	1	2	2	51-60	M	Some C	TN
Mammoth	2	2	2	2	1	2	2	2	2	1	2	2	18-30	F	Associates	WI
Mammoth	2	1	1	1	2	1	2	2	2	1	2	2	41-50	F	Masters	MO
Mammoth	2	1	2	2	1	2	1	2	2	1	1	2	31-40	F	High School	KY

Table A14: Post-training, Pre-tour Survey Assessments (Florida Caverns)

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q 5	Q6	Q7	Age	Sex	Education	Resid
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	31-40	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Associates	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	21-30	M	Masters	GA
Florida Caverns	2	2	2	2	2	2	2	1	2	1	2	2	41-50	M	Bachelor	AL
Florida Caverns	2	1	2	2	2	2	2	2	2	1	2	2	61-70	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-21	F	Some C	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	1	2	61-70	F	High School	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	1	2	2	18-21	M	High School	FL
Florida Caverns	1	2	2	1	2	2	2	2	2	2	2	2	41-50	M	High School	GA
Florida Caverns	2	2	2	2	2	2	2	1	1	2	2	2	18-21	F	Some C	NC
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	Masters	AL
Florida Caverns	2	2	2	2	2	1	2	1	2	1	2	1	31-40	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	61-70	F	Some C	GA
Florida Caverns	2	1	2	2	2	2	1	2	2	2	2	2	31-40	F	Some C	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	1	2	31-40	F	Masters	GA
Florida Caverns	2	2	2	2	2	1	2	2	1	2	2	2	21-30	M	Associates	FL

Appendix J (Continued)

Florida Caverns	2	2	1	2	1	2	2	2	1	1	2	1	41-50	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	18-21	F	High School	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	31-40	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelors	GA
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	High School	FL
Florida Caverns	1	2	1	2	2	2	2	1	2	1	1	2	18-21	F	Some C	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	2	2	1	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	2	2	1	18-21	F	Some C	GA
Florida Caverns	2	2	2	2	1	2	1	2	2	2	2	2	31-40	F	Bachelors	LA
Florida Caverns	2	2	2	2	1	2	2	2	1	2	2	2	61-70	F	Masters	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Associates	AL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Masters	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	18-21	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	FL

Appendix J (Continued)

Florida Caverns	2	2	1	2	1	2	2	2	1	1	1	1	31-40	F	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	AL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	High School	FL
Florida Caverns	2	2	1	2	1	2	1	2	1	1	1	2	18-21	F	High School	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	1	2	2	31-40	M	High School	FL
Florida Caverns	2	1	2	1	2	2	2	2	2	2	2	2	31-40	F	Bachelors	GA
Florida Caverns	2	1	1	2	1	2	1	2	2	1	2	1	41-50	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Associates	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	51-60	M	High School	FL
Florida Caverns	2	2	1	2	2	1	2	2	1	1	2	2	41-50	F	High School	GA
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	Associates	FL
Florida Caverns	1	2	2	1	2	1	2	2	1	1	2	2	31-40	F	High School	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	41-50	M	High School	FL
Florida Caverns	2	1	2	1	2	1	2	2	2	2	1	1	21-30	M	Bachelors	GA
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	2	61-70	F	Doctorate	GA
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	41-50	M	Masters	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	21-30	M	Some C	FL

Appendix J (Continued)

Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	Some C	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	31-40	F	Associates	FL
Florida Caverns	2	2	1	1	2	2	1	2	1	1	2	1	21-30	M	Bachelors	FL
Florida Caverns	2	2	2	1	2	1	2	1	2	1	2	1	31-40	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	18-21	F	High School	AL
Florida Caverns	2	2	1	2	2	1	2	2	2	1	1	1	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	51-60	F	Associates	GA
Florida Caverns	2	2	2	2	2	1	2	2	2	2	1	2	18-21	M	High School	FL
Florida Caverns	2	2	2	2	1	2	2	2	1	2	2	2	31-40	M	Some C	GA
Florida Caverns	2	2	1	2	2	2	2	2	2	1	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	1	1	1	2	2	2	2	2	1	1	2	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	2	1	2	21-30	F	Bachelors	LA
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	21-30	M	Masters	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	41-50	M	Bachelor	FL

Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	High School	FL
Florida Caverns	2	2	1	2	1	2	2	2	2	2	2	2	31-40	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	1	2	2	18-21	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Bachelor	GA
Florida Caverns	1	2	2	2	2	2	2	2	1	2	2	2	31-40	F	Associates	FL
Florida Caverns	2	2	1	1	2	2	1	2	2	1	2	2	21-30	F	High School	FL
Florida Caverns	1	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	1	2	1	2	2	31-40	M	Masters	FL
Florida Caverns	2	2	1	2	2	2	1	2	1	1	1	1	21-30	F	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	41-50	F	High School	LA
Florida Caverns	2	2	2	2	2	2	2	1	2	1	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	High School	FL
Florida Caverns	2	2	1	1	2	2	1	1	2	1	2	1	21-30	M	Bachelors	AL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Associates	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Some C	FL
Florida Caverns	2	2	2	1	2	2	2	2	2	2	1	2	61-70	F	High School	FL

Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	FL
Florida Caverns	2	2	2	1	1	2	2	1	2	2	2	2	41-50	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	1	18-21	F	Some C	GA
Florida Caverns	2	2	2	1	2	2	2	1	1	1	1	1	41-50	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	51-60	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	1	2	2	2	2	18-21	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	1	2	31-40	F	Associates	FL
Florida Caverns	2	2	2	1	1	1	1	2	2	1	2	1	41-50	M	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	1	2	2	18-21	F	High School	FL
Florida Caverns	2	2	1	2	1	2	2	1	2	1	1	2	21-30	F	Associates	FL
Florida Caverns	1	1	2	1	1	2	2	2	2	1	2	1	51-60	M	High School	FL
Florida Caverns	2	2	2	2	2	2	1	2	2	1	2	2	41-50	F	High School	SC
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	1	2	2	2	2	1	2	31-40	M	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	High School	FL

Appendix J (Continued)

Florida Caverns	2	2	1	2	2	2	2	2	2	2	1	2	18-21	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Some C	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	High School	FL
Florida Caverns	2	2	1	2	2	2	2	1	2	2	2	2	18-21	F	Some C	FL
Florida Caverns	1	1	2	2	2	2	2	2	2	2	2	2	31-40	M	Masters	FL
Florida Caverns	1	2	2	2	2	2	2	2	1	2	2	2	51-60	M	Bachelors	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	31-40	F	High School	FL
Florida Caverns	2	2	1	2	1	1	1	2	1	1	1	2	18-21	F	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	1	2	41-50	F	High School	TX
Florida Caverns	2	2	2	2	2	2	2	2	1	2	1	2	41-50	F	High School	FL
Florida Caverns	1	2	2	2	2	2	2	2	1	2	2	2	21-30	M	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	18-21	M	Associates	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	31-40	F	High School	FL
Florida Caverns	2	1	2	1	1	1	2	2	1	2	2	1	31-40	M	Bachelors	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	18-21	F	High School	GA
Florida Caverns	2	2	2	2	1	2	2	2	1	2	2	2	41-50	F	High School	FL

Appendix J (Continued)

Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	18-21	F	High School	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	2	2	2	51-60	F	High School	FL
Florida Caverns	2	2	1	2	2	2	2	2	2	2	2	1	31-40	M	Bachelors	FL
Florida Caverns	2	2	1	2	2	2	2	2	1	2	2	2	21-30	F	Bachelors	FL
Florida Caverns	2	2	2	2	2	2	2	2	1	1	2	2	41-50	M	Some C	FL
Florida Caverns	2	2	2	2	1	2	2	2	2	1	2	2	21-30	M	Some C	FL
Florida Caverns	2	2	1	1	2	1	1	1	1	1	1	2	31-40	F	Associates	FL
Florida Caverns	2	1	1	1	2	2	1	2	1	1	1	1	31-40	F	Bachelors	FL

Table A15: Post-training, Pre-tour Survey Assessments (Lost River)

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	KY
Lost River	2	2	2	2	1	2	2	2	2	2	2	2	31-40	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Bachelors	TN
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelors	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	18-20	M	High School	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	31-40	M	High School	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	1	2	2	2	2	1	2	2	31-40	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	61-70	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Associates	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	18-20	F	Associates	TN
Lost River	1	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Associates	KY
Lost River	2	2	1	2	2	2	2	2	1	2	2	2	18-20	M	High School	KY
Lost River	1	1	2	2	1	1	2	2	1	1	2	2	51-60	F	Bachelors	IN
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	31-40	F	Masters	KY
Lost River	2	2	2	2	1	2	2	2	2	1	2	2	51-60	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	18-20	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	51-60	F	High School	TN
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Associates	FL
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Associates	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	41-50	F	Bachelors	TN
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	41-50	M	Some C	TN
Lost River	1	2	2	2	2	1	2	2	2	2	2	2	18-20	M	Some C	KY
Lost River	2	2	2	2	1	2	2	1	2	1	2	1	31-40	F	Associates	KY

Appendix J (Continued)

Lost River	2	2	1	2	1	2	1	1	1	2	1	1	21-30	F	Some C	KY
Lost River	2	2	2	1	1	2	2	1	1	1	1	2	51-60	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	21-30	F	Bachelors	KY
Lost River	2	2	1	2	1	2	2	2	1	2	2	1	41-50	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Bachelors	NV
Lost River	2	2	1	2	2	2	2	2	2	1	2	2	21-30	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	Associates	KY
Lost River	2	2	2	1	2	1	2	2	2	2	2	2	18-20	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	KY
Lost River	1	1	1	1	2	2	2	1	1	1	2	2	31-40	F	Masters	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	31-40	F	Bachelor's	KY
Lost River	2	2	2	2	2	1	2	2	2	2	2	1	21-30	F	Some C	KY
Lost River	2	2	2	2	1	2	2	2	2	1	2	2	21-30	F	High School	KY
Lost River	2	2	2	2	1	2	2	2	2	2	2	2	51-60	M	Masters	KY
Lost River	2	2	1	2	1	2	2	1	2	2	2	1	41-50	M	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelors	KY
Lost River	2	2	2	2	2	1	2	2	2	2	2	2	41-50	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-20	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-20	M	High School	KY
Lost River	2	2	1	2	2	2	2	2	1	2	2	2	21-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-20	F	Some C	KY
Lost River	2	2	2	1	1	2	1	2	1	1	2	1	21-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	18-20	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	18-20	F	Some C	TN
Lost River	2	2	2	2	2	2	2	2	2	2	1	2	31-40	M	Some C	OH

Appendix J (Continued)

Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Master's	TN
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	F	Bachelor's	KY
Lost River	2	1	2	2	1	2	1	2	2	2	1	1	18-20	M	Some C	TN
Lost River	2	2	2	2	1	2	2	2	2	2	2	2	51-60	F	Master's	TN
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	61-70	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	41-50	F	High School	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	21-30	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	18-20	F	Some C	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	31-40	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	41-50	F	Masters	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	21-30	F	Some C	IN
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	61-70	M	Bachelors	TN
Lost River	1	1	2	1	1	2	1	2	2	1	1	1	41-50	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	21-30	M	Some C	TN
Lost River	2	1	1	1	1	2	1	1	2	1	2	1	18-20	M	Some C	KY
Lost River	2	2	2	2	1	2	2	2	2	2	2	1	21-30	M	Some C	AR
Lost River	2	2	2	2	2	2	2	1	2	1	2	2	21-30	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Masters	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	51-60	M	Some C	VA
Lost River	2	2	2	2	2	2	2	1	2	2	2	2	31-40	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	1	2	1	2	2	18-20	F	Some C	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	51-60	M	Associates	KY
Lost River	2	2	2	2	2	2	2	1	2	2	2	2	31-40	F	Associates	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	21-30	M	Associates	KY

Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	1	1	2	2	18-20	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	1	2	2	2	51-60	M	High School	MO
Lost River	2	2	2	1	1	1	2	1	1	1	1	1	31-40	F	Bachelor's	KY
Lost River	2	2	2	2	1	1	2	1	1	1	2	1	31-40	M	Some C	KY
Lost River	2	2	1	1	1	1	2	1	1	2	2	1	41-50	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	1	21-30	M	High School	KY
Lost River	1	1	2	1	1	2	1	1	2	2	1	1	31-40	F	Bachelor's	KY
Lost River	2	2	1	2	1	2	1	2	2	1	2	1	51-60	F	Some C	TN
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	KY
Lost River	2	2	1	2	1	2	2	2	2	2	2	2	18-20	F	High School	CA
Lost River	2	2	2	1	1	1	1	1	2	2	1	2	21-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	Some C	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	2	21-30	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Associates	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	41-50	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	21-30	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Associates	KY
Lost River	2	2	2	2	2	2	2	2	1	1	2	2	18-20	M	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	High School	KY
Lost River	2	2	2	1	2	2	2	2	2	1	2	1	21-30	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	High School	KY
Lost River	2	1	2	2	2	2	2	2	2	1	2	2	51-60	F	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Associates	KY
Lost River	1	1	1	1	2	2	2	1	1	1	2	2	31-40	M	Some C	KY
Lost River	2	2	1	2	2	2	2	2	1	2	2	2	18-20	F	High School	KY
Lost River	2	2	2	2	2	2	2	1	1	2	2	2	41-50	F	Bachelors	KY
Lost River	2	2	1	2	2	2	2	2	2	2	2	2	41-50	M	Associates	KY

Appendix J (Continued)

Lost River	2	2	2	2	1	1	1	2	1	1	1	1	41-50	F	High School	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	18-20	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	41-50	F	Associates	KY
Lost River	2	2	2	1	2	2	2	2	2	2	2	1	21-30	F	Masters	KY
Lost River	2	2	2	2	2	2	2	2	2	1	2	1	41-50	F	Bachelors	FL
Lost River	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	51-60	M	High School	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	31-40	M	High School	KY
Lost River	2	2	2	1	1	2	1	1	1	1	1	1	18-20	F	High School	TN
Lost River	2	2	2	2	2	2	1	2	2	2	2	2	18-20	M	Associates	FL
Lost River	2	2	2	2	2	2	2	1	2	1	2	2	31-40	M	Masters	TN
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-20	F	High School	KY
Lost River	2	2	2	2	1	2	2	2	1	2	2	2	41-50	F	Masters	KY
Lost River	1	1	1	1	2	2	2	1	2	2	1	2	41-50	M	Bachelors	KY
Lost River	2	2	2	2	2	2	2	2	2	2	2	2	18-20	M	Some C	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	18-20	M	High School	KY
Lost River	2	2	2	2	2	1	2	2	2	1	2	2	21-30	M	Some C	KY
Lost River	2	2	2	2	2	2	1	2	2	1	2	2	18-20	F	High School	KY
Lost River	2	2	2	2	2	2	1	2	2	2	2	1	21-30	M	Some C	KY
Lost River	2	2	2	1	1	2	1	1	1	1	2	1	31-40	F	Bachelors	KY

Table A16: Post-training, Pre-tour Survey Assessments (Cumberland)

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Cumberland	2	2	2	1	2	2	2	2	2	2	2	2	61-70	F	Some C	TN
Cumberland	2	1	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	1	2	2	2	2	71-80	F	High School	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	High School	TN
Cumberland	2	1	2	2	2	2	2	2	2	2	2	2	21-30	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Some C	TN
Cumberland	2	2	2	2	2	1	2	2	2	1	2	2	21-30	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	41-50	F	High School	FL
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	51-60	F	Master's	KY
Cumberland	2	2	2	2	2	1	2	2	2	2	2	2	41-50	M	Law degree	SC
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	31-40	M	Some C	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	21-30	F	Bachelor's	TN
Cumberland	2	1	2	2	2	2	2	2	2	1	2	2	61-70	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	IN
Cumberland	2	1	2	2	2	2	2	1	2	2	2	2	31-40	M	Some C	MO
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	High School	TN
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	21-30	F	Associates	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	1	2	1	2	2	2	2	1	1	2	1	21-30	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	51-60	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	1	2	1	2	2	61-70	M	High School	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	71-80	F	High School	KY

Appendix J (Continued)

Cumberland	2	1	2	1	1	2	2	2	1	2	2	1	18-21	F	High School	KY
Cumberland	2	1	1	1	2	2	2	2	1	1	2	2	51-60	M	Associates	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	41-50	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Some C	GA
Cumberland	1	2	2	2	2	2	2	2	2	1	2	2	31-40	F	High School	FL
Cumberland	1	1	2	2	2	2	2	1	2	1	2	2	31-40	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Associates	KY
Cumberland	1	1	2	2	1	2	2	2	1	1	2	1	18-20	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Master's	GA
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Some C	TN
Cumberland	2	1	2	2	2	2	2	2	2	1	2	2	18-21	F	High School	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	18-20	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelor's	VA
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	18-21	M	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	M	High School	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	21-30	F	Bachelor's	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	18-20	M	Some C	GA
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	31-40	M	Some C	TN
Cumberland	2	2	1	2	2	1	2	2	2	1	2	2	21-30	F	High School	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	Bachelor's	TN
Cumberland	1	1	2	2	2	2	1	2	1	1	1	2	51-60	M	Some C	TN

Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	Master's	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	F	High School	TN
Cumberland	2	2	2	2	1	2	2	2	2	2	1	2	31-40	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	F	Master's	TN
Cumberland	2	1	1	2	2	2	2	2	2	1	2	2	18-20	M	High School	TN
Cumberland	2	2	2	2	2	1	2	2	2	1	2	1	31-40	M	High School	FL
Cumberland	2	2	2	2	2	2	2	2	2	2	2	2	18-21	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	1	2	2	1	2	2	61-70	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	High School	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	31-40	F	Bachelors	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	51-60	F	Bachelor's	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	21-30	M	Some C	KY
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	High School	TN
Cumberland	2	2	2	2	1	2	2	2	2	1	2	2	61-70	M	High School	TN
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	21-30	F	High School	GA
Cumberland	2	2	2	2	2	2	2	1	2	1	2	2	41-50	M	Bachelor's	TN
Cumberland	2	2	1	2	2	2	2	2	2	2	2	2	21-30	F	Some C	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	Some C	MO
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	31-40	F	High School	TN
Cumberland	2	1	2	2	1	2	2	2	1	1	2	2	31-40	F	Master's	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	31-40	F	Master's	TN
Cumberland	2	2	2	2	2	1	2	2	2	1	2	1	51-60	M	Some C	FL
Cumberland	2	2	2	2	2	2	2	2	2	1	1	2	31-40	M	Bachelor's	KY
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	18-20	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	51-60	M	Some C	TN
Cumberland	2	2	2	2	2	1	2	2	2	1	2	2	31-40	F	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	High School	KY

Appendix J (Continued)

Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	41-50	M	Bachelor's	TN
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	21-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	F	Master's	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	31-40	F	Bachelor's	TN
Cumberland	2	2	2	1	2	2	2	2	2	1	2	2	41-50	M	Some C	MO
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	21-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	61-70	F	High School	GA
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	41-50	M	Bachelor's	TN
Cumberland	2	2	1	2	2	2	2	2	2	1	2	2	21-30	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	18-21	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	2	2	21-30	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	2	1	1	2	31-40	M	Bachelor's	TN
Cumberland	2	1	2	2	2	2	2	1	1	1	1	2	51-60	F	Some C	TN
Cumberland	2	2	2	2	1	2	2	1	2	1	2	2	61-70	F	High School	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	2	31-40	M	Bachelor's	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	2	18-21	M	High School	MI
Cumberland	2	2	2	2	2	2	2	2	2	1	2	1	31-40	M	Bachelor's	TN
Cumberland	2	1	1	2	2	2	2	1	2	1	2	2	18-20	M	Some C	TN
Cumberland	2	2	2	2	2	2	2	1	2	2	2	2	51-60	M	Some C	TN
Cumberland	1	1	2	2	1	2	1	1	1	1	1	1	31-40	F	Bachelor's	KY
Cumberland	2	2	2	2	2	2	2	1	1	1	2	1	21-30	F	High School	KY

Table A17: Post-training, Post-tour Survey Assessments (Mammoth)

Facility	Q 1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Mammoth	1	1	2	2	1	1	1	1	1	1	1	2	18-30	M	Some C	KY
Mammoth	2	2	2	1	2	2	2	2	1	2	2	2	41-50	F	High School	KY
Mammoth	1	1	1	2	1	1	1	1	1	1	2	1	51-60	F	High School	TN
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	18-30	F	Bachelors	IN
Mammoth	1	1	1	1	1	2	2	1	1	1	1	1	18-30	F	Associates	FL
Mammoth	1	2	1	1	1	1	1	1	1	1	1	2	61-70	F	Some C	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Some C	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	2	31-40	M	High School	CA
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	High School	KY
Mammoth	2	2	2	2	1	1	1	2	1	1	2	1	31-40	M	Bachelors	KY
Mammoth	1	1	1	1	2	1	1	1	1	1	1	1	18-30	M	Some C	FL
Mammoth	2	1	2	1	1	2	2	1	1	1	1	1	18-30	F	High School	NV
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	51-60	M	Doctorate	KY
Mammoth	1	1	1	1	1	1	1	2	1	1	1	2	31-40	F	Bachelors	IN
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	51-60	F	Bachelors	KY
Mammoth	1	1	2	1	1	2	1	2	1	1	1	1	31-40	M	Associates	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	2	18-30	F	Some C	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	2	1	18-30	M	High School	TN
Mammoth	2	2	2	2	1	2	1	2	1	1	1	1	18-30	F	High School	TN
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	F	Some C	MO
Mammoth	1	1	1	1	2	1	1	1	1	1	1	2	41-50	F	Masters	TN
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	F	Bachelors	KY
Mammoth	2	1	1	1	1	1	1	1	1	1	1	1	51-60	M	Masters	KY
Mammoth	1	1	2	1	1	1	1	1	1	1	1	1	41-50	F	Bachelors	KY
Mammoth	1	1	1	1	1	2	1	2	1	1	1	1	31-40	F	High School	KY
Mammoth	1	2	2	2	1	1	1	1	1	1	2	2	51-60	M	High School	TN

Appendix K (Continued)

Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	Some C	MO
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	41-50	M	Bachelors	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	18-30	F	Associates	FL
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	F	Associates	TN
Mammoth	1	1	1	2	1	2	1	1	1	1	1	1	51-60	M	Masters	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Doctorate	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	51-60	M	High School	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	61-70	F	High School	AR
Mammoth	1	1	2	2	1	2	2	1	1	2	1	1	51-60	F	High School	KY
Mammoth	2	1	2	1	1	1	1	1	1	1	1	1	18-30	F	Some C	KY
Mammoth	2	1	1	2	1	2	1	2	1	1	1	1	31-40	M	Bachelors	AR
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	18-30	M	Some C	IL
Mammoth	2	2	1	2	1	2	1	1	1	1	1	2	41-50	M	Masters	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Associates	MO
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	F	Bachelors	NV
Mammoth	2	2	2	1	1	2	1	2	1	1	1	1	61-70	M	Masters	KY
Mammoth	1	1	2	1	1	2	1	1	2	1	1	2	18-30	F	Masters	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	Bachelors	FL
Mammoth	1	1	2	1	1	2	1	1	1	1	1	1	51-60	M	High School	TN
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	51-60	M	Associates	KY
Mammoth	2	2	1	1	1	2	2	1	1	1	1	1	18-30	F	Some C	CA
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	31-40	M	High School	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	51-60	M	High School	AL
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	51-60	F	Masters	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	High School	KY
Mammoth	2	1	1	2	1	2	1	1	2	1	1	2	51-60	F	Bachelors	KY
Mammoth	1	1	2	1	1	1	2	1	1	1	1	1	18-30	M	Some C	GA
Mammoth	2	1	1	2	1	2	1	2	1	1	1	1	41-50	F	High School	KY

Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Bachelors	KY
Mammoth	2	2	1	2	1	2	1	1	1	1	1	2	51-60	F	Masters	FL
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	F	Bachelors	GA
Mammoth	1	1	2	1	1	2	1	1	2	1	1	2	51-60	F	High School	TN
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	51-60	F	High School	FL
Mammoth	1	1	1	1	1	1	2	1	1	1	1	1	41-50	M	Some C	KY
Mammoth	1	1	1	1	1	2	1	2	1	1	1	1	31-40	F	Associates	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	Associates	TN
Mammoth	1	2	2	1	1	2	1	1	1	1	1	2	31-40	F	Some C	KY
Mammoth	1	1	1	1	2	1	1	1	1	1	1	1	41-50	F	Bachelors	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Some C	KY
Mammoth	2	2	2	2	1	2	2	2	2	2	1	2	41-50	M	Associates	KY
Mammoth	2	1	2	1	1	2	1	2	1	1	2	1	18-30	M	High School	TN
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	18-30	M	Bachelors	WI
Mammoth	1	1	2	1	2	2	1	1	2	1	1	2	18-30	F	High School	TX
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Bachelors	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	High School	KY
Mammoth	2	2	2	1	1	1	2	1	1	1	1	1	31-40	M	Associates	CA
Mammoth	1	1	1	1	1	2	1	1	1	1	1	2	18-30	M	High School	AL
Mammoth	1	1	2	1	1	2	1	1	1	2	2	1	31-40	M	Masters	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	18-30	M	Associates	FL
Mammoth	2	2	2	2	1	1	1	2	2	2	1	2	18-30	M	Some C	GA
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	High School	KY
Mammoth	2	1	2	1	1	2	1	1	1	1	1	1	18-30	M	High School	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	31-40	M	Associates	TN
Mammoth	2	1	1	2	1	1	1	1	2	1	1	2	31-40	M	Bachelors	FL
Mammoth	1	1	1	1	2	1	2	1	1	1	1	1	41-50	F	Masters	TN
Mammoth	2	1	2	1	1	2	1	1	1	1	1	1	31-40	F	Doctorate	KY

Appendix K (Continued)

Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	51-60	M	Bachelors	KY
Mammoth	2	1	1	2	1	2	1	1	2	1	1	2	31-40	F	Some C	KY
Mammoth	1	1	1	1	1	1	2	1	1	1	1	1	18-30	F	High School	KY
Mammoth	1	1	2	1	1	2	1	1	2	1	1	2	18-30	F	Some C	TN
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	18-30	M	Some C	KY
Mammoth	1	2	2	1	1	2	1	1	1	1	1	1	61-70	F	High School	VA
Mammoth	1	1	1	1	1	2	2	1	1	1	1	1	41-50	F	Bachelors	OH
Mammoth	1	1	2	1	1	1	1	1	1	1	1	1	51-60	F	Associates	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	2	41-50	M	High School	KY
Mammoth	2	1	1	1	1	2	1	1	1	1	1	1	41-50	M	Bachelors	TN
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	18-30	M	Some C	KY
Mammoth	2	2	2	2	1	2	1	2	2	2	1	2	61-70	M	High School	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Associates	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	2	1	41-50	F	High School	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	High School	GA
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	High School	KY
Mammoth	1	1	1	1	1	1	1	2	1	1	1	1	18-30	F	Bachelors	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	18-30	M	High School	FL
Mammoth	1	1	2	1	1	1	1	1	1	1	1	1	31-40	F	Bachelors	KY
Mammoth	1	2	2	1	1	2	1	1	1	1	1	2	18-30	M	Associates	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	High School	KY
Mammoth	1	1	1	1	1	2	2	2	1	1	1	1	61-70	F	High School	VA
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	Bachelors	KY
Mammoth	1	1	1	2	1	2	1	1	1	1	2	1	41-50	M	Associates	KY
Mammoth	1	2	2	1	1	2	1	2	1	1	1	2	51-60	F	High School	TN
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	18-30	F	Some C	KY
Mammoth	1	2	2	1	1	2	1	1	1	1	1	2	41-50	M	High School	KY
Mammoth	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Bachelors	AL

Appendix K (Continued)

Mammoth	1	1	2	1	1	2	2	1	1	1	1	1	61-70	M	Some C	OH
Mammoth	1	1	1	1	1	2	1	2	1	1	1	1	31-40	F	Bachelors	KY
Mammoth	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	High School	KY
Mammoth	1	1	1	1	1	1	1	2	1	1	1	1	18-30	F	High School	TX
Mammoth	1	2	1	1	1	2	1	2	1	1	1	1	41-50	M	Bachelors	KY
Mammoth	1	2	2	2	1	2	2	2	2	1	1	2	51-60	M	Some C	TN
Mammoth	1	1	1	1	1	1	1	1	1	1	1	2	18-30	F	Associates	WI
Mammoth	2	1	1	2	2	2	1	1	1	1	1	1	41-50	M	Masters	KY
Mammoth	1	1	1	1	1	1	1	2	1	1	2	2	41-50	F	High School	MO
Mammoth	1	1	2	1	1	2	1	2	1	1	1	2	31-40	F	High School	KY

Table A18: Post-training, Post-tour Survey Assessments (Florida Caverns)

Facility	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Florida Caverns	1	1	2	1	1	1	1	2	2	1	1	1	31-40	F	Some C	FL
Florida Caverns	1	1	2	1	1	2	1	2	1	1	2	1	41-50	F	Associates	FL
Florida Caverns	1	1	2	1	1	1	2	2	1	1	1	1	21-30	M	Masters	GA
Florida Caverns	2	1	2	1	1	2	1	1	1	1	1	2	41-50	M	Bachelor	AL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	61-70	F	High School	FL
Florida Caverns	2	1	1	1	2	1	1	1	1	1	1	1	18-21	F	Some C	FL
Florida Caverns	2	1	1	1	1	1	1	2	1	1	1	2	61-70	F	High School	FL
Florida Caverns	1	1	2	1	1	2	1	2	1	1	1	1	18-21	M	High School	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	2	41-50	M	High School	GA
Florida Caverns	2	1	1	1	2	1	1	1	1	1	2	1	18-21	F	Some C	NC
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	31-40	M	Masters	AL
Florida Caverns	1	2	2	1	1	1	2	1	2	1	1	1	31-40	F	Bachelors	FL
Florida Caverns	2	1	2	1	1	1	1	2	1	1	1	2	61-70	F	Some C	GA
Florida Caverns	1	1	2	1	1	2	1	1	2	1	1	1	31-40	F	Some C	FL
Florida Caverns	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Masters	GA
Florida Caverns	2	1	2	1	1	1	2	1	1	1	2	2	21-30	M	Associates	FL

Florida Caverns	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	Some C	FL
Florida Caverns	2	1	1	1	1	1	1	1	2	1	1	1	18-21	F	High School	FL
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	High School	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	41-50	M	Bachelors	GA
Florida Caverns	2	2	1	1	1	1	2	1	2	1	1	1	31-40	F	High School	FL
Florida Caverns	1	1	1	1	1	1	1	1	2	1	1	2	18-21	F	Some C	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	21-30	M	Some C	FL
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	18-21	F	Some C	GA
Florida Caverns	2	1	1	1	2	1	1	1	1	1	2	1	31-40	F	Bachelors	LA
Florida Caverns	2	1	2	1	1	1	1	2	1	1	1	2	61-70	F	Masters	FL
Florida Caverns	1	1	2	1	1	2	1	1	1	1	1	1	41-50	M	Associates	AL
Florida Caverns	2	1	2	1	1	1	1	1	1	1	1	1	31-40	M	High School	FL
Florida Caverns	2	1	1	1	1	1	1	1	2	1	1	2	21-30	M	Bachelors	FL
Florida Caverns	1	2	2	1	1	1	2	1	2	1	1	2	31-40	F	Bachelors	FL
Florida Caverns	2	1	2	1	1	2	1	1	1	1	1	1	51-60	F	Masters	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	2	18-21	M	High School	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	2	2	21-30	F	Some C	FL

Florida Caverns	1	1	1	1	1	1	2	2	1	1	1	1	31-40	F	Associates	FL
Florida Caverns	1	2	2	1	1	1	2	1	2	1	1	2	18-21	M	High School	AL
Florida Caverns	2	1	2	1	1	1	1	2	1	1	1	2	51-60	M	High School	FL
Florida Caverns	1	1	1	1	1	1	1	2	1	1	1	2	18-21	F	High School	FL
Florida Caverns	2	1	2	1	1	2	1	1	1	1	1	1	31-40	M	High School	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	2	31-40	F	Bachelors	GA
Florida Caverns	1	1	1	1	1	2	2	2	1	1	2	1	41-50	M	Bachelors	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	21-30	M	Associates	FL
Florida Caverns	1	1	2	1	1	2	2	2	1	1	2	1	51-60	M	High School	FL
Florida Caverns	1	1	1	1	2	1	1	1	1	1	2	1	41-50	F	High School	GA
Florida Caverns	1	1	2	1	1	2	1	1	1	1	2	1	31-40	F	Associates	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	31-40	F	High School	FL
Florida Caverns	1	1	2	1	1	2	1	2	1	1	1	2	41-50	M	High School	FL
Florida Caverns	1	1	1	1	1	1	1	2	1	1	1	1	21-30	M	Bachelors	GA
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	61-70	F	Doctorate	GA
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	41-50	M	Masters	FL
Florida Caverns	1	1	1	1	1	2	1	1	1	1	1	1	21-30	M	Some C	FL

Appendix K (Continued)

Florida Caverns	1	1	2	1	1	2	1	1	1	1	1	1	51-60	M	Some C	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	2	31-40	F	Associates	FL
Florida Caverns	2	1	1	1	2	1	1	2	1	1	2	1	21-30	M	Bachelors	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	31-40	F	High School	FL
Florida Caverns	1	1	2	1	1	2	1	1	1	1	2	1	31-40	F	High School	FL
Florida Caverns	2	1	2	1	1	1	1	2	1	1	1	2	18-21	F	High School	AL
Florida Caverns	1	1	1	1	1	1	1	2	1	1	1	1	21-30	M	Some C	FL
Florida Caverns	1	1	2	1	1	2	2	2	1	1	1	1	31-40	M	Bachelors	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	51-60	F	Associates	GA
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	18-21	M	High School	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	2	31-40	M	Some C	GA
Florida Caverns	2	1	1	1	1	1	1	2	1	1	2	1	31-40	M	Bachelors	FL
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	21-30	M	Some C	FL
Florida Caverns	1	1	2	1	1	2	1	2	1	1	1	1	21-30	M	Some C	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	21-30	F	Bachelors	LA
Florida Caverns	1	1	2	1	1	1	2	2	1	1	1	1	21-30	M	Masters	FL
Florida Caverns	2	1	2	1	1	2	1	2	1	1	1	2	41-50	M	Bachelor	FL

Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	2	61-70	F	High School	FL
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	High School	FL
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	18-21	M	High School	FL
Florida Caverns	1	1	2	1	1	2	1	2	1	1	1	2	31-40	M	Bachelor	GA
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	31-40	F	Associates	FL
Florida Caverns	2	1	1	1	2	1	1	2	1	1	2	1	21-30	F	High School	FL
Florida Caverns	1	1	2	1	1	1	2	2	1	1	1	1	21-30	M	Some C	FL
Florida Caverns	1	1	2	1	1	2	1	1	1	1	1	2	41-50	M	Some C	FL
Florida Caverns	1	1	2	1	1	2	1	1	1	1	1	1	31-40	M	Masters	FL
Florida Caverns	1	1	1	1	1	2	1	1	1	1	1	1	21-30	F	Associates	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	41-50	F	High School	LA
Florida Caverns	1	1	2	1	1	2	1	1	1	1	1	1	31-40	M	Bachelors	FL
Florida Caverns	1	1	2	1	1	2	1	2	1	1	1	1	31-40	F	High School	FL
Florida Caverns	1	1	1	1	1	2	1	1	1	1	1	1	21-30	M	Bachelors	AL
Florida Caverns	1	1	2	1	1	2	1	1	1	1	1	2	41-50	M	Associates	FL
Florida Caverns	1	1	2	1	1	1	1	2	2	1	1	1	31-40	F	Some C	FL
Florida Caverns	2	1	2	1	1	2	1	2	1	1	1	2	61-70	F	High School	FL

Florida Caverns	1	1	2	1	1	2	1	2	1	1	1	1	18-21	M	High School	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	2	41-50	M	High School	FL
Florida Caverns	1	1	1	2	1	2	1	2	1	1	2	1	18-21	F	Some C	GA
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	41-50	M	Some C	FL
Florida Caverns	1	1	2	1	1	2	1	2	1	1	1	1	51-60	M	High School	FL
Florida Caverns	1	1	1	1	1	2	1	1	1	1	1	1	18-21	M	Some C	FL
Florida Caverns	1	1	2	1	1	2	1	2	1	1	1	1	31-40	M	Some C	FL
Florida Caverns	2	1	2	1	1	1	1	2	1	1	1	1	31-40	F	Associates	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	2	1	41-50	M	High School	FL
Florida Caverns	2	1	2	2	2	2	2	1	1	2	2	1	31-40	F	Bachelors	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	18-21	F	High School	FL
Florida Caverns	1	1	1	1	1	2	1	2	1	1	1	1	21-30	F	Associates	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	2	1	51-60	M	High School	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	41-50	F	High School	SC
Florida Caverns	2	1	2	1	1	2	1	2	1	2	2	1	31-40	M	Bachelors	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	31-40	M	Some C	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	2	2	31-40	M	High School	FL

Florida Caverns	1	1	1	1	1	1	2	1	1	1	1	1	18-21	F	Some C	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	21-30	F	Some C	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	41-50	F	Bachelors	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	2	41-50	M	High School	FL
Florida Caverns	2	1	1	1	2	1	1	1	1	1	2	1	18-21	F	Some C	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	1	1	31-40	M	Masters	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	51-60	M	Bachelors	FL
Florida Caverns	2	1	1	1	2	2	1	1	1	1	1	1	31-40	F	High School	FL
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	18-21	F	High School	FL
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	41-50	F	High School	TX
Florida Caverns	1	1	1	1	1	1	1	2	1	1	1	1	41-50	F	High School	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	21-30	M	Bachelors	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	18-21	M	Associates	FL
Florida Caverns	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	High School	FL
Florida Caverns	1	1	2	1	1	1	1	2	1	1	2	1	31-40	M	Bachelors	FL
Florida Caverns	1	1	1	1	1	1	2	2	1	1	1	1	18-21	F	High School	GA
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	41-50	F	High School	FL

Appendix K (Continued)

Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	18-21	F	High School	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	2	51-60	F	High School	FL
Florida Caverns	2	1	1	1	2	1	1	1	1	1	2	1	31-40	M	Bachelors	FL
Florida Caverns	1	1	1	1	1	1	1	2	1	1	1	1	21-30	F	Bachelors	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	41-50	M	Some C	FL
Florida Caverns	1	1	2	1	1	1	1	1	1	1	1	1	21-30	M	Some C	FL
Florida Caverns	1	1	1	1	1	1	1	1	1	1	1	1	31-40	F	Associates	FL
Florida Caverns	1	1	1	1	2	1	1	2	1	1	1	1	31-40	F	Bachelors	FL

Appendix K (Continued)

Table A19: Post-training, Post-tour Survey Assessments (Lost River)

Facilty	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Lost River	1	2	1	2	1	2	1	1	1	1	1	1	21-30	F	Some C	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Some C	KY
Lost River	1	1	1	2	1	2	1	1	1	1	1	1	51-60	M	Bachelors	TN
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	41-50	M	Bachelors	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	M	High School	KY
Lost River	1	1	2	1	1	2	2	1	1	2	1	2	31-40	M	High School	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Bachelors	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	31-40	M	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	51-60	M	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	61-70	M	Some C	KY
Lost River	2	2	2	2	1	1	1	1	1	1	1	1	31-40	F	Associates	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	18-20	F	Associates	TN
Lost River	1	1	2	1	1	2	1	1	1	1	1	1	31-40	M	Associates	KY
Lost River	2	1	1	1	1	2	1	1	1	1	1	1	18-20	M	High School	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	51-60	F	Bachelors	IN
Lost River	2	2	2	1	2	2	2	2	1	2	2	2	31-40	F	Masters	KY
Lost River	1	1	1	2	1	2	1	1	1	1	1	1	51-60	M	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	M	High School	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	51-60	F	High School	TN
Lost River	1	1	1	1	1	1	1	1	2	1	1	1	41-50	M	Associates	FL
Lost River	1	1	1	1	1	2	1	1	2	1	1	2	31-40	M	Masters	KY

Appendix K (Continued)

Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Associates	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	F	Bachelors	TN
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	41-50	M	Some C	TN
Lost River	1	2	1	2	1	1	2	2	2	1	2	2	18-20	M	Some C	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Associates	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	21-30	F	Some C	KY
Lost River	1	1	1	1	1	2	2	1	1	1	1	1	51-60	F	High School	KY
Lost River	1	2	1	1	1	1	1	1	1	1	1	1	21-30	F	Bachelors	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	High School	KY
Lost River	1	1	2	1	1	1	2	1	1	1	1	1	21-30	M	Bachelors	NV
Lost River	1	2	1	1	1	1	2	2	1	1	1	2	21-30	M	Bachelors	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Associates	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	18-20	M	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	31-40	F	Some C	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Masters	KY
Lost River	2	2	2	1	1	2	2	1	1	2	2	2	31-40	F	Bachelor's	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Some C	KY
Lost River	1	1	1	2	1	2	1	1	1	1	1	1	21-30	F	High School	KY
Lost River	2	2	2	2	1	2	1	2	1	2	2	2	51-60	M	Masters	KY
Lost River	2	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Masters	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Associates	KY
Lost River	1	1	1	1	1	2	1	1	2	1	1	2	31-40	M	Bachelors	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	F	Associates	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	M	High School	KY
Lost River	1	1	1	2	1	2	2	1	1	2	2	2	18-20	M	High School	KY

Appendix K (Continued)

Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	M	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	F	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	M	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	18-20	F	High School	KY
Lost River	1	1	2	2	1	2	2	1	1	2	1	1	41-50	M	Some C	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	21-30	F	Bachelors	KY
Lost River	1	1	2	1	1	2	1	2	1	1	1	1	18-20	F	Some C	TN
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	Some C	OH
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Master's	TN
Lost River	1	1	2	1	1	2	1	1	1	1	1	1	21-30	F	Bachelor's	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	M	Some C	TN
Lost River	2	2	2	2	1	2	1	2	1	1	1	1	51-60	F	Master's	TN
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	High School	KY
Lost River	2	1	2	1	1	2	2	1	1	1	1	1	31-40	F	Bachelors	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	61-70	F	High School	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	F	High School	KY
Lost River	1	1	1	1	1	1	2	1	1	1	1	1	21-30	F	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	18-20	F	Some C	KY
Lost River	1	1	1	1	1	1	1	2	1	1	1	1	31-40	F	High School	KY
Lost River	2	1	2	1	1	2	1	2	1	1	2	1	41-50	F	Masters	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Some C	IN
Lost River	2	1	2	2	1	2	1	1	1	1	1	2	61-70	M	Bachelors	TN
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	Bachelors	KY

Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	M	Some C	TN
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	M	Some C	KY
Lost River	1	1	2	1	1	2	1	2	1	2	2	1	21-30	M	Some C	AR
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Bachelors	KY
Lost River	1	1	1	2	1	1	1	1	1	1	1	1	31-40	F	Masters	KY
Lost River	2	1	2	1	1	2	1	2	1	1	1	1	31-40	M	Masters	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	51-60	M	Some C	VA
Lost River	1	1	2	1	1	2	1	2	2	2	2	2	31-40	M	Bachelors	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	F	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	51-60	M	Associates	KY
Lost River	2	2	2	2	1	2	1	2	1	1	1	1	31-40	F	Associates	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	M	Associates	KY
Lost River	2	1	2	1	1	2	1	1	1	1	1	1	31-40	M	Bachelors	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	F	High School	KY
Lost River	2	1	1	2	1	2	1	1	2	1	1	2	51-60	M	High School	MO
Lost River	1	1	1	1	1	1	2	1	1	1	1	1	31-40	F	Bachelor's	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	F	Associates	KY
Lost River	1	1	2	1	1	1	1	1	1	1	1	1	21-30	M	High School	KY
Lost River	1	1	2	1	1	2	1	1	1	1	1	1	31-40	F	Bachelor's	KY
Lost River	2	1	1	2	1	2	1	2	1	1	1	1	51-60	F	Some C	TN
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Some C	KY
Lost River	2	2	1	2	1	2	1	1	1	1	1	2	18-20	F	High School	CA
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	M	Some C	KY
Lost River	2	1	1	1	1	2	1	1	1	1	1	1	21-30	M	Some C	KY

Appendix K (Continued)

Lost River	1	1	1	1	1	2	1	1	1	1	1	1	21-30	M	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Associates	KY
Lost River	2	2	2	1	1	2	1	1	1	1	1	1	41-50	M	Bachelors	KY
Lost River	1	1	2	1	1	2	1	1	2	1	1	2	21-30	M	Bachelors	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	51-60	M	Associates	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	18-20	M	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	21-30	F	High School	KY
Lost River	1	2	2	1	1	2	1	1	1	1	1	1	31-40	M	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	51-60	F	Bachelors	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Associates	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	31-40	M	Some C	KY
Lost River	2	2	1	1	1	2	2	1	1	1	1	1	18-20	F	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	Bachelors	KY
Lost River	1	1	2	1	1	2	1	1	1	2	2	1	41-50	M	Associates	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	F	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	M	Some C	KY
Lost River	1	2	2	1	1	2	1	1	1	1	1	2	21-30	M	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	F	Associates	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	21-30	F	Masters	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	F	Bachelors	FL
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	31-40	F	Some C	KY
Lost River	2	2	2	2	1	2	1	2	2	2	1	2	51-60	M	High School	KY

Appendix K (Continued)

Lost River	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	18-20	F	High School	TN
Lost River	1	1	1	1	1	2	1	1	1	2	1	1	18-20	M	Associates	FL
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	Masters	TN
Lost River	2	1	1	1	1	2	2	1	1	2	2	1	18-20	F	High School	KY
Lost River	1	1	1	1	1	2	1	1	1	1	1	1	41-50	F	Masters	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	41-50	M	Bachelors	KY
Lost River	2	2	1	2	1	2	2	1	2	2	1	2	18-20	M	Some C	KY
Lost River	1	1	1	2	1	2	1	1	1	1	1	1	18-20	M	High School	KY
Lost River	1	1	1	1	1	1	2	1	1	1	1	1	21-30	M	Some C	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	18-20	F	High School	KY
Lost River	1	1	1	1	1	1	1	1	1	1	1	1	21-30	M	Some C	KY
Lost River	1	1	2	1	1	1	1	1	1	1	1	1	31-40	F	Bachelors	KY

Table A20: Post-training, Post-tour Survey Assessments (Cumberland)

Faciilty	Q1	Q2	Q3a	Q3b	Q3c	Q3d	Q4a	Q4b	Q4c	Q5	Q6	Q7	Age	Sex	Education	Resid
Cumberland	2	1	2	1	1	2	1	2	1	1	1	1	61-70	F	Some C	TN
Cumberland	1	1	2	2	1	1	2	1	1	1	1	1	31-40	F	Some C	TN
Cumberland	2	2	2	2	2	2	2	2	1	1	2	1	71-80	F	High School	TN
Cumberland	1	1	2	1	1	1	1	1	1	1	1	1	31-40	M	Bachelor's	TN
Cumberland	2	1	2	1	1	1	1	1	1	1	2	1	51-60	F	High School	TN
Cumberland	2	1	2	1	1	1	1	1	1	1	2	1	21-30	M	Bachelor's	TN
Cumberland	1	1	1	1	1	2	1	1	1	1	1	2	31-40	M	Some C	TN
Cumberland	2	1	2	1	1	1	1	1	2	1	1	2	21-30	M	Some C	TN
Cumberland	2	1	2	1	1	1	1	2	1	1	1	1	21-30	F	Bachelor's	TN
Cumberland	2	1	2	1	1	1	1	1	1	1	1	1	31-40	M	High School	TN
Cumberland	1	1	1	2	1	1	1	2	1	2	2	1	41-50	F	High School	FL
Cumberland	2	1	2	1	1	1	1	1	1	1	1	1	51-60	F	Master's	KY
Cumberland	1	1	2	1	1	1	1	2	1	1	1	1	41-50	M	Law degree	SC
Cumberland	1	2	2	2	1	2	1	1	1	1	1	1	31-40	M	Some C	FL
Cumberland	1	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Bachelor's	TN
Cumberland	2	1	1	2	1	2	1	1	1	1	1	2	61-70	M	High School	TN
Cumberland	1	1	1	2	1	1	1	1	2	1	1	1	18-21	M	High School	IN
Cumberland	1	2	2	2	1	2	2	1	2	1	1	1	31-40	M	Some C	MO
Cumberland	1	1	2	1	1	1	1	1	2	1	2	1	31-40	M	High School	TN
Cumberland	2	1	1	2	1	2	1	1	1	1	1	2	21-30	F	Associates	TN
Cumberland	2	1	2	1	1	2	2	1	1	1	1	1	31-40	M	Bachelor's	TN
Cumberland	2	1	1	1	1	1	1	1	1	1	1	1	21-30	F	Bachelor's	TN
Cumberland	2	1	2	2	1	1	1	1	2	1	1	2	51-60	F	Some C	TN
Cumberland	1	1	2	1	1	1	1	2	1	1	2	1	18-21	F	Some C	TN
Cumberland	1	2	1	1	1	1	1	2	1	1	1	2	61-70	M	High School	FL
Cumberland	2	2	2	1	2	1	1	1	1	1	1	1	71-80	F	High School	KY

Appendix K (Continued)

Cumberland	2	1	2	1	1	1	2	1	1	2	1	1	18-21	F	High School	KY
Cumberland	2	1	1	1	1	1	1	1	1	1	1	1	51-60	M	Associates	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	31-40	M	Bachelor's	TN
Cumberland	1	1	2	1	1	1	1	1	1	1	1	1	41-50	F	High School	TN
Cumberland	1	1	2	2	1	1	1	2	1	1	1	2	21-30	F	Bachelor's	TN
Cumberland	1	2	2	1	1	1	1	2	1	1	2	1	21-30	F	Some C	GA
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	31-40	F	High School	FL
Cumberland	1	1	2	2	1	1	1	1	1	1	1	1	31-40	F	Bachelor's	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	31-40	F	Some C	TN
Cumberland	1	1	2	2	1	2	2	1	1	1	1	1	51-60	M	Associates	KY
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	18-20	M	High School	TN
Cumberland	2	1	2	1	1	1	2	2	2	1	1	1	51-60	F	Some C	TN
Cumberland	1	1	1	1	2	1	2	1	2	1	1	1	41-50	M	Master's	GA
Cumberland	1	1	1	1	1	1	1	1	1	1	1	1	31-40	M	Bachelor's	TN
Cumberland	2	1	1	1	1	1	2	1	1	1	2	1	51-60	M	Some C	TN
Cumberland	2	2	2	2	1	1	1	1	2	1	1	2	18-21	F	High School	TN
Cumberland	1	1	1	1	1	2	1	1	2	1	1	1	18-20	F	Some C	TN
Cumberland	1	1	1	1	1	1	1	2	1	1	1	1	41-50	M	Bachelor's	VA
Cumberland	1	1	1	2	1	2	1	2	1	1	1	1	18-21	M	High School	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	31-40	M	High School	TN
Cumberland	1	1	1	1	1	1	2	1	1	1	1	1	21-30	F	Bachelor's	KY
Cumberland	1	1	1	1	1	2	1	1	2	1	1	1	18-20	M	Some C	GA
Cumberland	1	1	1	2	1	2	1	2	1	1	1	1	21-30	M	Some C	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	31-40	F	Bachelor's	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	31-40	M	Some C	TN
Cumberland	1	1	1	1	1	2	1	1	1	1	1	1	21-30	F	High School	KY
Cumberland	1	1	2	1	1	2	1	2	1	1	1	1	21-30	F	Bachelor's	TN

Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	51-60	M	Some C	TN
Cumberland	2	1	2	1	1	1	1	1	2	1	1	2	41-50	F	Master's	KY
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	41-50	F	High School	TN
Cumberland	1	1	2	1	1	2	1	2	1	1	1	1	31-40	M	Some C	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	51-60	F	Master's	TN
Cumberland	1	1	1	1	1	2	1	2	1	1	1	1	18-20	M	High School	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	31-40	M	High School	FL
Cumberland	2	1	2	1	1	1	1	2	1	1	1	1	18-21	M	Bachelor's	TN
Cumberland	1	1	1	1	1	2	1	2	1	1	1	1	61-70	F	Some C	TN
Cumberland	1	1	1	1	1	1	1	2	1	1	1	1	51-60	M	High School	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	31-40	F	Bachelors	TN
Cumberland	2	1	2	1	1	1	1	2	1	1	1	1	18-21	M	High School	TN
Cumberland	1	1	1	1	1	2	1	2	1	1	1	1	51-60	F	Bachelor's	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	21-30	M	Some C	KY
Cumberland	2	1	2	1	1	1	1	2	1	1	1	1	31-40	F	High School	TN
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	61-70	M	High School	TN
Cumberland	1	1	1	1	1	2	1	2	1	1	1	1	21-30	F	High School	GA
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	41-50	M	Bachelor's	TN
Cumberland	1	1	1	1	1	2	1	2	1	1	1	1	21-30	F	Some C	FL
Cumberland	2	1	2	1	1	1	1	2	1	1	1	1	18-21	M	Some C	MO
Cumberland	1	1	2	1	1	2	1	2	1	1	1	1	31-40	F	High School	TN
Cumberland	1	1	2	2	1	1	2	1	1	1	1	1	31-40	F	Master's	TN
Cumberland	1	1	2	1	1	2	1	2	1	1	1	1	31-40	F	Master's	TN
Cumberland	2	1	2	1	1	1	1	1	1	1	1	1	51-60	M	Some C	FL
Cumberland	2	1	2	1	1	1	1	1	2	1	1	2	31-40	M	Bachelor's	KY
Cumberland	1	1	1	1	1	2	1	1	2	1	1	1	18-20	F	Some C	TN
Cumberland	1	1	2	2	1	1	2	1	1	1	1	1	51-60	M	Some C	TN
Cumberland	1	1	2	1	1	2	1	2	1	1	1	1	31-40	F	Bachelor's	TN

Appendix K (Continued)

Cumberland	2	1	2	1	1	1	1	1	1	1	1	1	18-21	M	High School	KY
Cumberland	1	1	2	1	1	1	1	2	1	1	1	1	41-50	M	Bachelor's	TN
Cumberland	2	1	1	2	1	2	1	1	1	1	1	2	21-30	F	Some C	TN
Cumberland	2	1	2	1	1	1	1	1	2	1	1	2	18-21	F	Master's	TN
Cumberland	2	1	2	1	1	1	2	1	1	1	1	1	31-40	F	Bachelor's	TN
Cumberland	1	1	2	1	1	1	1	2	1	1	1	1	41-50	M	Some C	MO
Cumberland	1	1	1	1	1	2	1	1	2	1	1	1	21-30	F	Some C	TN
Cumberland	2	1	2	1	1	1	1	1	2	1	1	2	61-70	F	High School	GA
Cumberland	1	1	2	1	1	2	1	1	1	1	1	1	41-50	M	Bachelor's	TN
Cumberland	1	1	1	1	1	2	1	2	1	1	1	1	21-30	F	Some C	TN
Cumberland	2	1	1	1	1	2	1	1	1	1	1	1	18-21	M	Some C	TN
Cumberland	1	1	2	1	1	1	1	2	1	1	1	2	21-30	F	High School	TN
Cumberland	1	1	2	1	1	2	1	2	1	1	1	1	31-40	M	Bachelor's	TN
Cumberland	2	1	2	1	1	1	1	1	1	1	1	1	51-60	F	Some C	TN
Cumberland	2	1	2	1	1	1	1	1	2	1	1	2	61-70	F	High School	TN
Cumberland	1	1	2	1	1	2	1	2	1	1	1	1	31-40	M	Bachelor's	TN
Cumberland	2	1	2	1	1	1	1	1	1	1	1	1	18-21	M	High School	MI
Cumberland	2	1	2	1	1	1	1	1	2	1	1	2	31-40	M	Bachelor's	TN
Cumberland	1	1	1	1	1	2	1	1	2	1	1	1	18-20	M	Some C	TN
Cumberland	1	1	2	2	1	1	2	1	1	1	1	1	51-60	M	Some C	TN
Cumberland	1	1	2	1	1	2	1	2	1	1	1	1	31-40	F	Bachelor's	KY
Cumberland	2	1	2	1	1	2	1	1	1	1	1	1	21-30	F	High School	KY

ABOUT THE AUTHOR

Leslie A. North is a sixth generation Floridian and is the first in her family to receive a PhD. She holds two bachelors degrees (Environmental Science and Policy and Anthropology) and earned a masters degree in Environmental Science and Policy in 2007 from the University of South Florida. After she reached the startling conclusion that both the general public and policy makers have very limited understanding of valuable and sensitive karst terrains, she decided to remain at the University of South Florida and continue her research on karst disturbance, policy and informal education. Leslie has served as President for the Karst Research Group, the Editorial Assistant for the Southeastern Geographer journal, and an Environmental Research Specialists for the Hoffman Environmental Research Institute. Leslie will begin her academic career as an Assistant Professor of Geography and Geology at Western Kentucky University, Bowling Green, Kentucky, in Fall 2011.