A Study of Ethnogeological Knowledge and

Other Traditional Scientific Knowledge

in Puerto Rico and Dominican Republic

by

Angel A. Garcia Jr.

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Graduate Supervisory Committee:

Steven Semken, Chair
Elizabeth Brandt
Everett Shock
Cassie Bowman
Ariel Anbar

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ABSTRACT

Ethnogeology is the scientific study of human relationships with the Earth as a system, typically conducted within the context of a specific culture. Indigenous or historically resident people may perceive local places differently from outside observers trained in the Western tradition. Ethnogeologic knowledge includes traditional indigenous knowledge (alternatively referred to as *traditional ecological knowledge or TEK*), which exceeds the boundaries of non-Indigenous ideas of physical characteristics of the world, tends to be more holistic, and is culturally framed. In this ethnogeological study, I have implemented several methods of participatory rapid assessment (PRA) from the discipline of field ethnography to collect culturally framed geological knowledge, as well to measure the authenticity of the knowledge collected. I constructed a cultural consensus model (CCM) about karst as a domain of knowledge. The study area is located in the karst physiographic region of the Caribbean countries of the Dominican Republic (DR) and Puerto Rico (PR). Ethnogeological data collected and analyzed using CCM satisfied the requirements of a model where I have found statistically significance among participant's agreement and competence values. Analysis of the competence means in the population of DR and PR results in $p < 0.05$ validating the methods adapted for this study. I discuss the CCM for the domain of karst (in its majority) that is shared among consultants in the countries of PR and the DR that is in the form of metaphors and other forms of culturally framed descriptions. This work continuing insufficient representation of minority groups such as Indigenous people, Native Americans, Alaska Natives, and Hispanic/Latinxs in the Earth Sciences.

DEDICATION

I want to dedicate this work to my beautiful wife Grace “guayaba”. She is my strong foundation since day one. Every moment that I need her, she was there smiling. Grace, I am lucky that our souls crossed paths. I want to dedicate this work to my parents Ángel A. García-Vargas and Carmen A. Romero-Suazo. I am in the place that they wanted me to be. Even if sometimes they cannot comprehend entirely where their effort placed me. Every sold “limber, alcapurria, and pasteles” paid off. Thanks to my sister Joseline Gonzalez and her family for showing me perseverance and love with her example. As well, I dedicate this work to my extended family Grisette Lozada, Juan Lopez, Jose L. Negron that have always believe in me and my dreams.

Thanks Puerto Rico for giving me so much through the years, this work is my way to give a little back, my beautiful “Perla del Caribe”.

This work is in loving memory of my greatest fan, mentor, and best friend; my father Ángel Antonio García-Vargas (1948-2018).

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TABLE OF CONTENTS

APPENDIX Page

LIST OF TABLES

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

To be more inclusive of ethnically, culturally, and linguistically diverse students, teaching should be rich in relevant context and culturally accommodating (Ares, 2011). Educators who integrate culturally relevant material as context in their lessons and foster investigations of authentic scientific problems that are locally situated with students are usually successful in teaching them scientific concepts and theories (Fensham, 2009). Inclusiveness and diversity in geosciences have been of increasing interest in the past few years and have been integrated in mission statements of well-known professional organizations around the planet, including geoscience organizations as well in the United States (American Geophysical Union, 2002; Geological Society of America, 2010) as a response to lack of diversity observed in Earth sciences. These have adopted many strategies and policies with the goal of becoming more diverse and inclusive organizations.

In my dissertation work, I adapted the method of cultural consensus modeling (CCM), typically used in field ethnography and other anthropological sub-disciplines to model ethnogeologic knowledge about karst features and processes in Puerto Rico (PR) and Dominican Republic (DR). In this study, I used the term *place* in *place-based* education from a different angle, one that is widely used and well defined among the disciplines of cultural geography and environmental psychology. This work is an effort to gather and analyze evidence for the authenticity of some forms of geological knowledge that are culturally framed and locally situated, so that this knowledge can be applied toward more diverse and culturally inclusive geoscience education.

1.1 Place and Sense of Place

I use the term *place* as it is understood in cultural or human geography: *place* is a locality given meaning by human experience (Tuan, 1977). Place meaning is socially constructed by individuals, groups, or societies; or, as Cresswell (2004, p. 11) described:

> "Place is also a way of seeing, knowing, and understanding the world. When we look at the world as a world of places we see different things. We see attachments and connections between people and place"

As well, I use the term *sense of place* as it is used in disciplines such as field ethnography (Basso, 1996), environmental psychology (Hay, 1998), and cultural geography (Cresswell, 2004), to encompass the meanings and attachments that people hold for specific locations based on current or historical relationships with location related resources or events.

1.2 Indigenous Senses of Place and Place-Based Education

Indigenous or historically resident people may perceive local places differently from outside observers trained in the "Western" or Euro-American tradition. Traditional Indigenous knowledge (alternatively referred to as *traditional ecological knowledge* or TEK) exceeds the boundaries of non-Indigenous ideas of physical characteristics of the world (Cajete, 1999) in that it is far more holistic. This way of perceiving and approaching the natural world embraces and highlights unique and specific ways of thinking that are locally situated and culturally specific (McLeod, 2007; Kovach, 2010; Wulff, 2010). Basso

(1996) and Cajete (1999) present specific examples of Indigenous senses of place that include a robust understanding of the surrounding physical world, including geology (landscapes, rivers, sky, etc.) that is typically well represented in cultural knowledge systems, observable in traditional practices, and documented in oral history.

Place is known to be useful as an organizing theme for effective geoscience instruction for students from Indigenous and historically resident (e.g., Hispanic/Latinx[*]) cultures (Cajete, 1999; Semken, 2005; Riggs, 2005). The use of well-known landscapes and environments enables the instructor and learner to systematically organize and construct knowledge in relevant and engaging ways (Warren et al., 2001; Hudicourt-Barnes, 2003; Ault, 2008). Thoughtful integration of local knowledge, history, geology, geography, and language provides context for global scientific concepts (e.g., plate tectonics, geologic time). In such *place-based* methods of teaching (Elder et al., 1998), sense of place serves as an assessable learning outcome (Semken & Butler Freeman, 2008).

Indigenous senses of place, teaching philosophies; and interactions with and empirical knowledge of surrounding Earth systems (the latter also known as *ethnogeology*) have increasingly been used to enrich geoscience education (e.g., Semken & Morgan, 1997; Murray, 1997; Stephens, 2001; Riggs, 2005; Semken, 2005; Gibson & Puniwai, 2006; Palmer et al., 2009; Apple et al., 2014; Semken et al., 2017). In these papers, we can observe how students are able to share and integrate their common cultural heritage with mainstream scientific ideas and theories for effective learning. In many cases, place-based education serves equity and diversity (Ault, 2008) by functioning as a "bridge" between

[*] Gender-neutral term to describe Latino and Latina.

underrepresented students, education degrees, and mainstream geoscience (e.g., Williams & Semken, 2011) as well as in other STEM fields.

1.3 Indigenous Communities in Puerto Rico and Dominican Republic

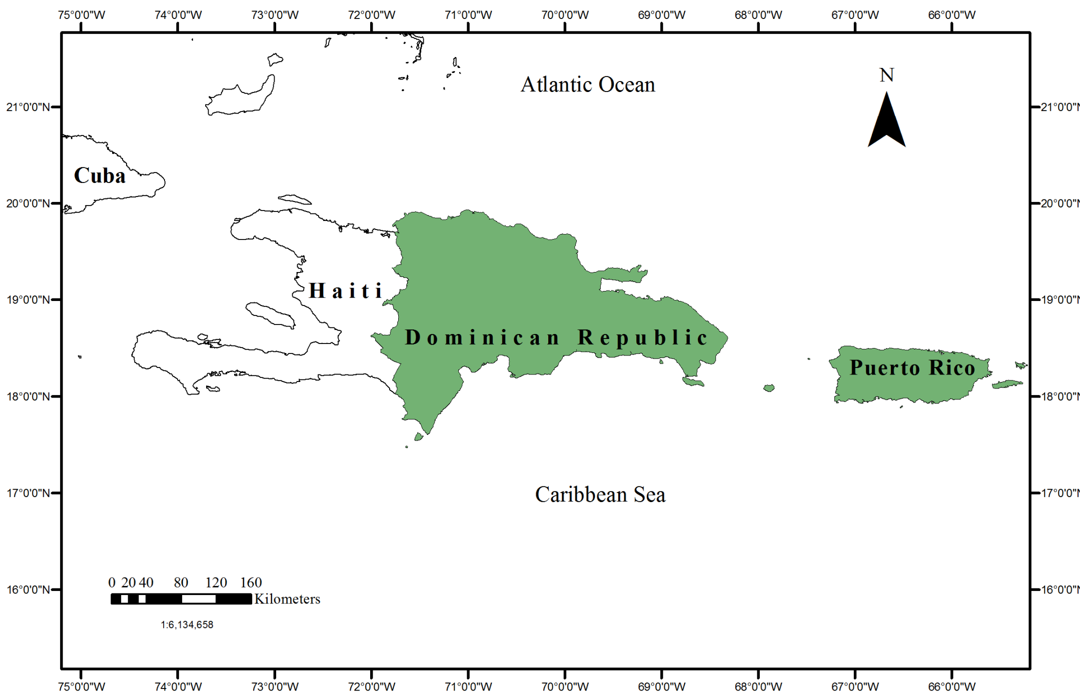

Figure 1. Ethnogeological study area.

Evidence found in the form of pictographs in 'Las Cabachuelas' caves in Puerto Rico (PR) suggest that Indigenous communities have been inhabiting the Caribbean region at least since 400 B.C.E. (Rodríguez-Ramos, 2017). Countries such as PR and Dominican Republic (DR) are locations (see figure 1) where descendants of the indigenous *Taíno*[1] and

[1] *Taínos* were the first civilization encountered by European explorers upon their arrival in the Americas (Keegan & Maclachlan, 1989) and the last Amerindian manifestation in the Caribbean that goes back 300B.C. (Rodríguez-Ramos, 2008).

other cultural groups residing at the time of the Columbian "discovery" event in 1493 C.E. still reside, still use TEK in their daily lives, and have accrued and retained ethnogeologic knowledge about processes and features in the local environment from pre-Columbian and African-diaspora ancestors. The *Taíno*, as a distinctive Arawakan-speaking group, were distributed in different *cacicazgos* (chiefdoms) among the Caribbean Greater Antilles and left a legacy of knowledge in the form of vocabulary (fragmented language), traditional practices, and understandings of the natural world. We can find such evidence by studying elements of the contemporary Caribbean culture. Modern countries such as Puerto Rico, Dominican Republic, Haiti, Jamaica, and eastern Cuba are places where *Taíno* descendants still reside in their traditional homelands. These communities have been the scope of dedicated research efforts from federal agencies such as the Smithsonian Institution, specifically the branch of the National Museum of the American Indian in New York City (Palmer, 2018). In some communities, anthropological and linguistic evidence (Granberry & Vescelius, 2004) suggest that there is abundant local ethnogeological knowledge that dates from pre-Columbian times and is transferred from one generation to the next through oral history, cultural practices, and the implementation of metaphors for the explanation of environmental changes, as well processes. Through this research (described in depth below) I have gathered and identified a valid set of ethnogeologic knowledge about karst terrain among inhabitants of such physiographic region within the countries of DR and PR. In the case of PR[2], the developing of culturally based geological research could be interpreted as a direct response to have a more diverse and inclusive geoscience community in the United States as a whole. Such observation, environmental data, epistemology, and

[2] Annexed as a territory to the U.S.A. in the 1898.

ways of knowing have potential to be integrated in geoscience curricula in the countries of PR and DR.

I have selected PR and DR for this ethnogeological study because of the abundant anthropological evidence of cultural continuity and historical parallels existing between the two countries (Stevens-Arroyo, 1993). Physiographical characteristics and ethnohistorical proximity make both countries good candidates for gathering scientific observations about geological processes that are culturally rooted and contextualized.

1.4 Puerto Rican and Dominican Geology

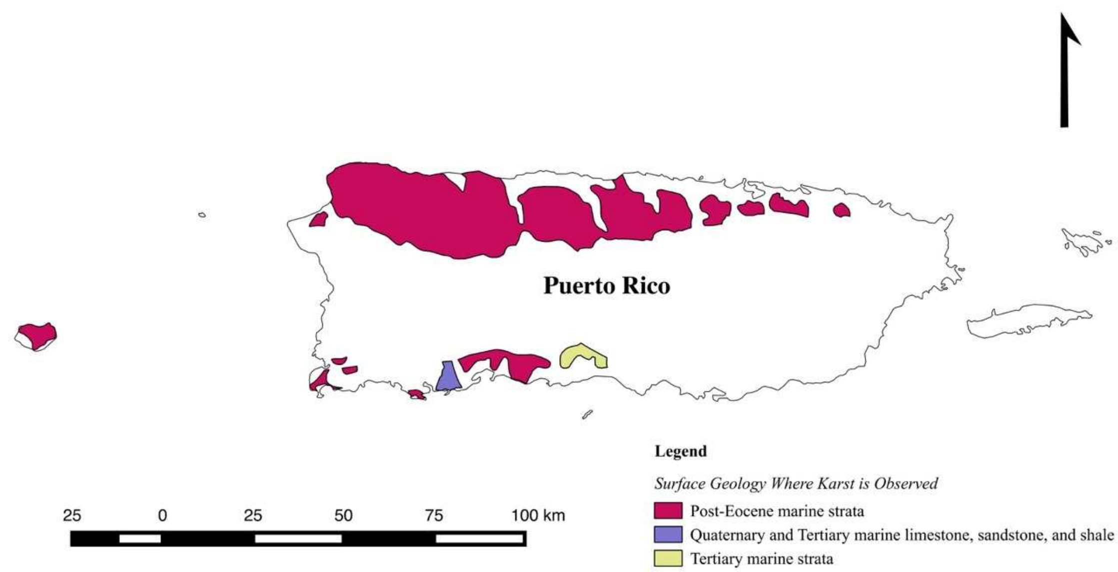

Figure 2: Map of Puerto Rico showing karstic surface geology.

The archipelago of Puerto Rico is a volcanic island-arc terrane associated with the Caribbean-North American Plate boundary containing a geologic record that extends back as far as 150 Ma. The main island is composed mostly of volcanic rocks, including lava and tuff, and sedimentary rocks ranging from Upper Jurassic to Lower Paleogene (middle Eocene; Akers & Briggs, 1965) with Late Cretaceous to Paleogene intrusive rocks

(Bawiec, 1998). Puerto Rico is subdivided into three main physiographic divisions: a belt northern belt of rugged karst topography (see figure 2) formed on marine limestone, a mountainous area that constitute two-thirds of the main island, and discontinuous coastal plains (Monroe, 1976). Karst topography covers more than a quarter of the main island (Lugo et al., 2004). The archipelago of Puerto Rico has a wide variety of karst features that represent formation in a tropical climate that is humid on the north side of the island and dry (semiarid) on the south side, behind the rain shadow of the mountains (Monroe, 1976). The karst belt in the northern side, locally known as the “Carso Norteño” of Puerto Rico, comprises six formations of Oligocene and Miocene carbonate rocks (mostly limestone) (Miller & Lugo, 2009).

The DR occupies around 67% of the island of Hispaniola and has a geological record of the north-Caribbean basin that is almost continuous from the Jurassic (Pérez-Estaún et al., 2010; Abad de los Santos et al., 2012). The island of Hispaniola was formed as a complex island arc associated with a bipolar subduction history that extended from the Cretaceous to the late Eocene Epoch (Mann et al., 1995). Sedimentary rocks are abundant in the Paleogene stratigraphic succession, mostly in the east part of the island the Hispaniola (see figure 3). In the DR, karst terrain from the Pliocene and Pleistocene Reef constitutes the most surface geology and occurs mostly in the east. The geology of Hispaniola affords study of Miocene and younger neotectonics and geologic history of the Caribbean Plate (Mann et al., 1991).

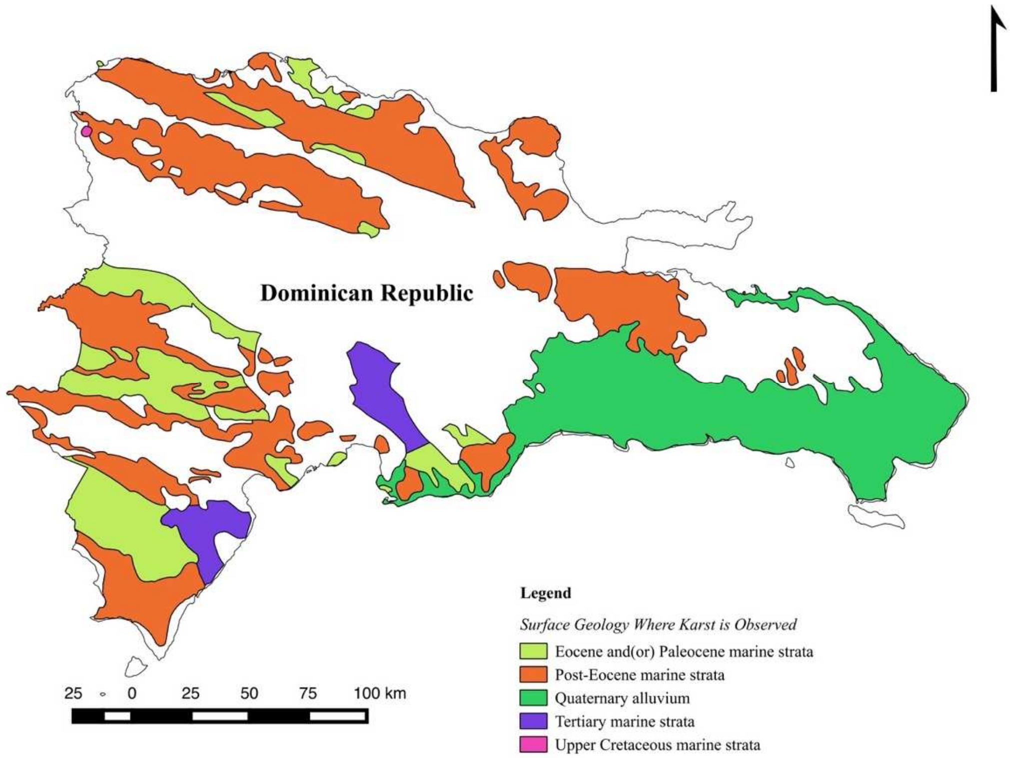

Figure 3: Map of Dominican Republic showing karstic geology.

1.5 Ethnogeology

Ethnosciences are focused on the ways that individuals and communities obtain and organize knowledge of specific subjects, from physical objects to concepts. Since the early twentieth century C.E., field ethnographic methods have been applied to study culturally based knowledge systems of different components of the natural world. One of the earliest subdisciplines was ethnobotany, dating to the work of the field ethnographer and linguist John P. Harrington, who compiled the ethnogeographic knowledge of the Tewa people of

New Mexico in 1916 and also co-authored a volume on the *Ethnobotany of the Tewa* (Robbins et al., 1916). Ethnobotany has subsequently come to be recognized as a mature discipline with a considerable literature base (Schultes & von Reis, 1995) and ethnogeologists aspire to the same. Ethnogeology (Kamen-Kaye, 1975; Murray, 1997; Semken, 2005; Londoño et al., 2016) is often described as the scientific study of people's knowledge of and relationships with Earth systems (i.e., with Earth materials, structures, processes, hazards, and resources). Ethnogeologic research adapts and combines methods of ethnography and geology, is primarily field-based, and typically carried out among a particular cultural group or community. The application of ethnogeologic knowledge to formal or informal place-based geoscience education is intended to address challenges to local cultural and environmental sustainability by using place as the theme in the learning process (e.g., Semken, 2005; Londoño et al., 2016). Geoscience education informed by culturally appropriate use of ethnogeologic knowledge, and hence made more place-based, has the potential to make geosciences in general more accessible and relevant to diverse students.

Specific field ethnographic methods useful in ethnogeological research include free-listing, participatory mapping, and cultural consensus analysis (Bernard, 2006). I have integrated several of these methods and adapted them for the collection and analysis of geological knowledge in this study. For this dissertation, I have studied a portion of the established cultural domain of knowledge about karst terrain and processes, especially in caves, among Puerto Rican *jíbaro*[3] and Dominican *campesino*[4] communities. Results suggest an existing cultural model that is rich in karst-related knowledge, but the data are not exclusive to the karstification phenomena. In this dissertation, I address in detail these research questions: (1) what methods are suitable for the collection and organization of ethnogeological knowledge? (2) what elements of ethnogeological knowledge related to karst in Puerto Rico and Dominican Republic can be identified? and (3) how authentic is the ethnogeologic knowledge collected?

[3] Coming from the *Taíno* person of the forest. In this context we use *jíbaro* as a person considered indigenous of Puerto Rico.
[4] *Campesino* is the Spanish word for farmer. It is widely used in the Caribbean, especially in Dominican Republic to substitute *jíbaro* (PR) or *guajíro* (Cuba)

CHAPTER 2

THE CONSTRUCTION OF CULTURAL CONSENSUS MODELS TO CHARACTERIZE ETHNOGEOLOGICAL KNOWLEDGE AND OTHER TRADITIONAL SCIENTIFIC KNOWLEDGE

As described in the preceding chapter, ethnogeology is the scientific study of human relationships with and knowledge of the Earth system, generally investigated within the context of a specific culture, by means of geologic and ethnographic field methods. Many Indigenous and local systems of environmental knowledge and place knowledge incorporate empirical observations and culturally framed interpretations of geological features and processes. I discuss in this chapter the use of cultural consensus models (CCM), a method derived from field ethnography for the collection, analysis, and organization of ethnogeological knowledge. I describe my methods and cite selected examples to bring context to the results discussed. In this chapter I detail the construction of a CCM for ethnogeological knowledge related primarily to karst terrain and riverine areas, among local *campesino* and *jíbaro* communities in DR and PR respectively. My results yield a CCM for the knowledge domain of karst terrain that is shared by the inhabitants of karst regions in DR and PR. Additional data that support the CCM include localized metaphors for the description of speleothem formation in caves, the process of erosion, and mechanical weathering. This chapter focuses on the methods used to construct an ethnogeological CCM; a more detailed description and interpretation of the elements of this CCM (i.e., the system of knowledge thus obtained) will be presented in chapter 3.

2.1 Introduction

Critical needs in the U. S. geosciences workforce are not likely to be met without more proportional participation of underrepresented minorities (American Geological Institute, 2008). There remain many challenges to greater participation in the geosciences by underrepresented minorities, particularly Hispanic/Latinx and Indigenous (Native American/Alaska Native/Native Hawaiian/Pacific Islander) students. In the case of the Indigenous population, underrepresentation in natural-science studies and careers is particularly staggering based on abundant evidence that Indigenous people tend to have highly developed, culturally based understanding of natural systems that is characterized by thoughtful observation and sophisticated reasoning (Cajete, 1999; Bang et al., 2007; Unsworth et al., 2012). This discrepancy could be related to the way that scientific knowledge is organized and presented in the classrooms. There is abundant literature (e.g., Aikenhead, 1996; Aikenhead & Jegede, 1999) in science-education research that documents the ways mainstream science education is oriented and based on Euro-American tradition, perspectives, and events, promoting that humans are “apart from their environment.” In contrast, Indigenous adults and children are more inclined to think of themselves to be “part of their environment” (Bang et al., 2007).

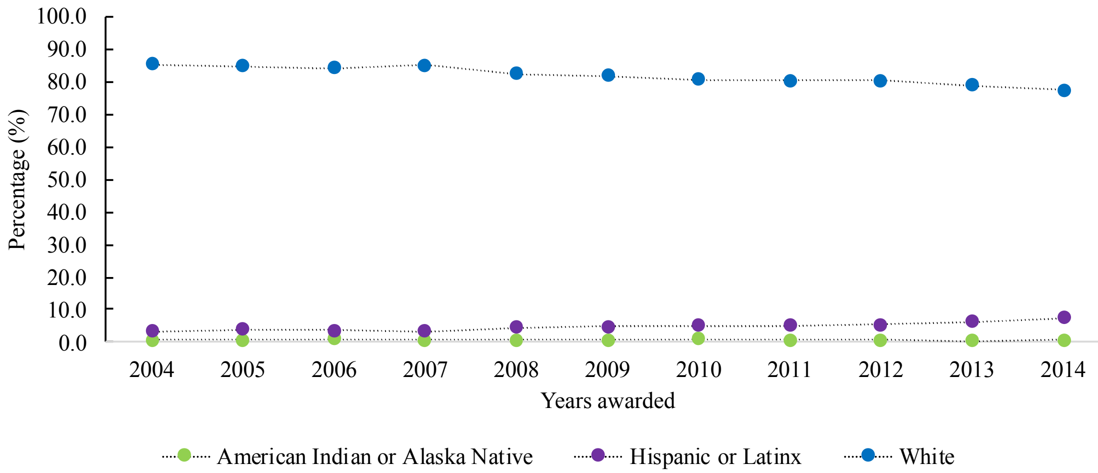

Figure 4: Bachelor’s degrees awarded in Earth, atmospheric, and ocean sciences to Hispanic/Latinx, American Indian or Alaska Native, and White students: 2004-2014. Data from table 2-4. National Center for Science and Engineering Statistics (2017)

A general scarcity of Earth science teaching that is more culturally accommodating, affording Indigenous and Hispanic/Latinx students the space to integrate their own means of knowledge organization, may underlie the gap between students’ scientific knowledge and their performance in science education (Unsworth et al., 2012). In 2014, Hispanics/Latinxs received about 7% and Native Americans and Alaska Natives received less than 1% of all appointed undergraduate degrees in the Earth sciences in the United States (Figure 4; National Center for Science and Engineering Statistics, 2017). Both percentages are lower than the representation of these groups in the U. S. population. Research-based educational interventions offering more inclusive, more culturally informed, and more effective geoscience education have the potential to addressing the continuing gaps in preparation for and participation in the geoscience community. For example, Bang and Medin (2010) have documented several positive outcomes for Native American youth who participate in culturally informed science education programs that complement mainstream pedagogy with Indigenous methodologies in specific domains of scientific knowledge (Kovach, 2010).

2.1.1 Culturally Inclusive Education and the Case of Puerto Rico

After the U.S. occupation of the country of Puerto Rico in 1898, educational systems went through many drastic changes. Immediately following the American occupation, schools were established with organization, curriculum, and teaching practices similar to those in the mainland United States (Cook, 1934). As part of the process, English was imposed as the official language for instruction on the island until 1949, when its status was changed to a second language taught in schools (Bou, 1966; Rodriguez et al., 2004). This strategy implemented educational paradigms developed in the mainland that were largely foreign and culturally irrelevant to Puerto Ricans. At present in PR, education in science, among other disciplines, still relies heavily on mainland textbooks that are directly translated from English to Spanish, retaining largely Anglo-American and European idioms that offer minimal context to local students (González-Espada et al., 2014). In other words, little has changed from the beginning of the previous century. The problems with context and relevance are propagated by a scarcity of good programs for science teacher preparation in PR starting with elementary education. Further, the efforts to locally and culturally contextualize information in most pre-service courses and professional development programs for science teachers are minimal (Claudio, 2000; Llerandi-Roman, 2007). The example of Puerto Rico just mirrors what is the education reality of other countries such like Hawaii and Guam that have a long relationship with the US, as well Native Americans nations around the country

2.1.2 Ethnogeologic Research to Inform Place-based Education

Ethnogeology is the scientific study of human relationships with and knowledge of the Earth system and is typically investigated within the context of a specific culture. Many Indigenous and/or local systems of environmental and place knowledge incorporate empirical observations and culturally framed interpretations of geological features and processes. Ethnogeological interpretations may differ from those of conventional mainstream geoscience (also referred to as Western science), but they are validated by their direct relevance to long-term cultural and environmental resilience and sustainability, typically in challenging environments (e.g., Murray, 1997; Cajete, 2000; Londoño et al., 2016). Ethnogeologic findings can enrich geoscientific knowledge bases for further research and inform place-based geoscience education that has been shown to engage and enrich students from underrepresented minority communities in many different settings (see the review by Semken et al., 2017). Place-based geoscience education, informed by ethnogeology, holds promise to serve as an effective bridge between underrepresented students and degrees and careers in geoscience.

2.1.3 The Use of Field Ethnographic Methods to Study Ethnogeology

Applied ethnographic fieldwork is often carried out in a particular region in only a few weeks (Bernard, 2006), using a methodology known as Participatory Rapid Assessment (PRA). PRA involves the collection of data in the field without the need to first develop a long interval of rapport with the community studied. Even if the name of this collection of methods implies a “quick” or “short” way to obtain data, PRA done correctly should not be considered a hasty or slipshod way of assessment (Bernard, 2006). The total time I invested in networking with participants and in fieldwork in DR and PR was approximately 4 years, which is hardly hasty, though rapid compared to typical study durations of a decade or more in conventional field ethnography. However, it is understood that in field ethnographic terms, 4 years does not represent enough time to develop the relationship necessary for a fully representative study. Owing to the limitations to time and resources I had as a graduate student, I used PRA and consider this ethnogeographic project a “proof of concept study" that will inform and guide subsequent work in the study area. PRA afforded me the opportunity to construct a reasonable ethnogeologic model under these limitations.

In this chapter I review the construction and use of a CCM as a means to test the authenticity of the body of knowledge collected from multiple participants through field ethnography, by mathematically modeling the participants' agreement on and competence in that knowledge. I discuss Cultural Consensus Theory, on which the CCM is based, and free-listing methods that were used to construct the CCM. I present a selected sample of the results to show the effectiveness of the cultural consensus analysis and offer a more thorough discussion of the ethnogeological knowledge contained in the CCM in Chapter 3.

Cultural Consensus Theory was proposed by Romney et al. (1986) in order to address the common ethnographic challenge of accurately capturing the diversity of a population studied while encapsulating their knowledge into a well-constrained domain (which is represented by the CCM). Cultural consensus analysis does this by analyzing patterns of agreement to assess: (1) different levels of expertise among individuals, (2) the degree to which there are individuals who agree on a single cultural model, and (3) the degree to which there is disagreement among subgroups (Romney et al., 1986; Hruschka et al., 2008). My first step in developing a CCM for ethnogeological knowledge was to collect data on selected relevant domains of knowledge using PRA. For my study, I integrated free-listing (structured interviews), grand-tour questions (semi-structured interviews), and participant observation to construct a cultural consensus questionnaire (see Table 1 for a summary of the PRA methods used).

Cultural Consensus Theory relies on four assumptions (Hruschka & Maupin, 2013):

1) There is a single body of knowledge (often called folk knowledge) that everyone in a specific society has access to, but no single person knows all of it.
2) Differences in responses obtained from respondents related to this body of knowledge are attributed to random guessing when respondents do not know the correct information.
3) Each person draws identically from the same body of knowledge.
4) Each person has similar competency to correctly answer about a subject related to the common body of knowledge.

Cultural Consensus Theory enables the researcher to determine how much of a particular domain of knowledge is shared among different cultural consultants. The knowledge level of each consultant is reported as *competence*: the probability that an informant's knowledge is accurate when compared to the consensus among all of the cultural consultants. An important aspect of CCM is that it corresponds to a locally held cultural model, obtained by analysis of respondents' answers, and is not subject to *a priori* assumptions held by the researcher. Hence CCM can be used to identify models that are unique to each cultural setting and to each particular domain of knowledge of interest (Romney et al., 1987).

Free-listing can be used to study and make inferences about participants' cognitive structure from the order of recall and the frequency of recall (Romney & D'andrade, 1964; Bernard, 2006). The analytical purpose of this technique is to count the number of mentions of each mentioned item in the list, and to create a respondent-by-item numerical relation to denote which respondents mentioned which item in what order (Borgatti, 1996). Computer software is used to analyze data from free-listing. ANTHROPAC (Borgatti, 1996) is software used to count the number of items occurring per list and compute the average saliency index, measured as:

$$S_j = {}^{nr_j}/_{n1} \tag{2.1}$$

where n is the number of items and r_j is the position of an item in the j list. For the computation of the saliency index, ANTHROPAC (Borgatti, 1996) selects the average of S_j of all participants. The salience used in ANTHROPAC is an adaptation made by Smith (1993).

PRA data collection method	Analysis of the data	Purpose of the method
Participant observation	Notes transcribed, coding, themes.	Organizes information from places and other sources of TEK that cannot be organized in lists. Usually in form of oral stories, metaphors, and comparisons.
Free listing interviews (structured interviews)	Item frequency, participant percentage, average rank, and salience index (Smith's S)	The analytical purpose of this technique is to count the number of mentions of each mentioned item in the list, and to create a respondent-by-item numerical relation to denote which respondents mentioned which item in what order.
Grand-tour questions	Notes transcribed, coding, themes, recordings, videos, and photography	Reinforce data collected from free-listing about domains of knowledge listed in free-listing questionnaires.
Cultural Consensus questionnaires (structured interview)	Cultural Consensus Analysis	Describe cognitive patterns and behavior in a society while also capturing diversity among the population studied.

Table 1: Summary of methods used for the development of domains in ethnogeological study.

2.2 Methods

2.2.1 Constructing a Cultural Consensus Questionnaire

Authors such as Handwerker (2001) and Bernard (2006) explain that the key to high-quality ethnographic research while doing free-listing as identifying clear domains and limiting them to five, to avoid exhausting the participants and to facilitate rapid data collection. For the construction of a free-listing questionnaire, I therefore chose five knowledge domains relevant to ethnogeology of karst terrain: (1) uses of local rock units (particularly limestones); (2) textures of local rock units, (3) karst hydrology (flow, circulation, and drainage); (4) regional geography; and (5) community uses of caves and karst. I chose these domains of knowledge based on preliminary knowledge gathered from a literature review that indicated in some Caribbean communities (Alvarez Nazario, 1972; Dominguez-Cristobal, 1989, 1992, 2007; Stevens-Arroyo, 1988; Pané, 1999) these domains of knowledge are abundant among Puerto Ricans and Dominicans in general. On this basis I presumed that many if not most of my selected cultural consultants would have abundant direct experience with these particular domains.

From these domains I drafted 9 questions to use in free-listing interviews (Appendix A). Free-listing interviews can be done in groups or with individuals (Bernard, 2006); I worked solely with individual consultants. Cultural consultants were asked to provide interpretation along short walks (also known as grand-tour questions) that were carried out during the free-listing interviews (Spradley, 1979) in order to elaborate their knowledge about locations that were included within their questionnaire (see Appendix B). Data from participant observations in the form of stories, metaphors, and analogies were collected as audio recordings, written notes, and photographs during participant interviews and interpretive walks. I asked the participants not to draw on any sources of knowledge outside of themselves (e.g., conferring with other cultural consultants, or reading written references). Each participant had the option of providing written responses to the questionnaire, but in the majority of the cases, consultants asked the interviewer to transcribe their answers owing to limited writing ability.

In order to construct the Cultural Consensus Questionnaire, I analyzed data collected from participant observation, grand-tours, and free-listing. I transcribed conversations coming from grand-tours, and participant observations to be used as data. Within this data set I identified some of the common elements (metaphors, stories, analogies) that our cultural participants were using to describe geological processes (see Appendix C). The data set was combined with Smith's saliency results (see Appendix D for more information) coming from free-listing interviews during fieldwork in the Dominican Republic. This combination gave me the foundation necessary to have an educated guess to construct the questionnaire to be used during fieldwork.

I drafted a total of 73 questions (see Appendix E) in order to reject an assumption of equal competence (Hruschka & Maupin, 2013). Questions were translated into Spanish, which was spoken by all participants (see Appendix F). To avoid exhaustion among the participants I limited the interviews to 60 minutes or less. These questions were drafted to ask participants if they consider each of the findings obtained from the prior fieldwork to be "true" or "false" in their opinion. One of the main objectives of the integration of this method in our research is to measure the authenticity of the culturally based geological knowledge as reported in a CCM, as well to measure participants' competence and agreement about the CCM.

2.2.2 Selecting Cultural Consultants

As noted above, I employed PRA to collect data during fieldwork. For this study I recruited (see Appendix G) 40 cultural consultants in PR (see figure 5) and 40 in DR (see figure 6), all of whom lived in the regions of karst terrain. As noted above, I employed PRA to collect data in the field. Cultural consultants were recruited by chain referral, better known as snowball sampling, which is a non-probabilistic sampling method (Goodman, 1961), in which existing study participants recruit future candidates from among their own acquaintances. (Thus, the sample group is said to grow like a rolling snowball.) I identified several regions of interest within the karst terrain in the east of DR (purple squares in Figure 5) and within the northern karst belt in PR (blue circles in Figure 6). All locations were visited in the company of and with the guidance of a local cultural expert. Appendix H provides detailed information about participant demographics.

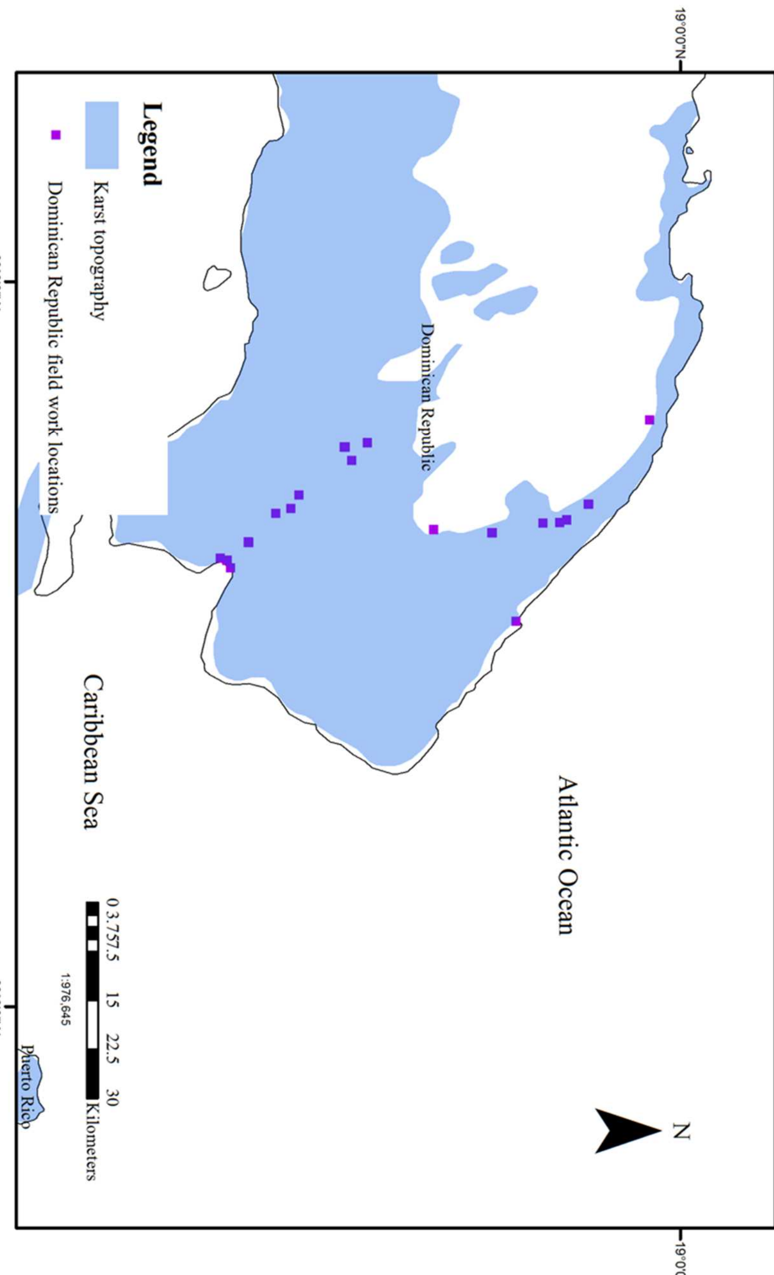

Figure 5: Field locations for ethnogeological interviews in the Dominican Republic. Each point represent could represent one or more locations for interviews. This map cannot be presented with higher resolution based that in some cases the interview density (participants/area) was high in comparison with other locations. The map represents 40 locations.

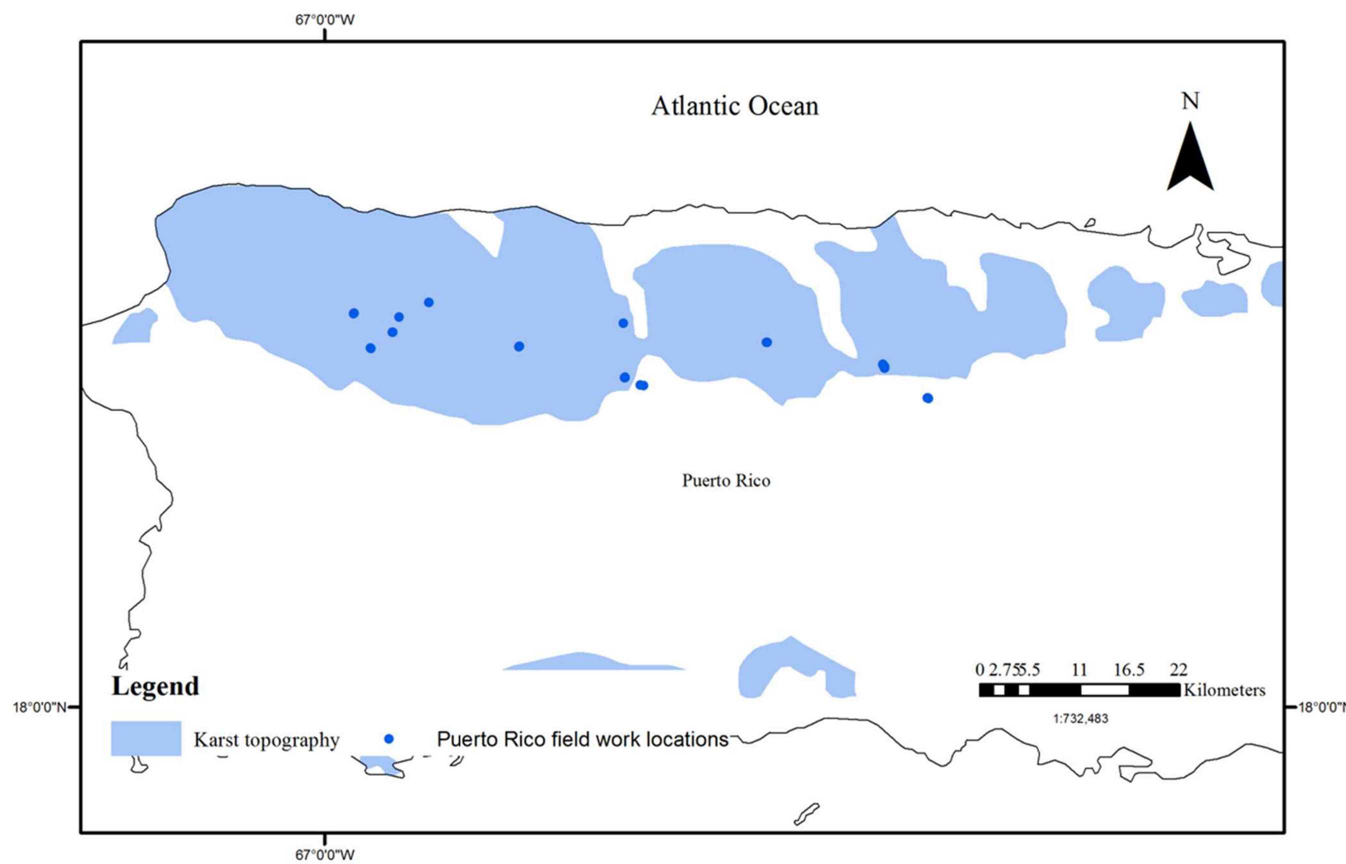

Figure 6: Fieldwork locations for ethnogeological interviews in Puerto Rico.

2.3 Results and Discussion

2.3.1 Cultural Consensus Model

Cultural consensus analysis (see Table 2 below) applied to the questionnaire responses (see Appendix I) for more information about participant's response of the questionnaire) from DR (*n*=40) and PR (*n*=40) shown that the model is satisfied by the following criteria (eigenvalue ratios = 4.6 [DR] and 4.7 [PR], mean competences = 0.55 [DR] and 0.63 [PR], SD = 0.18 [DR] and 0.19 [PR], one negative competence (explained below) in the DR; conducted with UCINET 6, a software package for Windows OS for the analysis of social network data (Borgatti et al., 2002). An unpaired-samples *t-test* applied to competence means in the population of DR and PR results in $p < 0.05$; therefore, the results are statistically significant. More information about the participants competence calculation from the cultural consensus questionnaire can be found in the Appendix J.

Table 2: Cultural Consensus Analysis

Country	Sample size	Questions	Competence†					Demographics			
			Avg.	σ	Variance	Neg.	Ratio of largest	Males	Females	Age avg.	TRP**
DR	40	73	0.55	0.18	0.034	1	4.604	31	9	56	47
PR	40	73	0.63	0.19	0.036	0	4.669	19	21	57	45
DR+PR	80*	N.A§	0.57	0.19	0.037	1	4.938	50	30	56	46

Note: Data is collected in one field season (June-August 2016).
*N is the combination of all participants from Dominican Republic and Puerto Rico.

†Cultural Consensus Analysis was performed with UCINET 6.
§Questionnaire size was the same when population was combined.

**TRP refers to time residing in the same place

Cultural consensus analysis was applied to the combination of both countries DR+PR (*n*=80); the model was satisfied as well (eigenvalue ratio = 4.94, mean competence = 0.6, SD = 0.19, one negative competence). The purpose of combining both countries was to identify possible subgroups of cultural consensus knowledge that may separately exist in each country. The good fit of the CCM suggests that local ethnogeological knowledge about karst is authentic and valid in both DR and PR. The cultural approximation and many similarities in geological features in the karst terrains of DR and PR shows that the indigenous inhabitants have developed similar knowledge across the two countries.

One negative competency was found within the DR sample. This finding does not imply that the one consultant knew "nothing" or was deliberately obstructive when compared with the rest of the participants. Rather, it implies that this participant randomly answered the questions during the structured interview. The responses provided by this participant did not fit with the mathematical model that calculates the probability of guessing in the cultural consensus analysis. However, the average competence for DR and PR consultants suggests that the vast majority know the answers to the questions and their tendency was not to randomly guess. Our results suggest that for every question, consultants were answering based on their personal experiences, in a cultural context, and were attached closely to their environmental reality. Cultural consultants were consistently offering further explanations and description to support their answers. The "answer key" sheet for more information about cultural consultants' knowledge based on their answers as a group is presented in Appendix K. This "key" from the study groups is the foundation of the CCM.

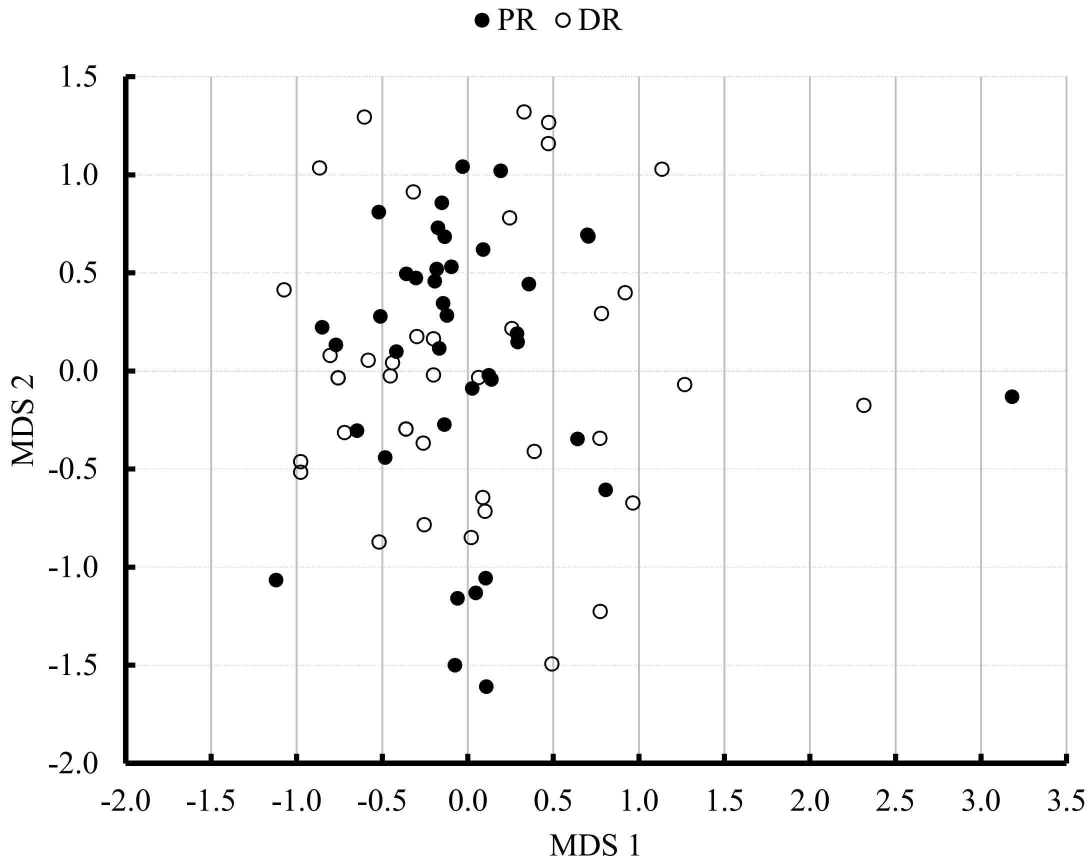

Figure 7: Multidimensional scaling (MDS) of the cultural consultant agreement in DR and PR. Note: DR (n=40) and PR (n=40), stress DR (0.2) and PR (0.1) is in two dimensions. Points closer together in space show more agreement about the CCM in the countries of DR and PR.

Multidimensional scaling (MDS) converts resemblance into proximity, to visualize in a graph the relationship that many parts have in the model (Kruskal, 1964; Kruskal & Wish, 1978). The measurement of the goodness of the model of a given dimensional solution in MDS is referred to as "stress." High values of stress indicate a poor fit (poorly mapped representation of the relationship calculated in the similarity matrix); but on the other hand, a stress value close to zero indicates good fit (see Appendix L for more information). Non-metric multidimensional scaling analysis was performed on the agreement values of DR (*n*=40) and PR (*n*=40) using UCINET 6. I used the default settings of 2 dimensions to represent the values in the Euclidean space. Stress values for agreement (Figure 7) for each sample are respectively 0.2 (DR) and 0.1 (PR). The difference in stress values indicates that the cultural consultants in PR agree more closely than do the consultants in DR. The differences in stress values for agreement could be influenced by the single negative competence that is found in the DR sample.

These results yield a CCM encompassing ethnogeologic knowledge of karst terrain in the two countries of DR and PR. The CCM incorporates metaphor, analogies, stories, and practices (agricultural and ceremonial) to describe key geological processes in karst terrain. The first metaphor that is embedded in the CCM is that rocks are "*alive.*" This metaphor is used by consultants to describe the rock's structure and integrity. Loose rock debris found close to the outcrop rocks is not considered to be "*alive*" in their description. This metaphor was further explored and developed by some cultural consultants to describe relative ages of the fragmentation of the outcrop (mechanical weathering). Cultural consultants mentioned (see the following three examples) that rocks are alive in reference to the structural integrity of the rock that serves as a foundation for structures and roads, as well as the foundation (i.e., the porosity) for organisms that grow attached to rocks.

"Las piedras cuando están vivas son fuertes y seguras para construir con ellas"
"When rocks are alive they are [structurally] secure and strong for construction [as a foundation]"
(Participant CC02, personal communication, July 18, 2016)

“Las piedras cuando están vivas cuando puedes ver cosas creciendo”
“When rocks are alive you can see things (organisms) growing attached to them”
(Participant FW0209, personal communication, August 3, 2016)

“Las piedras cuando están en su entorno están vivas, las sueltas no”
“When rocks are [attached]to their [original] setting they are alive, but those that are loose (fragments) are not”
(Participant FW0207, personal communication, August 4, 2016)

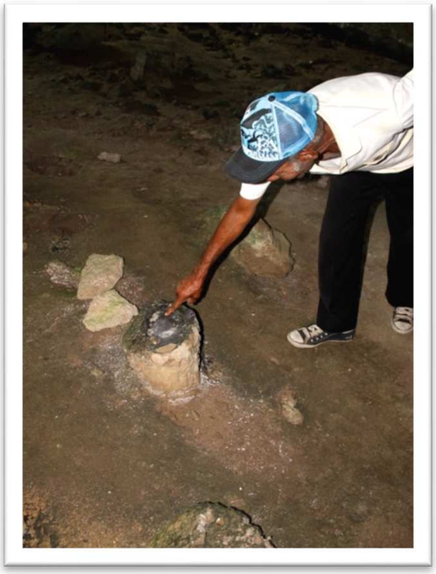

Figure 8: Cultural consultant showing that rocks are able to grow in caves. The consultant is pointing at a stalagmite and how calcite has been deposited from the stalactite.

Figure 9: Cultural consultant showing that rocks are able to "grow" next to rivers. In this image, the consultant is standing next to the "parental rock" (the rock that is was exposed first).

Another metaphor found within the CCM is that rocks are able to "*grow.*" This term is variously used in describing processes of erosion, mechanical weathering, and speleothem formations. In speleothem formations, cultural consultants used the metaphor that rocks "*give birth*" to other rocks. It is important to note that the process of "*growth*" in rocks is applied to different geomorphological scenarios among consultants in DR and PR. I learned that rocks were able to "*grow*" in caves (figure 8), river floodplains (figure 9), beaches, and river floors among other locations. During interpretative tours cultural consultants emphasized that rocks were "*growing*" (at a different rate than other local environmental processes of change) within their gardens, farms, caves, and next to rivers. One consultant emphasized that this kind of knowledge was generational and not exclusive to their own family; it was shared by the community (V. Castillo, personal communication, September 20, 2014). A more detailed and extensive discussion of the knowledge catalogued by the CCM is presented in chapter 3.

2.4 Implications of the Study

A CCM is an instrument that integrates gathered metaphors, oral traditions, and other ways of knowing, in order to construct a model of how the population studied collects and organizes information in respect to a specific domain of knowledge. The construction of the model offers a mathematical view of the agreement and competence of the holders of the shared knowledge, which are indicators of the authenticity of the knowledge. I have found that much of the ethnogeological knowledge shared by the cultural consultants is directly relevant to characterization and conservation of natural resources (e.g., groundwater) and the flora and fauna of the karst-related ecosystem. This knowledge is amenable and appropriate to be further documented and detailed by mainstream methods of surveying, geological mapping, and environmental sampling and analysis. I interpret the results from this CCM to be authentic ethnogeological knowledge that can potentially inform more effective local and regional environmental protection, more sustainable resource use and economic development, and more culturally inclusive place-based formal and informal education for the underserved nations of DR and PR.

2.5 Conclusions

In this chapter I have presented and discussed the PRA methods used to verify and organize the authenticity of the ethnogeological knowledge collected, in the form of a CCM. The field-ethnographic methods used in this study and discussed in this chapter were used for the study of ethnogeologic knowledge of karst terrain that is held by inhabitants of the karst regions of DR and PR. Cultural consensus theory offers a robust means of analysis of ethnogeologic knowledge collected in the field, including an opportunity to characterize the authenticity of that knowledge. I have briefly presented and interpreted part of the CCM in this chapter, but a more detailed discussion of the model is offered in chapter 3.

It is very important to note that this study was not in any way intended to "validate" the Indigenous ethnogeological knowledge in comparison to mainstream geoscientific knowledge, nor to label any ideas or concepts as scientific misconceptions. My intent was to determine the internal consistency, and hence the authenticity, of a particular regional system of ethnogeological knowledge. I choose to take the ethnogeological knowledge that has been statistically validated in the CCM at face value and leave it to curriculum developers and educators to determine how best to integrate it into teaching. I offer this use of Cultural Consensus Theory and PRA as a practical means of collecting, analyzing, organizing, and interpreting ethnogeological knowledge obtained through field ethnography and geology.

CHAPTER 3

KARST ETHNOGEOLOGY IN PUERTO RICO AND THE DOMINICAN REPUBLIC: LOCAL INTERPRETATIONS OF FEATURES AND PROCESSES

Indigenous senses of place, teaching philosophies, and empirical knowledge of surrounding Earth systems (also known as ethnogeology) can be used to enrich geoscience education. Indigenous or historically resident people may perceive local places differently from outside observers trained in the "Western" tradition. Traditional Indigenous knowledge (alternatively referred to as *traditional ecological knowledge* or TEK) exceeds the boundaries of non-Indigenous ideas of physical characteristics of the world, tends to be more holistic, and is culturally framed. Ethnogeological research blends methods from field geology with methods from field ethnography that include participatory observation, free-listing, participatory mapping, and cultural consensus analysis. In this chapter, I discuss in detail different elements of the CCM constructed (see chapter 2) for the ethnogeological knowledge about karst terrain among local Indigenous communities in DR and PR.

3.1 Introduction

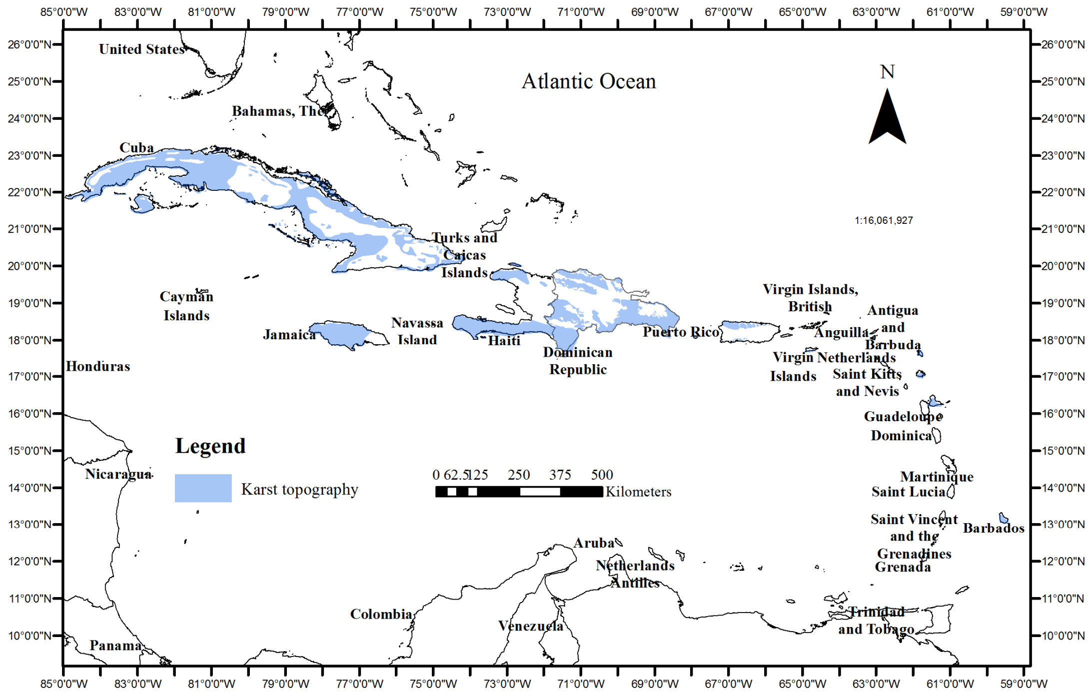

Figure 10: Caribbean Karst. Data modified from French and Schenk (2004) and (Ford & Williams, 1989).

Karst is one of the geological features that have figured prominently in the development of cultural norms and use of natural resources (Day, 2010) in many parts of the Caribbean. Karst terrain, largely formed by dissolution of limestone, comprises a vast portion (130,000 km^2; Day, 1993) of the surface geology in the Caribbean (Figure 10). Approximately 90% is located in the Greater Antilles, which include DR and PR. In DR and PR karst topography constitutes a considerable portion of the freshwater aquifer, the home for the mature forests (Kelly et al. 1988), and coastal wetlands. Indigenous families residing in the northern Caribbean for millennia have accrued rich empirical knowledge about cave processes and uses (e.g., Krieger, 1929, 1931; Lovén, 1935; Pagán-Perdomo &

Jiménez-Lambertus, 1983; Maggiolo et al. 1977; Pané, 1999) that have been transferred across generations. In the countries of PR and DR many Indigenous or historic inhabitants of the karst regions, including *Taíno* and descendents of the people of the African diaspora, consider these regions to be their traditional homelands and continue to use traditional local knowledge. Many conceptual models, terms, metaphors, and ideas are implemented about natural phenomena to explain karst landscapes and processes are still embedded in cultural knowledge and practices. Part of this relationship includes karst features that are embedded in creation stories, ceremonial locations and practices, artistic expressions, family stories, oral tradition, and place-names (Alvarez Nazario, 1972; Dominguez-Cristobal, 1989, 1992, 2007; Stevens-Arroyo, 1988; Pané, 1999).

> "There is province in the Hispaniola called *Caonao*[5] in which has two caves. The name of one of these is *Cacibajagua*, and *Amayaúna* the other. The majority of the people who populated the island came from *Cacibajagua*…" (Pané, 1999)

Knowledge of karst features and processes in Caribbean Indigenous communities has accrued from empirical observations and regular use. For generations, caves have been known as places of refuge in the event of *temporales* (storms in general), *baguadas* (oceanic storms), and *huracanes* (hurricanes).

Indigenous senses of place, teaching philosophies, and knowledge of the natural world (including ethnogeology) are increasingly used to enrich geoscience education, particularly for underrepresented minority students (e.g., Stephens, 2001; Riggs, 2005; Semken, 2005; Gibson & Puniwai, 2006; Palmer et al., 2009; Miele & Powell, 2010; Apple et al., 2014). We observe in these examples how students are able to integrate and share

[5] Region with abundance of gold.

their common cultural heritage with mainstream scientific ideas and theories for effective learning. In other words, place-based education can target specific scientific concepts with the thoughtful integration of folk knowledge, history, geology, geography, and language. Place-based, culturally relevant education serves as a “bridge” between underrepresented students and degrees and careers in geoscience (e.g., Semken, 2005) and other natural and environmental sciences. Hence, this study was motivated by a need for more local ethnogeological knowledge to propel wider use of place-based education in DR and PR.

As established in the previous chapter, I have analyzed the data collected using cultural consensus analysis. I found that the cultural consensus model is satisfied by the agreement and competence parameters (see section 2.3.1 in the previous chapter for a detailed discussion). In this chapter, I discuss in detail the elements of the CCM that is was developed as a result of field ethnographic work in the countries of DR and PR.

3.2 Key elements of ethnogeologic knowledge of karst in DR and PR

From the CCM I have identified five primary conceptual key elements (CKE), which are ideas that cultural consultants used to describe geological processes inside of caves and in adjoining riverine areas within the karst regions. These CKE were the most frequent metaphors first uncovered by using informal questionnaires, confirmed using a cultural consensus questionnaire, and analyzed by cultural consensus analysis that resulted in the CCM. Metaphors implemented by cultural consultants were used to describe different geologic processes, and the existing individual and communal relationships with such locations that frame the knowledge. The primary CKE identified in this study in two sections A: caves and B: rivers (Table 3) are: (A1) that rocks are "alive," (A2) that rocks "give birth to other rocks", (A3) that caves are "alive," B1) that rocks "grow" (a process observed in river floodplains), and B2) rocks are able to give “birth” to other rocks.

Table 3: Metaphors Used by Participants to Describe Geological Processes

Conceptual key elements	Locations	Processes	Explanation	Metaphors in context
Las piedras están vivas (rocks are alive)	Caves	Dissolution and deposition	Rocks are *alive* when dissolution is active (rates changes with climate patterns)	"The stalactite is alive because it has a drop constantly dripping"
Las piedras paren (rocks give birth to rocks)	Caves	Speleothem formation	Rocks give *birth* when chemical deposition is observable (variety of formation of speleothems)	"The cave breasts (stalactites) are feeding the newborns (stalagmites)"
Las cuevas están vivas (caves are alive)	Caves	Active chemical deposition, drainage, sediment deposition and erosion	Describing the *healthiness* (active dissolution, healthy ecology, constant erosion, drainage)	"This cave is alive because it talks"
Las piedras crecen (rocks grow)	River floodplains	Soil and sediment erosion	Buried rocks are able to *grow* when sediment is eroded.	"These rocks grow every time that we have heavy rain"
Las piedras paren (rocks give birth to rocks)	River sediments (gravel +)	Mechanical weathering	Rocks give *birth* when clasts collide, increasing in number and surface.	"When rocks get against each other, the number of rocks start increasing"

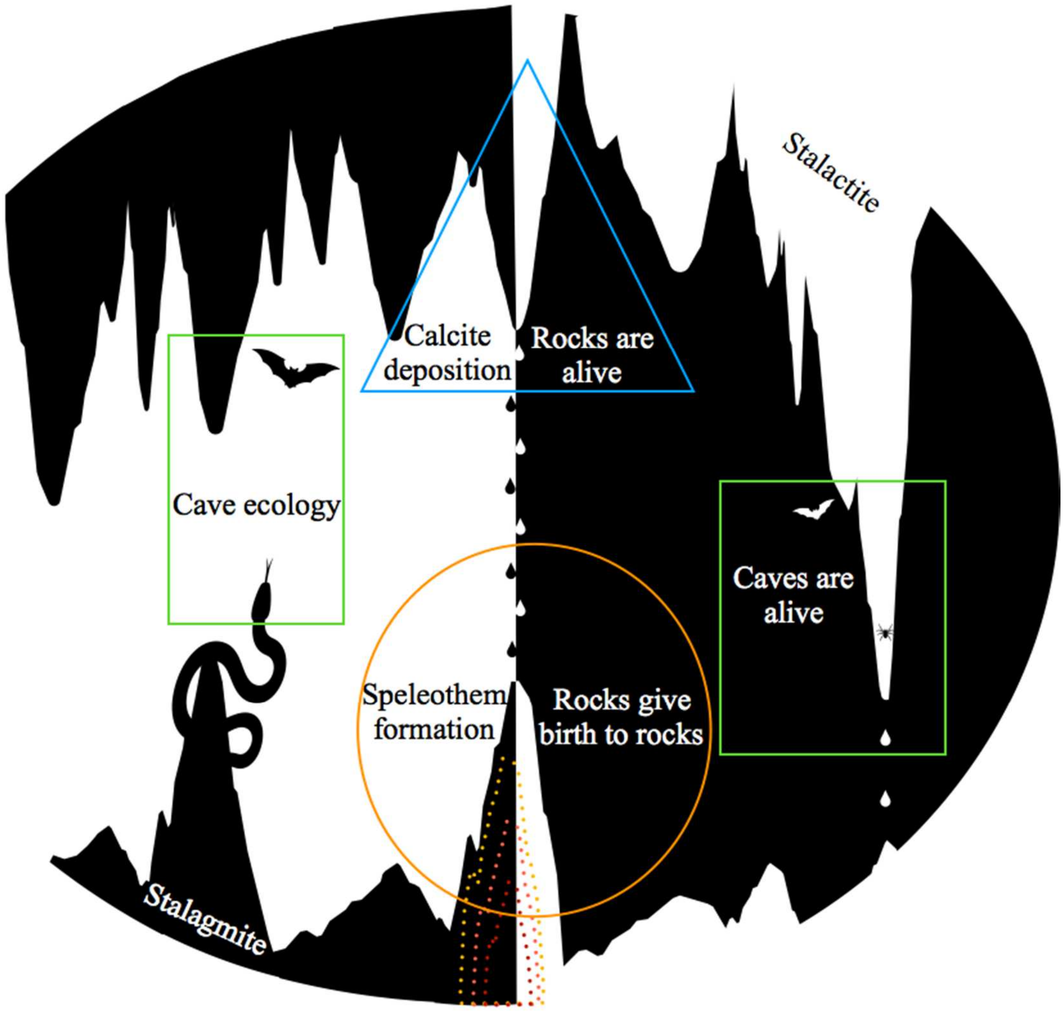

Figure 11: Metaphors that cultural consultants used to describe processes that happen inside of caves. The CKE within the triangle is used as analog to talk about dissolution of limestone among other processes, the squares refer to cave inventory, and the circle to speleothem (specially stalagmite) formation in caves. Below the circle, dotted lines colored in red, orange, and yellow represent the timescale in the process of speleothem formation.

Figure 11 is a visual representation of the CKE that were commonly used by the cultural consultants to describe processes inside of caves. The figure resembles a cave that is divided in two, with equivalent speleothems, organisms, and processes shown variously in black or white. The diagram compares mainstream speleological terms on the left with metaphors from Indigenous ethnogeology from DR and PR on the right. One of the metaphors found in the CCM is that "*rocks are alive*", organized in the blue triangle. Consultants often started tours inside the caves making the statement that caves are dynamic and in constant change (in comparison with other environments) and what we observe about caves in the present it is not what their ancestors (referring to pre-Columbian inhabitants of the regions) nor future generations will observe. In other words, that some processes that happen inside of caves are representing a snapshot in geologic time.

The metaphor that "*rocks are alive"* aligned directly with a set of processes related to speleothem formation such as dissolution of limestone, rate of dissolution, deposition of calcite, and formation of stalactites (among other speleothems). Consultants mentioned that they had observed events when rocks in caves are more "*alive*" and less "*alive*" in other periods of time. This metaphor talks directly to considerable events of dry and rainy seasons in DR and PR. In addition, this metaphor alludes to observable changes in pattern of caves drainage. In the eastern DR, many participants shared their experience that when storms with heavy rains occurred, maintaining a clean cave free of debris and garbage was one of the main reasons why flooding was not more severe in the community. In addition, consultants were able to describe observable differences in the rate of dissolution and deposition of calcium carbonate (in the form of calcite) by combining observations from different individuals within the community about rates in the precipitation of "milky" drops from stalactites into the cave floor. The observation that "*rocks are alive"* has a foundation that the "*milky* drop" at the bottom of stalactites has the capacity to (1) create new forms of structures in caves and (2) effectively exchange material from one part of the cave to another. There is no evidence that consultants have observed stalagmites and stalactites connecting to form columns, but they find “clues” or evidence to support their ideas by comparing and observing different examples of material exchange between speleothems at the different parts of the cave.

The circle shape in figure 11 encapsulates the metaphor that “*rocks give birth to other rocks.”* This metaphor refers to the process of stalagmite formation, growing, and to the consistency in depositional conditions that the bottom of the cave requires for stalagmite formation. I have collected and transcribed a culturally important metaphor that describes the relationship that stalactites and stalagmites have for the consultants in this study. Consultants mentioned that caves are similar to “motherhood entities” that have many changes inside of them (referring to female bodies) and they are able to give birth to other rocks (referring to ability of reproduction). In this metaphor, the “mother” is the cave, the “newborn” is the stalagmite, and the method to feed the newborn is breastfeeding (stalactite) with milk referring to the chemical deposition of calcite.

Lastly, I found a third metaphor in the CCM about cave processes: “*caves are alive*” (green boxes in Figure 11). In this metaphor, consultants distinguished two types of caves: (1) those that are *alive* and (2) those that are *not alive* (but not in the sense of death). Here, the observation and interpretation framed in the metaphorical form that caves are alive relies heavily on aural and vision modes of information gathering. These modes of observation are different in comparison with previous CKE that were mostly visual. It is the norm among consultants to share that their observations are accompanied with evidence in the form of oral history (among others) that other members of the community, in different time spans, have made before them. In this metaphor, consultants say that it is useful to use these two modes of information gathering in order to make more accurate assessment of the "healthiness" of the caves, referring to the holistic observation of abiotic processes and the ecological conditions inside caves. Many consultants offered tours in parts of the caves where sunlight could not reach. In that scenario, tour givers practiced an inventory processes that relied on an aural mode of information gathering. They identified sounds coming from inside the cave such as water dropping (and its rate of precipitation), water flowing noise levels, rocks falling, bats and swallows flapping wings among other organisms and sounds of geological and biological activity. By practicing this type of cave assessment, consultants were able to describe recent cave history (flooding, minor earthquakes, new passage openings) and other changes that the location and surrounding had undergone in recent years.

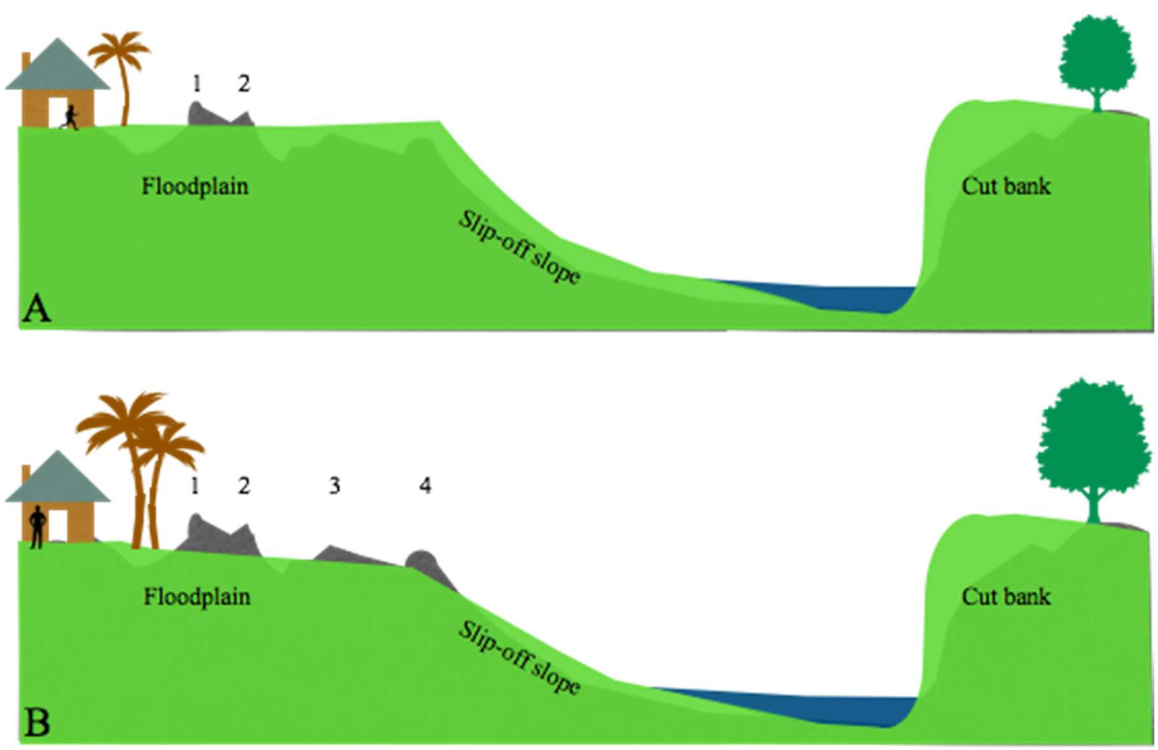

Figure 12: Rocks are able to "grow" from the ground. This metaphor is used to describe a relative growing of numbers of rocks using the land of the reference point.

I identified in the CCM two more metaphors used to describe weathering and erosion in floodplains and river channel. The process of erosion is described by the metaphor that rocks are able to "*grow*" (see figure 12). Many of the consultants interviewed for this study explained that this process of "*growth*" happens often in floodplains. In this case the metaphor is not directly related to a process that happens to a rock, but refers to a geomorphic process, such as erosion and mechanical weathering, observable in rivers. "Rocks are able to *grow*" is a metaphor used to describe the apparent increase in size of rocks that is related to rock exhumation by heavy rains, describing changes in terrain from the reference point between terrain and exposed bedrock. In the figure 12-part A, consultants often offered stories from young age of observing fewer rocks flourishing in the premises of their properties. Upon reaching late adulthood, figure 12-part B, they observed that the rocks had increased in number and sizes as well. In some cases, consultants argued between themselves how fast are rocks were "*growing*" in their backyards, but they found consensus that significant changes have been happening through their life span. The apparent rate of "*growing*" could be associated with the locations of the observations, different reaches of the river (upstream versus downstream) and its distance from areas of development (river channelization, urban development, sewage, etc.). In the same riverine areas, I identified another metaphor that is used to discuss weathering by river currents.

For this chapter I discussed just 5 CKE as I understand that the rest of the 73 questions that makes the CCM will reinforce these particular ideas and concepts. For a more detailed version of the CCM, please see Appendix J. By using participant observation during field ethnographic work, I collected other forms geological interpretations that included metaphors, analogies, as well personal experiences that were related to karst ethnogeology that they not became part of the questionnaire nor of the CCM, as well other information related to environmental conditions and observations about their surroundings (see Appendix C). As I developed more field ethnographic work, I was able to observe adaptations of the CKE to different processes that differ to some of the elements of the CCM. One example is the adaptation of rocks "give birth to other rocks". Consultants used the metaphor that rocks "*give birth to other rocks*" to explain the observed abrasion and fragmentation of rocks in river currents, increasing rocks in number and surface area, while decreasing their size.

3.3 Conclusions

I have found that among Indigenous and historic (*Taíno* and *campesino*) inhabitants of the karst regions of DR and PR, there is a consistent system of ethnogeological knowledge about cave and karst processes. Cultural consultants' observations of karst processes and their interpretations were culturally framed in a well-known system of references that are locally (geographically) situated and authentic to the population studied. It is important to note that these observations were collected using scientific methods of ethnography, in which observers can consult, replicate, compare, and even argue with other observers about their findings. It should also be noted that mainstream science education uses its own metaphors to facilitate understanding of complex, time-integrated natural phenomena by non-experts (e.g., *ocean currents work as conveyor belts of global* *temperature*). This difference in the system of reference provides to the community the understanding of their natural world in their own terms.

This work has the potential to inform formal place-based Earth and environmental science curricula in Puerto Rico (and possibly also in the Dominican Republic) at the pre-college and introductory undergraduate levels to help local students better grasp cave and karst processes and their relationship to local and regional resilience and sustainability. In Puerto Rico, as in other parts of the United States, science curriculum reform is informed by the Next Generation Science Standards or *NGSS* (NGSS Lead States, 2013). As the NGSS were intentionally written to be flexible enough to allow for multicultural, place-based, and locally contextualized science teaching (Semken et al., 2017), the results of this study can be used to inform more effective pedagogy for Puerto Rican schools and students.

It is hoped that this study will contribute to further curriculum reform in geosciences, as well in other physical sciences, by informing teaching and research practices that are more inclusive, diverse, and culturally sensitive, particularly for Puerto Rico and other parts of the Caribbean. Further, our findings also offer potential to improve interpretive programs that promote public literacy about caves and karst. It is understood that this CCM is a small part of a much greater system of local and regional ethnogeologic knowledge related to karst and to other aspects of Caribbean geology and physiography.

CHAPTER 4

THE IDENTIFICATION OF POSSIBLE VARIABLES THAT INFLUENCE CULTURAL CONSULTANT'S COMPETENCE

This ethnogeological research project blends methods from field geology such as cave surveying with methods and strategies from field ethnography that include participatory observation, grand-tours, and free-listing, leading to the construction of the CCM that encompasses the ethnogeological knowledge obtained in this study. For this chapter, I consider possible statistical or practical relationships between participant's age and time residing in the location of the interview and the competence calculated in the CCM. To test for statistically significant correlations, I applied single and multiple linear regression analysis to the data collected during fieldwork in DR and PR. Results from cultural consensus analysis suggest a good fit for the CCM about geological processes among culturally expert consultants in DR and PR, as well as a competence average with scores around 0.6 in both cases. Single and multiple linear regression analysis yielded no statistically significant correlations for PR participants among the following elements: competence, participant's age, and time residing in the location of the interview.in the country of Puerto Rico. For participants in the DR, I find a significant correlation between competence and age of participants, but when the data were revised for the purpose of understanding their practical significance (i.e., the application in real life), the results suggest no significance.

4.1 Introduction

Data from this study were collected, analyzed, and interpreted to answer the following ethnogeological questions, introduced in Chapter 1 above: (1) what methods are suitable for the collection and organization of ethnogeological knowledge? (2) what elements of ethnogeological knowledge related to karst in Puerto Rico and Dominican Republic can be identified? and (3) how authentic is the ethnogeologic knowledge collected? All three questions were tested and answered by work reported in the previous chapters. In this chapter, I apply statistics to explore possible correlations between elements such as CCM's competence, age of the participant/cultural consultant, and the time residing in the same location of the interview. I used the methods of single and multiple linear regression to analyze the data in order to find any existing statistical significance.

I focus here on any possible patterns in the information collected during field ethnographic work that might explain the differences between competence among the participants. Such information could prove useful for selection of cultural consultants in future ethnogeologic research. My initial hypothesis was that a participant's age and time residing at the location of the interview predicts the competence of that participant; for example, the older the participant, the more competent they will be about a domain of knowledge. Besides age, history of contact with or proximity to examples of the domain of knowledge (i.e., time residing in the location of the interview), in this case caves and rivers, might also prove a significant predictor of competence. Cultural consensus questionnaire interviews were done purposely close to riverine areas and cave sites. One of the purposes was to provoke tours (using grand-tour questions) as well to probe other knowledge in the form of participant observation that could be related to the proximity of the participant to these environments. Here, I used multiple linear regression analysis to observe any influence that the variables (1) participant's age and (2) participant's time residing in the location of the interview could have over the participant's competence (as the constant). This statistical analysis provides the opportunity to identify possible suppressor or suppressive variables. In multiple regression analysis suppressor variables are considered as variables that substantially enhance the prediction through the addition of a variable that is uncorrelated with the criterion but is related to another possible predictor (Thompson & Levine, 1997).

Once I have identified a variable that could act as a suppressor, I applied single linear regression analysis with the intent to: (1) enhance the prediction with the unsuppressor variable and competence, and (2) compare existing changes in statistical significance. In this chapter, I use the term *practical significance* to signify whether statistical significance is great enough to be of value in a practical sense (Gall, 2001).

4.2 Descriptive statistics

Data collected for the cultural consensus questionnaire include 73 questions (analyzed and discussed in Chapter 2 with further examples discussed in Chapter 3), competences from the CCM, ages of the participants, and times residing in the location of the interview. Using these data, I constructed three different histograms that report the distribution of cultural consultant's competences, ages of the participant, and times residing in the location of the interview (see figures 13-18).

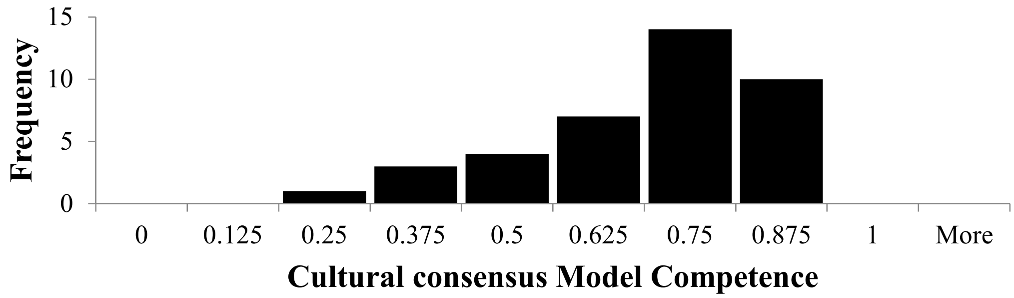

Figure 13: Competence frequency among participants in Puerto Rico.

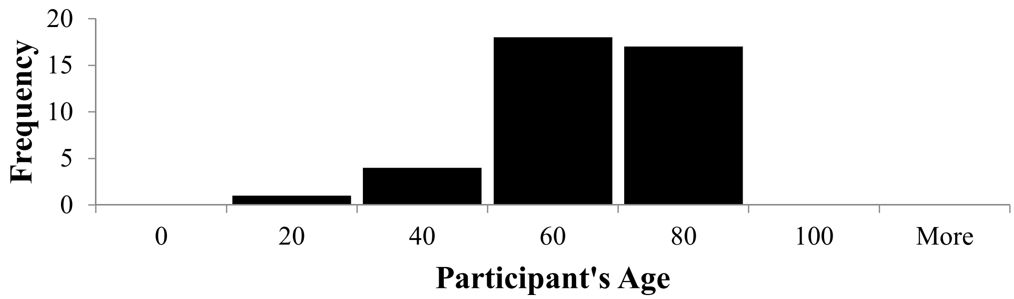

Figure 14: Age frequency among participants in Puerto Rico.

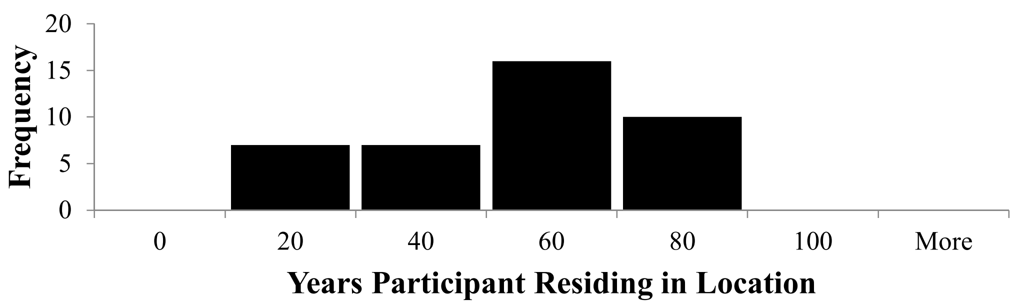

Figure 15: Frequency of years in where the participant was residing in the same location of the interview in the country of Puerto Rico.

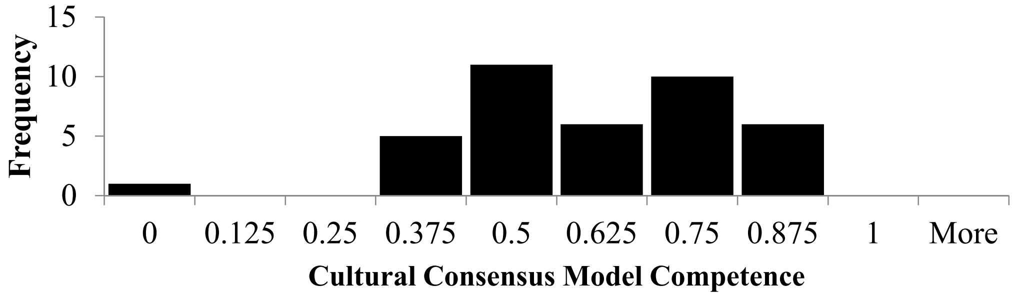

Figure 16: Competence frequency among participants in the Dominican Republic.

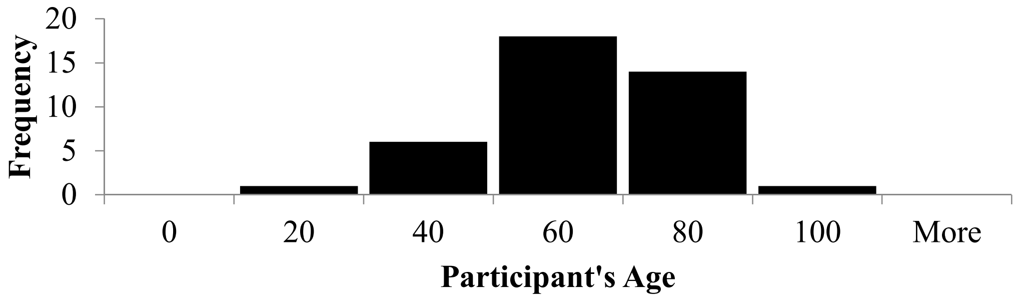

Figure 17: Age frequency among participants in the Dominican Republic.

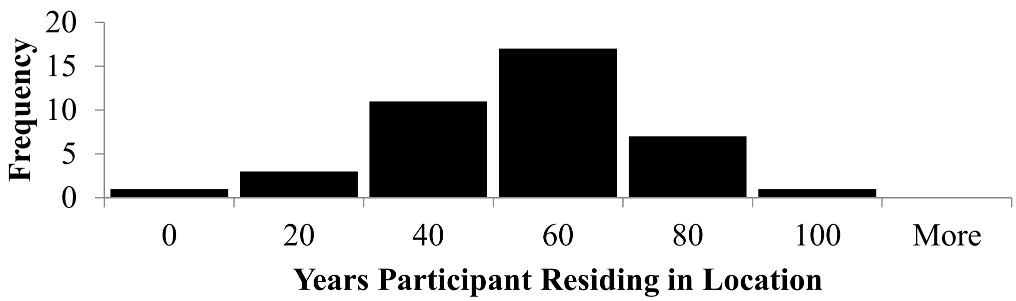

Figure 18: Frequency of years in where the participant was residing in the same location of the interview in the country of Dominican Republic.

The distribution of the competence scores in PR is left-skewed (see figure 13), while in the DR the trend is to be distributed in a binomial form (figure 16). In the competence histogram I observe more frequency in competence around 0.75-0.875 among participants in PR with a mean value of 0.628 and a standard deviation of 0.193. In the DR, I observe high frequency in competence around 0.5 and 0.75 with the mean value of 0.534 and a standard deviation of 0.201. In both countries, I found that the CCM about karst ethnogeology met the parameters and can be used as a model. I found one negative competence among DR participants and no negative competence in PR.

In order to analyze any existing correlation among competence in both countries with the age of the cultural participant and their time residing in the location of the interview, I have constructed histograms with such values to understand their distribution. In this study we have participants with ages ranging from 19 years (above the age permitted by ASU's Institutional Review Board standards; see Appendix M for more information) to 98 years. In PR, I found that the average participant's age is 57 years old (see figure 14) and the time residing in the same location of the interview with an average of 45 years with SD of 15 years (higher frequency in the 60 years bin; see figure 15) in comparison with participants from the DR that has a mean age of 56 with SD of 19 years (see figure 17) and time residing in the location of the interview of 47 years with a higher frequency in the 60 years old bin (see figure 18).

4.3 Regression analyses

For PR participants, I observed that the multiple and linear regression analysis in each of the instances yielded a *p-val*ue > 0.05, indicating no significance. In the multiple regression analysis, I put the following variables into the model: competence (as the constant), participant's age (variable 1), and the participant's TRiLI (variable 2; see table

4 for a summary of the results). In the analysis I identified TRiLI as a suppressive variable. In my preliminary hypothesis, I anticipated that age in combination with the time residing in the same location of the interview were variables that were strongly associated with the participant's competence in the CCM. When I eliminated the second variable to test the significance between the constant (competence) and the primary variable (participant's age), the model improved (see table 5) but I did not find the results to be statistically significant.

Table 4: Multiple Linear Regression Analysis on the variables participant's age, time residing in the location of the interview using as a constant participant's competence among participants in PR. Predictors for this analysis are competence (constant), age (variable 1), and time residing in the location of the interview (TRiLI, variable 2).

Model Summary

Model	R	R square	Adjusted R square	Std. Error of the Estimate
	0.156	0.024	-0.028	0.19539

ANOVA

Model	Sum of squares	df	Mean Square	F	Sig.
Regression	0.035	2	0.018	0.461	0.634
Residual	1.413	37	0.038		
Total	1.448	39			

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
Competence	0.738	0.127		5.813	0
Age	-0.003	0.003	-0.206	-0.943	0.352
TRiLI	0.001	0.002	0.108	0.495	0.623

Table 5: Single Linear Regression Analysis on the variables competence and age among participants in PR. For this analysis I did not selected time residing in the location of the interview as it was identified as a suppressible variable in the analysis.

Model Summary

Model	R	R square	Adjusted R square	Std. Error of the Estimate
	0.134	0.018	-0.008	0.19345

ANOVA

Model	Sum of squares	df	Mean Square	F	Sig.
Regression	0.026	1	0.206	0.69	0.411
Residual	1.422	38	0.037		
Total	1.448	39			

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
Competence	0.728	0.124		5.87	0
Age	-0.002	0.002	-0.134	-0.831	0.411

Table 6: Multiple Linear Regression Analysis on the variables participant's age, time residing in the location of the interview using as a constant participant's competence among participants in DR. Predictors for this analysis are competence (constant), age (variable 1), and time residing in the location of the interview (TRiLI, variable 2).

Model Summary

Model	R	R square	Adjusted R square	Std. Error of the Estimate
	0.383	0.147	0.101	0.19081

ANOVA

Model	Sum of squares	df	Mean Square	F	Sig.
Regression	0.232	2	0.116		
Residual	1.347	37	0.036	3.187	0.53
Total	1.579	39			

Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
Competence	0.323	0.093		3.466	0.001
Age	0.005	0.002	0.511	2.184	0.035
TRiLI	-0.002	0.002	-0.196	-0.839	0.407

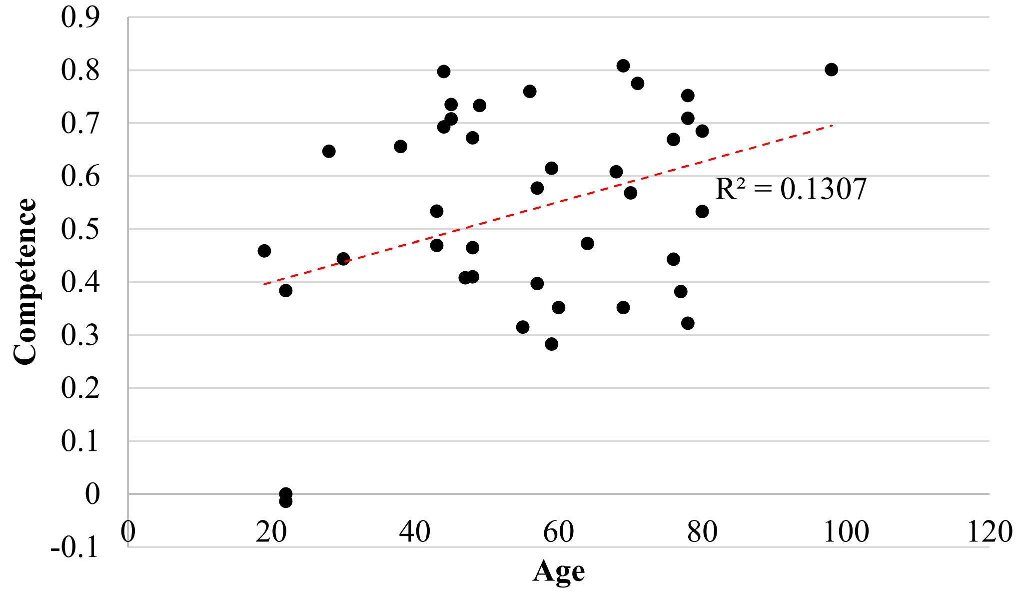

Figure 19: Linear regression analysis between CCM's competence and participant's age in DR. Regression statistics summary output: Multiple R 0.36155692, R^2 0.130723407, Adjusted R^2 0.107847707, Std. error 0.190061043, Coefficient 0.003, Observations 40.

I approached the data from DR in the same way as with those from PR. I used linear regression analysis to understand any coefficient significance using the same constant and variables. Multiple linear regression was applied to data computed in the cultural consensus analysis, and data collected during fieldwork. Similar to the case of PR, results from the analysis suggest that time residing in the location of the interview can be interpreted as a suppressive variable. After it was removed, I found that the significance coefficient improved, suggesting a statistical significance with a *p-val*ue < 0.05 (see figure 19). As I scrutinize the results, I found that even if we found there was statistical significance between participant's competence and their respective age, the practical significance suggests otherwise. These results just imply that the trend is positive (not flat), but as I observe the data there is no apparent trend of the results. Data are randomly scattered with no possible way to predict that competence values will increase or decrease based on the age of the participant. As in many statistical analyses that involve human behavior, I observed value for R^2 values with a $p\text{-}value<0.05$ suggesting statistical significance. Humans are simply harder to predict than physical processes in nature. For this reason, I posit the null hypothesis.

4.4 Conclusions

I did not find statistical or practical significance in any of the multiple and single linear regression analyses using participant's competence scores as a constant, and age and time residing in the location of the interview as the variables that I thought serve as predictors of a participant's competence in the CCM. Clearly, we are still distant from identifying any significant relationship among cultural consultant's competence, and other variables such as age, distance of a participant's residence to the geological features studied, and a participant's time residing in the location of the interview. Since the assumptions of the distribution of the folk knowledge among the "drawers" does not involve time (neither age nor residence time), finding predictors of competence could be exceedingly complex to decipher. Since the knowledge is not exclusive to parts of the community, no community member is restricted from contributing to or gathering from the body of knowledge, it is not erroneous to conclude that time does not directly affect individual competences in a model the community together develops in a specific domain of knowledge such as karst ethnogeology. Future ethnogeological research could be directed toward a more thorough search for factors that could predict competence, leading toward more robust cultural competence models for folk explanations of geological features and processes.

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CHAPTER 5

SUMMARY

I introduced ethnogeology, Indigenous or traditional knowledge (also known as TEK), and Cultural Consensus Models (CCM) in Chapter 1 and connected the topics of field-ethnographic methods to collect and interpret ethnogeological knowledge (Chapter 2), knowledge elements of karst ethnogeology in Puerto Rico and Dominican Republic (Chapter 3), and statistical tests for correlation among salient elements of the CCM (Chapter 4). In Chapter 4, I briefly state the main conclusions of those three chapters.

In Chapter 2, I discussed the use of CCM for the characterization of culturally based interpretations of geological processes by applying field ethnographic work in the form of PRA. My field study area is in the karst region of Dominican Republic (DR) and Puerto Rico (PR). I characterized and reviewed ethnogeological knowledge related to karst, in its majority, among Indigenous communities located in the karst regions in DR and PR. My results define a CCM for the knowledge domain of ethnogeology of caves, karst, and riverine geomorphology that is shared by inhabitants in DR and PR. Cultural consensus analysis applied to questionnaire responses from DR and PR showed that the model was satisfied and there is an acceptably low possibility ($p < 0.05$) of observing significant difference even if the competence means of the two populations were identical.

In Chapter 3, I presented the knowledge encapsulated in the CCM, which indicates that Indigenous inhabitants of the karst regions of PR and DR have a common system of ethnogeological knowledge about cave and karst processes and fluvial geomorphology. Cultural consultants' observations of karst processes and their interpretations were culturally framed in a well-known system of references that are localized and authentic to the population studied. This "proof-of-concept" study is proposed to further discussion in geosciences about using different ways of knowing to inform Earth-science teaching and research practices to render them more inclusive, diverse, and culturally sensitive, particularly in regard to the local populations in DR and PR.

In chapter 4, I analyzed possible predictors of competence among the participants by using multiple and single linear regression to characterize any existing statistical significance between participant's competence about the CCM, with their age or with their time residing in the location of the interview. I did not find any statistical significance in any of the linear regression analyses among participant's competence scores, age, and time residing in the location of the interview in PR. Further, I did not obtain statistical significance from the single linear regression analysis to participant's competence and time residing in the DR. I found that in the DR, although participant's competence and age correlated significantly, the practical significance indicated that the statistical significance had no actual meaning in the data.

This dissertation was highly motivated by the underrepresentation of Hispanics/Latinxs and Native Americans in geosciences classrooms and careers. As a doctoral student, I had the opportunity to develop this study accordingly with my research interest in karst geology, as well with my personal background as an Indigenous Caribbean person. I believe that this works, when taken as a whole, and demonstrates that (1) scientific research can be performed with the collaboration of Indigenous communities and (2) their unique knowledge is worthy of further ethnogeologic study. As such, I hope that this work encourages a closer partnership between researchers and Indigenous communities, not only in the Caribbean, but with other Indigenous communities around the world, to enhance both geoscientific research and geoscience education.

5.1 Future Directions for Ethnogeologic Research

At the beginning of this research, my committee and I had this burning question about whether ethnogeological knowledge obtained from multiple consultants could be considered "authentic" and appropriate to inform locally situated pedagogy such as place-based education and teaching practices in the Caribbean. During this process I have found that CCM was a valid method to catalog and organize authentic knowledge in a way that can be used to inform formal ways of education. Further, CCM affords the opportunity to understand the consensus about a place, either through feelings or attachments, or the ideas centered on that area and its natural processes.

As a follower and ethnogeological practitioner, I think future work will best be aimed at selecting one culture for study, not just to develop better rapport with the community, but also to overcome some of the limitations of CCM. As I learned during this study, four years performing field ethnographic research are not sufficient to construct a more substantial model with multiple levels of CKE and knowledge from many diverse environments or geological phenomena. I consider myself fortunate that I had an established rapport with a few communities in Puerto Rico, and that my field assistant had a close relationship among some communities in the Dominican Republic.

Fieldwork should be done over much longer periods than 10 to 14 days. Based on my experience, fieldwork should be carried out intensively with a duration of at least 6 months. This experience should not be done in a "daily fieldwork" style; instead, the researcher should seek the opportunity to reside and experience what the members of the community studied consider "normal life". These recommendations are based on my experience that trying to "connect" with a consultant in a matter of minutes is challenging for both sides. Researchers are often seen as outsiders who are only interested in collecting the local knowledge to share with other outsiders and misappropriate what in many cases is considered the most important resource of the community for its value to sustainability, as well its sentimental value.

Ethnogeological research takes time. First, knowledge (in any domain) has to be collected to construct the cultural consensus questionnaire. Cultural consensus analysis does not allow the researcher to keep adding more elements to the questionnaire, so data relating to knowledge in different domains cannot be analyzed using CCA. This became problematic for me, in that I derived five CKE from analysis of the questionnaire and construction of the CCM, but from my fieldwork I found far more knowledge of interest that I could not discuss as results because they were not part of the CCM, or in some cases were not appropriate for our study. Overcoming some of these limitations with longer periods of research will allow construction of a more robust CCM with multiple elements related to local geology (e.g., igneous rocks, karst, geomorphology, etc.).

Place-based education curriculum development should be integrated in part of the research design process. It seems that ethnogeologic studies do not always gather enough data to inform place-based curricula. This could be alleviated by integrating pedagogic questions in the initial research design. It will serve a way to organize new knowledge with the purpose to inform the curricula, as a type of backward design. By incorporating a theory of place more explicitly, as it is defined in cultural geography or environmental psychology, it may be possible to reveal other useful elements of ethnogeology.

Finally, CCM will provide competence scores and agreement, but its calculation cannot distinguish between estimates of knowledge and actual knowledge, in part because the model cannot distinguish between luck and expertise (Hruschka & Maupin, 2013). In some cases, we observe that unfamiliar domains of knowledge could prompt more guessing instead of informed responses from consultants in the community studied. For this study I chose to further investigate what I thought was a common domain of knowledge among the cultural consultants.

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APPENDIX A

SCRIPT FOR DATA COLLECTION THROUGH FREE-LISTING

This is the Spanish version of the free-listing interview administered in Puerto Rico and Dominican Republic.

Fecha: Coordenadas de GPS:

Información que necesitamos para el estudio. Por favor, entienda que no se le pedirá numero de identificación, nombre o dirección.

Edad: Lugar de nacimiento:

Sexo (genero): ☐Masculino ☐Femenino

¿En que país usted nació?

¿Cuantos años lleva viviendo en este lugar?

¿Cuál es su ocupación actual?

En los próximos 11 artículos se le pedirá la elaboración de listas sobre objetos o conceptos que pueda recordar. Estas listas no pueden ser elaboradas con la ayuda de recursos externos tales como libros, computadoras o llamadas telefónicas. Todo individuo parte de este estudio debe realizar este ejercicio a solas con el investigador.

1. Escriba todos los usos que se le puedan dar a una piedra que pueda recordar.
2. Escriba todos los colores de piedras que recuerde que están cerca de aquí.
3. Nombra todas las montañas que conozcas.
4. Nombra todos los lugares en donde se puede encontrar agua que usted conozca cerca de aquí.
5. Nombra todos los nombres de los ríos que conozcas

6. Nombra todas las playas que conozcas
7. Nombra todas las cuevas que conozcas
8. Escriba todos los usos que una cueva tiene que pueda recordar.
9. Menciona el nombre de los países que están cerca de aquí.

This is the English version of the free-listing interview administered in Puerto Rico and Dominican Republic.

In the 11 following items we ask you to elaborate list of objects or concepts that you could possibly remember. Lists cannot be elaborated with the help of any outside sources such as books, computers, or phone calls as an example. Each participant should elaborate each asked list by only accompanied by the investigator.

1. Write down as many uses that rocks have as you think of.
2. Write down as many colors of rock as you think of.
3. Name all the mountains that you know.
4. Name all the places in where we can find water that you know.
5. Name all the rivers that you know.
6. Name all the beaches that you know.
7. Name all the caves that know.
8. Write down as many uses that a cave has that you think of.
9. Write down as many names of towns in your country as you think of.

APPENDIX B

SCRIPT FOR GRAND-TOURS

1. Could you show me around and describe me the places that are more important to you?
    a. Why are these places important to you?
2. Do you know any stories that happened in this place or a place similar to this one?
3. You showed me around and described to me many places that are important for you. Can you draw for me some of the information that you have showed me today and describe with names the elements of your drawing?

APPENDIX C

PARTICIPANT OBSERVATION NOTES COLLECTED DURING FREE-LISTING INTERVIEWS, GRAND-TOURS, AND CULTURAL CONSENSUS QUESTIONNAIRE

Cultural Consultant	Participant observational notes (Spanish)	Participant observational notes (English)	Country of residence	Gender	Occupation	Age	Time Residing in the Location of the Interview
CC37	Las piedras mantienen las humedad para las plantas	Rocks are able to lock humidity	Puerto Rico	Male	Handyman	40	36
	Las estalagmitas crecen los minerales como en los bizcochos	Stalagmites grows in layers, same as in cakes					
	El agua debajo de la tierra es mas pura que la del rio	Underground water is more pure than river water					
	Se usa el agua caliente para ablandar y romper la caliza	You can use hot water to make softer and break limestone rocks					
	Las piedras crecen y paren con los choques	Rocks grow and give birth to other rocks when they collide [with other objects]					
	Las formaciones dentro de las cuevas parecen senos que botan leche con vitaminas y minerales	Formation inside of caves (stalagmites) look like breast that is dripping milk with vitamins and minerals					
	Con la lluvia, las formaciones dentro de las cuevas crecen	The formations inside of caves are able to grow with rain					
CC31	El agua hace crecer las piedras en tamaño, las extiende	Water allow rocks to grow, makes them bigger	Puerto Rico	Female	Teacher	49	47
	Por causas atmosféricas, las cuevas cambian a la misma vez que envejecemos	Atmospheric causes makes caves to grow at the same rate that we are growing					
	Las piedras son un filtro de agua	Rocks are a type of water filter					
CC26	El agua puede romper la piedra lentamente para crear otras	Water is able to break the rock apart for the construction of other rocks	Puerto Rico	Male	Retired	59	59
	El agua daña los terrenos	Water can damage [agricultural] lands					

Cultural Consultant	Participant observational notes (Spanish)	Participant observational notes (English)	Country of residence	Gender	Occupation	Age	Time Residing in the Location of the Interview
	Las piedras me dicen su edad	When I look at rocks, I am able to estimate [relatively] the age					
	"Piedra viva" es que no se rompe con el impacto	A "living rock" is because it does not break when is impacted					
CC23	Los filtros de piedra de antes con rotos se usaban en combinación con las tinajas para almacenar agua limpia	Years ago, rocks were used as filters when we were collecting water	Puerto Rico	Female	Housekeeper	58	41
	El manantial sale de las piedras	Springs are coming out from rocks					
	El rio destruye y limpia	The river [is able] to destroy and clean					
	Se escucha como coca-cola cuando se forma la piedra	The sound is similar like in soda when I hear the rock forming					
	El aguacate crece mejor en caliza	Avocados grow better in limestone					
	El aguacate se da en temporada de hucaranes	Avocados grow more abundant in hurricane season					
CC20	El agua es alta en calcio y te tapa el calentador (ducha)	Tap water is so rich in calcium that it will block you heater tank	Puerto Rico	Male	Retired	64	40
	Yo veo las piedras parir	I can see rocks giving birth					
FW0232	Hay que dejas correr el agua en la piedra para que mantenga el agua limpia	Water can maintain rocks clean when you let it run	Dominican Republic	Female	Housekeeper	60	30
FW0231	El agua que viene del pozo es mas segura para tomar que la que viene del río porque es más orgánica	Water that is coming from wells is safer than water coming from the river. Well water is more organic	Dominican Republic	Female	Housekeeper	78	51

Cultural Consultant	Participant observational notes (Spanish)	Participant observational notes (English)	Country of residence	Gender	Occupation	Age	Time Residing in the Location of the Interview
FW0228	El agua hace parir las piedras	Water makes rocks give birth	Dominican Republic	Male	Agricultor	70	20
	Hay tres clases de agua: 1)agua de arriba (cielo), 2) agua del medio (río), 3) agua de abajo (subterráneo)	There are three types of water: 1) the water above (sky), 2) middle water (found in rivers), and 3) underground water					
	Las piedras crecen dentro del agua	Rocks grow when submerged in water					
FW0222	El pasto agarra las piedras	Grass is able to hold rocks in place	Dominican Republic	Female	Retired	98	98
	Las piedras se mueven pero son jaranas	Rocks are able to move, but they are lazy					
	Las piedras son medicina para el agua	Rocks are water's medicine					
	Es necesario tener diferentes piedras para el bienestar de la naturaleza	It is necessary to have variations of rocks for nature's sake					
	La piedra hace falta en el agua, es como fruta en el agua	Rocks are needed in water, they are like fruits in water					
FW0209	El agua debajo de la tierra es la misma que encuentro en el río, pero con diferente composición	Underground and river water are the same, but with different composition	Dominican Republic	Male	Artisan	56	40
	Las piedras cambian en tamaño parcialmente durante el transcurso de nuestra vida	Rocks are able to change in size in my lifetime					
	La piedra se agarra de sedimento y por eso crece	Rocks are hold in place in sediments, that is why they are able to rock					
	Las piedras están vivas porque tienen organismos adentro	Rocks are alive because are able to sustain live inside					
CC02	La cueva está viva cuando está húmeda	Caves are alive when they are humid	Puerto Rico	Male	Retired	75	48
	Cuando la cueva esta seca, no está viva	When caves are dry, they are not alive					

Cultural Consultant	Participant observational notes (Spanish)	Participant observational notes (English)	Country of residence	Gender	Occupation	Age	Time Residing in the Location of the Interview
	Cuando la piedra está viva no se rompe	When rocks are alive, they do not break easily					
	Las piedras son un filtro natural	Rocks are a natural filter					
	Existen formaciones de agua dentro de las cuevas que parecen venas de agua botando leche	They are existing rocks formations inside of caves that looks like veins dripping milk					
CC14	El agua que viene del pozo es más pura que la que viene del río	Water coming from well is more pure than water coming from the river	Puerto Rico	Male	Retired	19	3
	Las raíces de las plantas le hacen grietas a las piedras	Roots can fracture some rocks					
CC11	Las formaciones dentro de las cuevas parecen coladores para café porque son porosas y actúan como un filtro	Some formations inside of caves looks like coffee percolators, because they are porous and act like filters	Puerto Rico	Female	Housekeeper	50	32
CC05	Las piedras se destruyen pero vuelven a crecer	Rocks get destroyed and able to grow back	Puerto Rico	Female	Retired	57	57
	Dependen las circunstancias, las nuevas envejecen a la misma vez que nosotros	Depending the conditions, rocks and human can grow older at the same rate					
	Por causa del hombre demasiado, las piedras cambian más rápido de lo normal	Humans are causing rocks to change quickly than usual					
	Las piedras pueden ser hermafroditas.	Rocks can have both genders					
FW0207	La acción del agua puede cambiar las piedras en ciertos momentos	In some instances, water can alter the developing of rocks	Dominican Republic	Male	Park ranger	69	69
	El agua del río es más simple que todas las aguas que tengo acceso	River water is more stable than other water sources					

Cultural Consultant	Participant observational notes (Spanish)	Participant observational notes (English)	Country of residence	Gender	Occupation	Age	Time Residing in the Location of the Interview
	Solo Dios puede alterar el crecimiento de las piedras	Just God can alter the developing of a rock					
	Las cuevas tienen vida adentro cuando están en el bosque, fuera del bosque se atrasan	Caves are alive when they are located in the middle of the forest					
	La mayoría de las rocas que están en su entorno están vivas, las que están en el suelo no	Rocks that are part of the block are alive, those that are loose they are not alive					
	El ser humano es responsable por la erosión	Humans are responsible for erosion					
	Las piedras se mueven dentro del agua mejor que en tierra firme porque son más livianas	Rocks can move freely inside when submerged, they become more lightweight					
	La lluvia mantiene el crecimiento de las formaciones dentro de las cuevas	Rain is responsible for the developing of formations inside of caves					
	Debajo de la tierra las aguas se unen	Underground water is unified (from different sources)					
	La basura y los sedimentos achican las cuevas	Trash and sediments can reduce caves size					
	Los cambios en temperature cambian el ritmo de las piedras	Temperature changes can alter the rhythm of rocks					
CC28	Las piedras están vivas y dan vida	Rocks are alive and they provide life	Puerto Rico	Female	Retired	60	60
	Las piedras no tienen el mismo origen, pero sus raíces	Rocks do not have the same origin, but same roots					
	Por los cambios atmosféricos y de temperatura las piedras están cambiando más rápido de lo normal	Current atmospheric and temperature changes are making rocks change quicker than what is normal					

Cultural Consultant	Participant observational notes (Spanish)	Participant observational notes (English)	Country of residence	Gender	Occupation	Age	Time Residing in the Location of the Interview
	Las piedras claras (calizas) se abren cuando se usan para cocinar en el fogón	Lighter rocks (limestones) break apart when used for cooking					
CC18	La acción del agua puede hacer que las piedras cambien de tamaño y de color	Water can alter rock's size and color	Puerto Rico	Male	Retired	72	72
	El agua que está debajo de la tierra es más dulce que la que encuentro en el río	Underground water is sweeter than water coming from the river					
	Las piedras caminan	Rocks are able to walk					
	Últimamente está lloviendo agua más dulce	Lately, there is more sweet rain					
	Los vientos que afectan las piedras tienen nombre	The wind that is affecting the rocks has a name					
	El viento puede hacer correr las piedras	Wind can make the rocks run					
	Las cuevas se quieren conectar con otras cuevas	Caves want to connect with other rocks					
	Cada gota de agua hace crecer las puyas/los picos	Every drop just make the thorn (stalagmite) grow					
	Algunas formaciones dentro de las cuevas parecen venas con agua	Some formations inside of caves look like veins filled with water					
FW0218	Las piedras tienen que estar sumergidas en el agua para que crezcan	Rocks need to be submerged to be able to grow	Dominican Republic	Male	Farmer	59	59
FW0240	El sol puede aumentar en número las piedras	The sun can make rocks grow in numbers	Dominican Republic	Male	Educator	78	56
	Las vacas cuando están bien apollá botan leche	[stalagmites] looks like a cow that is ready to produce milk					
FW0237	Hay venas de agua debajo de la tierra	There is veins of water underground	Dominican Republic	Male	Agricultor	78	78

Cultural Consultant	Participant observational notes (Spanish)	Participant observational notes (English)	Country of residence	Gender	Occupation	Age	Time Residing in the Location of the Interview
	Las cuevas están vivas por el agua	Caves are alive because of the water that is inside					
FW0235	Las estalagmitas parecen tetas de vacas	Stalagmites looks like the udder from the cow	Dominican Republic	Male	Agricultor	59	59
FW0234	Solamente los indigenas pueden alterar las piedras	Just indigenous people are able to alter rocks	Dominican Republic	Male	Agricultor	76	76
	El agua no corre debajo de la tierra es por filtrante	Underground water is not freely flowing, it move slowly like in a filter					
	Las plantas crecen en caliza cambian el color de la plantación. El maní sale blanco en caliza y verde en otras	Plants that grows in limestones are able to mimic the color of the rock.					
FW0215	Las piedras se dividen	Rocks are able to divide themselves	Dominican Republic	Male	Own company	22	0
FW0216	Las cuevas con agua salubre en sumideros siempre está lista para la temporada de cuaresma y sequía	Flooded sinkholes are always ready [to supply water] when is drought season	Dominican Republic	Male	Hospedery	30	30
FW0217	El agua de pozo se contamina menos	Water coming from well is less contaminated	Dominican Republic	Female	Student	19	1
FW0220	Donde hay piedras el agua está más viva	Water is more alive when it has rocks	Dominican Republic	Male	Agricultor	71	30
FW0212	El limo hace las piedras más grandes	Lime can make the rock bigger	Dominican Republic	Male	Transportation	48	48
	Las cuevas conservan el mensaje	Caves are able to conserve the message					
FW0202	El agua hace las piedras más fuertes	Water makes rock stronger	Dominican Republic	Male	Agricultor	49	49

Cultural Consultant	Participant observational notes (Spanish)	Participant observational notes (English)	Country of residence	Gender	Occupation	Age	Time Residing in the Location of the Interview
	Nosotros morimos, las piedras se mantienen vivas	We will die, but rocks will live satay alive					
FW0201	Las cuevas sirven de desague para el pueblo	When the town in flooded we rely on caves to drain the town	Dominican Republic	Male	Student	22	22
FW0219	Todas las piedras que están enterradas, están vivas	All rocks that are underground are alive	Dominican Republic	Male	Agricultor	47	47

APPENDIX D

ANALYSIS OF LIST FREE-LISTING INTERVIEWS

Respondent-Level Statistics:

		1	2	3	4
		Length of	Frequency	Avg Freque	Corr w/ Fr
1	1	4.00	25.00	6.25	-0.67
2	2	6.00	15.00	2.50	0.06
3	3	2.00	2.00	1.00	0.00
4	4	5.00	25.00	5.00	0.44
5	5	5.00	32.00	6.40	-0.87
6	6	3.00	3.00	1.00	0.00
7	7	3.00	28.00	9.33	0.39
8	8	3.00	5.00	1.67	0.00
9	9	4.00	26.00	6.50	-0.67
10	10	3.00	23.00	7.67	-0.81
11	11	7.00	39.00	5.57	-0.35
12	12	4.00	32.00	8.00	-0.93
13	13	2.00	21.00	10.50	-1.00
14	14	2.00	6.00	3.00	1.00
15	15	2.00	21.00	10.50	-1.00
16	16	3.00	4.00	1.33	-0.87
17	17	5.00	43.00	8.60	-0.28
18	18	5.00	42.00	8.40	-0.88
19	19	2.00	28.00	14.00	-1.00
20	20	3.00	36.00	12.00	-0.90
21	21	2.00	27.00	13.50	-1.00
22	22	1.00	8.00	8.00	1.00
23	23	3.00	19.00	6.33	-0.87
24	24	5.00	28.00	5.60	-0.91
25	25	3.00	22.00	7.33	-0.72
26	26	1.00	8.00	8.00	1.00
27	27	3.00	29.00	9.67	0.44
28	28	4.00	24.00	6.00	-0.96
29	29	3.00	34.00	11.33	-0.95
30	30	3.00	20.00	6.67	-0.96
31	31	4.00	38.00	9.50	-0.95
32	32	2.00	7.00	3.50	-1.00
33	33	1.00	9.00	9.00	1.00
34	34	3.00	30.00	10.00	-0.67
35	35	2.00	11.00	5.50	1.00
36	36	6.00	15.00	2.50	0.06

```
Sensitivity level:        OFF
Max respondents:          50
Max items:                500
Input dataset:            C:\APAC\SETAFL01\SETAFL01.TXT
```

SORTED BY SMITHS

	ITEM	FREQUENCY	RESP PCT	AVG RANK	Smith's S
1	FOGON	19	53	1.316	0.487
2	DECORACION	9	25	1.667	0.209
3	CONSTRUCCION	9	25	2.556	0.147
4	ENCACHE	8	22	2.125	0.139
5	MAJAR SAZON	6	17	2.667	0.099
6	DEFENSA	4	11	2.750	0.072
7	RELLENAR	2	6	1.000	0.056
8	JARDIN	5	14	3.400	0.055
9	CEMENTO	3	8	3.333	0.053
10	MANO DE PILON	4	11	3.500	0.049
11	CALICHE	2	6	2.000	0.046
12	RELLENO	2	6	1.500	0.042
13	TAPAR HOYOS	3	8	3.333	0.040
14	PILON	2	6	2.500	0.039
15	DRENAJE	2	6	2.500	0.035
16	PARED	2	6	3.000	0.034
17	ARENA	3	8	3.333	0.033
18	ARTESANIA	2	6	3.000	0.031
19	FUEGO	4	11	4.250	0.031
20	GRAVA	1	3	1.000	0.028
21	PILETA	1	3	1.000	0.028
22	MINA	1	3	1.000	0.028
23	CORRAL	2	6	2.500	0.028
24	CAL	1	3	1.000	0.028
25	CARPA	1	3	1.000	0.028
26	MINERIA	1	3	1.000	0.028
27	CONSTRUIR	1	3	2.000	0.022
28	PAREDES	1	3	2.000	0.021
29	DISENO	1	3	2.000	0.021
30	MANO DE MAJAR	1	3	2.000	0.019
31	PIZO	1	3	2.000	0.019
32	PARA HACER GRANITO	1	3	2.000	0.019
33	MENUDERO	2	6	5.000	0.019
34	BASE ENCONSTRUCCION	1	3	3.000	0.017
35	MATERIAL DE CEMENTO	1	3	3.000	0.017
36	HERRAMIENTA	1	3	3.000	0.014
37	CARRETERA	1	3	2.000	0.014
38	DECORACIONES	1	3	5.000	0.012
39	GRAVILLA	1	3	3.000	0.009
40	PALOMITA	2	6	6.000	0.009
41	COLLARES	1	3	3.000	0.009
42	ENCACHE SEPTICO	1	3	3.000	0.009
43	CERAMICA	1	3	3.000	0.009
44	REPRESA	1	3	5.000	0.006
	Total/Average:	119	3.306		

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0.498
0.259
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0.019
0.019
0.017
0.014
0.014
0.011
0.009
0.009
0.009
0.007
0.007
0.006
0.005

Respondent-Level Statistics:

		1	2	3	4
		Length of	Frequency	Avg Freque	Corr w/ Fr
1	1	4.00	51.00	12.75	-0.93
2	2	4.00	35.00	8.75	0.27
3	3	4.00	35.00	8.75	0.27
4	4	3.00	38.00	12.67	-1.00
5	5	2.00	6.00	3.00	1.00
6	6	4.00	62.00	15.50	0.81
7	7	5.00	41.00	8.20	-0.32
8	8	3.00	11.00	3.67	0.33
9	9	5.00	36.00	7.20	0.28
10	10	5.00	19.00	3.80	-0.53
11	11	4.00	50.00	12.50	-0.32
12	12	6.00	50.00	8.33	-0.74
13	13	2.00	28.00	14.00	-1.00
14	14	3.00	41.00	13.67	-0.99
15	15	3.00	39.00	13.00	-1.00
16	16	3.00	32.00	10.67	-0.89
17	17	4.00	54.00	13.50	0.18
18	18	3.00	49.00	16.33	0.87
19	19	3.00	19.00	6.33	0.33
20	20	3.00	50.00	16.67	0.83
21	21	3.00	14.00	4.67	-0.87
22	22	2.00	3.00	1.50	1.00
23	23	2.00	37.00	18.50	-1.00
24	24	3.00	38.00	12.67	0.46
25	25	2.00	29.00	14.50	1.00
26	26	4.00	53.00	13.25	0.36
27	27	2.00	37.00	18.50	-1.00
28	28	3.00	29.00	9.67	-0.83
29	29	2.00	29.00	14.50	1.00
30	30	3.00	19.00	6.33	0.33
31	31	3.00	49.00	16.33	0.87
32	32	3.00	29.00	9.67	-0.81
33	33	4.00	51.00	12.75	-0.93
34	34	2.00	3.00	1.50	-1.00
35	35	4.00	41.00	10.25	-0.71
36	36	3.00	29.00	9.67	-0.10

```
Sensitivity level:        OFF
Max respondents:          50
Max items:                500
Input dataset:            C:\APAC\SETAFL04\SETAFL04.TXT
```

SORTED BY SMITHS

	ITEM	FREQUENCY	RESP PCT	AVG RANK	Smith's S
1	RIO	28	78	1.643	0.632
2	SUBTERRANEO	16	44	2.188	0.309
3	CANAL	11	31	2.091	0.232
4	MAR	13	36	3.077	0.224
5	ARROYO	11	31	2.273	0.213
6	ACUEDUCTO	10	28	3.100	0.160
7	CUEVA	7	19	2.000	0.139
8	MANANTIAL	7	19	2.429	0.125
9	LLUVIA	12	33	4.667	0.107
10	LAGUNA	7	19	5.714	0.048
11	POZO	1	3	2.000	0.021
	Total/Average:	123	3.417		

Respondent-Level Statistics:

		1 Length of	2 Frequency	3 Avg Freque	4 Corr w/ Fr
1	1	4.00	53.00	13.25	0.86
2	2	2.00	44.00	22.00	-1.00
3	3	2.00	44.00	22.00	-1.00
4	4	5.00	70.00	14.00	-0.75
5	5	2.00	26.00	13.00	-1.00
6	6	4.00	63.00	15.75	0.59
7	7	3.00	53.00	17.67	-0.06
8	8	2.00	24.00	12.00	1.00
9	9	1.00	28.00	28.00	1.00
10	10	3.00	57.00	19.00	-0.19
11	11	2.00	44.00	22.00	1.00
12	12	3.00	48.00	16.00	0.69
13	13	1.00	7.00	7.00	1.00
14	14	2.00	35.00	17.50	-1.00
15	15	3.00	48.00	16.00	-0.28
16	16	4.00	48.00	12.00	-0.47
17	17	4.00	55.00	13.75	0.90
18	18	7.00	97.00	13.86	-0.53
19	19	6.00	82.00	13.67	-0.73
20	20	3.00	37.00	12.33	0.78
21	21	4.00	43.00	10.75	-0.83
22	22	1.00	10.00	10.00	1.00
23	23	1.00	28.00	28.00	1.00
24	24	4.00	65.00	16.25	-0.58
25	25	7.00	92.00	13.14	-0.72
26	26	2.00	39.00	19.50	-1.00
27	27	1.00	28.00	28.00	1.00
28	28	4.00	42.00	10.50	-0.36
29	29	7.00	92.00	13.14	-0.72
30	30	6.00	82.00	13.67	-0.73
31	31	7.00	97.00	13.86	-0.53
32	32	3.00	37.00	12.33	-0.93
33	33	3.00	50.00	16.67	-0.87
34	34	4.00	65.00	16.25	0.52
35	35	3.00	55.00	18.33	-0.69
36	36	3.00	55.00	18.33	-0.29

Sensitivity level: OFF
Max respondents: 50
Max items: 500
Input dataset: C:\APAC\SETAFL11\SETAFL11B.TXT

SORTED BY SMITHS

	ITEM	FREQUENCY	RESP PCT	AVG RANK	Smith's S
1	PUERTO RICO	25	69	1.160	0.648
2	HAITI	16	44	2.063	0.275
3	CUBA	8	22	2.500	0.111
4	JAMAICA	5	14	2.000	0.095
5	SANTO DOMINGO	3	8	1.333	0.069
6	NA	2	6	1.000	0.056
7	CURACAO	3	8	2.333	0.056
8	JICOTEO	1	3	1.000	0.028
9	LA MINA	1	3	1.000	0.028
10	MEXICO	1	3	1.000	0.028
11	SAN CRISTOBAL	1	3	1.000	0.028
12	ARUBA	1	3	1.000	0.028
13	HIGUEY	1	3	1.000	0.028
14	LA GUAMA	1	3	2.000	0.022
15	MICHE	1	3	2.000	0.021
16	CALLEJONES	1	3	2.000	0.021
17	NEW YORK	2	6	3.000	0.019
18	EL PENON DE LOS CHIVOS	1	3	3.000	0.017
19	VENEZUELA	2	6	3.500	0.016
20	SUIZA	1	3	2.000	0.014
21	LA SABANA	1	3	3.000	0.014
22	BARRIO SUIZO	1	3	3.000	0.014
23	LAS SANJAS	1	3	4.000	0.011
24	BRASIL	1	3	3.000	0.009
25	EL PENON	1	3	4.000	0.007
26	LA OTRA BANDA	1	3	4.000	0.007
27	SAN MARTIN	1	3	4.000	0.007
28	LOS SUMIDEROS	1	3	5.000	0.006
	Total/Average:	85	2.361		

Respondent-Level Statistics:

		1	2	3	4
		Length of	Frequency	Avg Freque	Corr w/ Fr
1	1	3.00	8.00	2.67	0.24
2	2	4.00	40.00	10.00	-0.83
3	3	1.00	25.00	25.00	1.00
4	4	3.00	43.00	14.33	-0.99
5	5	3.00	46.00	15.33	-0.45
6	6	3.00	49.00	16.33	-1.00
7	7	5.00	5.00	1.00	0.00
8	8	4.00	4.00	1.00	0.00
9	9	1.00	2.00	2.00	1.00
10	10	1.00	25.00	25.00	1.00
11	11	4.00	4.00	1.00	0.00
12	12	3.00	49.00	16.33	-1.00
13	13	2.00	9.00	4.50	1.00
14	14	1.00	25.00	25.00	1.00
15	15	1.00	2.00	2.00	1.00
16	16	2.00	26.00	13.00	-1.00
17	17	2.00	11.00	5.50	1.00
18	18	4.00	52.00	13.00	-0.99
19	19	2.00	41.00	20.50	-1.00
20	20	2.00	41.00	20.50	-1.00
21	21	2.00	41.00	20.50	-1.00
22	22	1.00	25.00	25.00	1.00
23	23	1.00	25.00	25.00	1.00
24	24	3.00	38.00	12.67	-0.93
25	25	3.00	43.00	14.33	-0.99
26	26	3.00	46.00	15.33	1.00
27	27	2.00	4.00	2.00	1.00
28	28	3.00	42.00	14.00	-0.99
29	29	1.00	3.00	3.00	1.00
30	30	1.00	25.00	25.00	1.00
31	31	1.00	3.00	3.00	1.00
32	32	2.00	41.00	20.50	-1.00
33	33	2.00	41.00	20.50	1.00
34	34	2.00	41.00	20.50	1.00
35	35	4.00	45.00	11.25	-0.67
36	36	3.00	49.00	16.33	-0.53

```
Sensitivity level:       OFF
Max respondents:         50
Max items:               500
Input dataset:           C:\APAC\SETAFL09\SETAFL09.TXT
```

SORTED BY SMITHS

	ITEM	FREQUENCY	RESP PCT	AVG RANK	Smith's S
1	TURISMO	25	69	1.160	0.648
2	RECREACION	11	31	1.818	0.199
3	REFUGIO	7	19	1.429	0.153
4	MINERIA	6	17	1.333	0.144
5	ESTUDIO	8	22	2.000	0.125
6	NA	1	3	1.000	0.028
7	AGUA	1	3	1.000	0.028
8	AGRICULTURA	1	3	2.000	0.014
9	TAREAS DEL HOGAR	1	3	2.000	0.014
10	CEREMONIA	1	3	2.000	0.014
11	COMIDA	1	3	3.000	0.009
	Total/Average:	63	1.750		

Respondent-Level Statistics:

		1	2	3	4
		Length of	Frequency	Avg Freque	Corr w/ Fr
1	1	3.00	40.00	13.33	0.05
2	2	2.00	32.00	16.00	-1.00
3	3	2.00	32.00	16.00	-1.00
4	4	3.00	32.00	10.67	-0.95
5	5	2.00	18.00	9.00	1.00
6	6	1.00	7.00	7.00	1.00
7	7	1.00	11.00	11.00	1.00
8	8	3.00	44.00	14.67	-0.77
9	9	2.00	7.00	3.50	-1.00
10	10	2.00	32.00	16.00	-1.00
11	11	1.00	25.00	25.00	1.00
12	12	2.00	36.00	18.00	-1.00
13	13	1.00	1.00	1.00	1.00
14	14	2.00	36.00	18.00	-1.00
15	15	2.00	12.00	6.00	-1.00
16	16	1.00	11.00	11.00	1.00
17	17	3.00	43.00	14.33	0.21
18	18	1.00	25.00	25.00	1.00
19	19	1.00	25.00	25.00	1.00
20	20	2.00	33.00	16.50	1.00
21	21	2.00	33.00	16.50	-1.00
22	22	1.00	1.00	1.00	1.00
23	23	1.00	25.00	25.00	1.00
24	24	2.00	33.00	16.50	-1.00
25	25	2.00	33.00	16.50	-1.00
26	26	2.00	36.00	18.00	-1.00
27	27	1.00	25.00	25.00	1.00
28	28	2.00	36.00	18.00	-1.00
29	29	2.00	33.00	16.50	-1.00
30	30	1.00	25.00	25.00	1.00
31	31	1.00	25.00	25.00	1.00
32	32	2.00	14.00	7.00	1.00
33	33	2.00	31.00	15.50	-1.00
34	34	2.00	7.00	3.50	-1.00
35	35	2.00	36.00	18.00	1.00
36	36	1.00	6.00	6.00	1.00

```
Sensitivity level:        OFF
Max respondents:          50
Max items:                500
Input dataset:            C:\APAC\SETBFL09\SETBFL09.TXT
```

SORTED BY SMITHS

	ITEM	FREQUENCY	RESP PCT	AVG RANK	Smith's S
1	NA	11	33	1.000	0.333
2	REFUGIO	12	36	1.250	0.323
3	CEREMONIA	8	24	1.250	0.222
4	RECREACION	6	18	1.667	0.136
5	VIVIENDA	3	9	1.000	0.091
	Total/Average:	40	1.212		

Respondent-Level Statistics:

		1	2	3	4
		Length of	Frequency	Avg Freque	Corr w/ Fr
1	1	1.00	3.00	3.00	1.00
2	2	1.00	3.00	3.00	1.00
3	3	1.00	8.00	8.00	1.00
4	4	2.00	18.00	9.00	1.00
5	5	1.00	11.00	11.00	1.00
6	6	1.00	11.00	11.00	1.00
7	7	1.00	12.00	12.00	1.00
8	8	1.00	11.00	11.00	1.00
9	9	1.00	11.00	11.00	1.00
10	10	2.00	18.00	9.00	-1.00
11	11	1.00	11.00	11.00	1.00
12	12	1.00	11.00	11.00	1.00
13	13	1.00	3.00	3.00	1.00
14	14	1.00	12.00	12.00	1.00
15	15	1.00	12.00	12.00	1.00
16	16	1.00	12.00	12.00	1.00
17	17	1.00	11.00	11.00	1.00
18	18	1.00	11.00	11.00	1.00
19	19	1.00	8.00	8.00	1.00
20	20	2.00	20.00	10.00	1.00
21	21	1.00	11.00	11.00	1.00
22	22	1.00	8.00	8.00	1.00
23	23	1.00	8.00	8.00	1.00
24	24	3.00	26.00	8.67	-0.33
25	25	1.00	8.00	8.00	1.00
26	26	1.00	11.00	11.00	1.00
27	27	1.00	12.00	12.00	1.00
28	28	1.00	11.00	11.00	1.00
29	29	1.00	12.00	12.00	1.00
30	30	3.00	26.00	8.67	-0.65
31	31	1.00	6.00	6.00	1.00
32	32	1.00	6.00	6.00	1.00
33	33	1.00	12.00	12.00	1.00

APPENDIX E

CULTURAL CONSENSUS QUESTIONNAIRE ORIGINS

HOW DO ROCKS GROW AND GIVE BIRTH?

(main metaphor collected through fieldwork)

Cultural Consensus Questionnaire is designed with information from previous notes from participant observation during structured and semi-structured interviews during field ethnographic work in the Dominican Republic. Next to the questions there is a simple sentence explaining the origin of the question, in the form of participant observation.

Main topics to develop in the questionnaire among the metaphors collected:

1. Inside of caves for speleothems (chemical weathering)
2. Floodplains (erosion)
3. River beds (mechanical weathering)

1. Can water be stored in rocks? **The water that is underground is stored between rocks and soil.**
2. Can water travel through rocks? **Participants have observed the relationship of levels of water changing based on level changes in surrounding flooding caves.**
3. Can water make rocks smaller (dissolve)? **Rocks give birth (limestone rocks).**
4. Can the human action change the landscape that we observe? **Construction in top of caves can change the roof of cave (collapsing).**
5. Can water change the landscape that we observe? **Water is able to move rocks and everything that is on its way. This observation was made in context of floods and river areas.**

6. Can water make rocks grow? **Mechanical weathering in rivers are able to multiply rocks in number.**
7. Can the rocks that I see surrounding me be found anywhere in my country? **Rocks are unique to regions.**
8. Are the rocks that I observing in my surroundings unique to this region? **Rocks are unique to regions.**
9. Do vegetation has a close relationship with the rocks? **Rocks grow better when they are with grass (participant observation). Erosion of sediments in flooding planes.**
10. Can water flow underground? **They have observed the relationship of levels of water changing based on level changes in surrounding flooding caves.**
11. Can water flow through rocks? **They have observed the relationship of levels of water changing based on level changes in surrounding flooding caves.**
12. Can water breaks the rocks to make caves? **Dissolution of limestone.**
13. Are caves important for me? **Activities that are appropriated to do inside of caves.**
14. Are caves important for my neighbors? **Activities that are appropriated to do inside of caves.**
15. Are caves important for my family? **Activities that are appropriated to do inside of caves.**
16. Is the water that I used underground the same from the closest body of water? **They have observed the relationship of levels of water changing based on level changes in surrounding flooding caves.**
17. Can rocks change in size during my lifetime? **This observation is related to erosion of sediments that were covering rocks.**

18. Can rocks grow faster than me? **This observation is related to erosion of sediments that were covering rocks.**
19. Can rocks grow slower than me? **This observation is related to erosion of sediments that were covering rocks.**
20. Can I change how rocks grow? **This observation is related to erosion of sediments that were covering rocks.**
21. Can water form crystals inside of caves? **Referring to stalactites and stalagmites**
22. Are caves just holes in the ground with no life? **Caves are dynamic and alive**
23. Do caves have life inside? **Caves are ecosystems and habitats for bats species.**
24. Are caves alive? **Caves are dynamic and alive**
25. Are rocks alive? **Caves are dynamic and alive, and rocks grow do to erosion and weathering.**
26. Do all caves have water inside? **Levels of humidity are higher inside of caves in comparison with outside levels of moisture.**
27. Are all caves dry? **Levels of humidity are higher inside of caves in comparison with outside levels of moisture.**
28. Do caves change through the years? **Caves are dynamic and alive**
29. Do caves can change in my lifetime? **Caves are dynamic and alive**
30. Do caves change as the same time that I change? **Caves are dynamic and alive**
31. Is the same water that is to the closest body of water the same that I use underground? **They have observed the relationship of levels of water changing based on level changes in surrounding flooding caves.**

32. Can rocks change the flavor of water? **Observation made by comparing water from dwells and springs.**
33. Can rocks clean the water? **Observation made by comparing water from dwells and springs.**
34. Is the water coming from underground safe to drink? **Observation made by comparing water from dwells and springs.**
35. Is the water coming from underground cleaner than the closest body of water? **Observation made by comparing water from dwells and springs.**
36. Is the water coming from the closest body of water cleaner than the water underground? **Observation made by comparing water from dwells and springs.**
37. Can rocks change their form? **Observations made inside of caves.**
38. Can rocks multiply by themselves? **Observation made to describe mechanical weathering by the action of water.**
39. Can water help in the multiplication of rocks? **Observation made to describe mechanical weathering by the action of water.**
40. Can wind help in the multiplication of rocks? **No data from participant observation.**
41. Can grass (vegetation in general) help in the multiplication of rocks? **This observation is related to erosion of sediments that were covering rocks. Grass is commonly covering alluvial sediments.**
42. Do all rocks have the same origin? **Based on difference in color classification from free-listing information.**
43. Do all rocks have the same color? **Based on difference in color classification from free-listing information.**

44. Is the water coming from the sky the same as the water found underground? **Precipitation is the agent to recharge the water that is underground.**
45. Do rocks grow? **Rocks are able to grow.**
46. Do rocks give birth? **Rocks are able to give birth.**
47. Can I see how old are the rocks? **This observation is related to erosion of sediments that were covering rocks. Grass is commonly covering alluvial sediments. In addition, texture of rocks was leading to this observation.**
48. Can we find “teticas” (little breast) dripping milk inside of caves? **Stalactites are breasts.**
49. Can rocks grow faster in water? **Water is the agent of milk forming making stalactites grow.**
50. Can I observe rocks changing during the last years? **Big events in can change the landscape (erosion in floodplains).**
51. Are there different kinds of rocks? **Some kinds of rocks are better for different tasks.**
52. Are light rocks (color) better for cooking? **Limestone is better for fire style cooking.**
53. Are dark rocks (color) better for cooking? **Limestone is better for fire style cooking.**
54. Can rocks move? **Erosional processes in water.**
55. Are rocks males? **Rocks are able to give birth**
56. Are rocks females? **Rocks are able to give birth**
57. Can rocks make water purer? **Groundwater taste different (better) than water coming from the water system.**
58. Can caves connect with other caves?

59. Can caves connect with the beach (ocean)? **Caves can connect us with other environments.**
60. Were caves important to my ancestors? **The amount of pictography and petrography inside of caves, as well ceremonial traditions.**
61. Do caves have important draws from my ancestors? **The amount of pictography and petrography inside of caves and ceremonial traditions.**
62. Can caves connect with rivers? **Caves can connect us (humans) with other environments.**
63. Can caves connect with "ojos de agua" spring? **Caves can connect us with other environments.**
64. Is water only available in rivers? **Free-listing observations of where we can find water.**
65. Is water only available from rain? **Free-listing observations of where we can find water.**
66. Do rocks only grow on rivers? **Mechanical weathering observation analogy.**
67. Can rocks give birth in water? **Mechanical weathering observation analogy.**
68. Can rocks give birth outside of water (dry)? **Mechanical weathering observation analogy.**

Final questionnaire in Spanich

1. ¿Puede el agua almacenarse en las piedras?
2. ¿Puede el agua viajar a través de las piedras?
3. ¿Puede la acción del agua hacer que las piedras se hagan más pequeñas con el tiempo?

4. ¿Puede la actividad humana cambiar los paisajes que observamos?
5. ¿Puede la acción del agua cambiar el paisaje que observamos?
6. ¿Puede la acción del agua hacer crecer las piedras en número?
7. ¿Puede la acción del agua hacer crecer las piedras en tamaño?
8. ¿Son todas las piedras que veo iguales?
9. ¿Son las piedras que veo alrededor de mi propiedad solamente de esta región?
10. ¿Existe una relación única entre las plantas que observo a mi alrededor con las piedras?
11. ¿El agua corre debajo de la tierra?
12. ¿Puede la acción del agua romper la piedra para crear cuevas?
13. ¿Son las cuevas importantes para mí?
14. ¿Son las cuevas importantes para mis vecinos?
15. ¿Son las cuevas importantes para mi familia?
16. ¿Es el agua que debajo de la tierra la misma que encuentro en el río?
17. ¿Puedo observar como las piedras cambian en tamaño durante el transcurso de nuestra vida?
18. ¿Pueden las piedras crecer en tamaño más rápido de lo que nosotros crecemos en tamaño?
19. ¿Pueden crecer las piedras más lento de lo que nosotros crecemos?
20. ¿Podemos nosotros alterar el crecimiento de las piedras?
21. ¿Puede el agua formar cristales dentro de las cuevas?
22. ¿Las cuevas están vivas?
23. ¿Tienen las cuevas vida adentro?

24. ¿Las piedras están vivas?
25. ¿En esta área las cuevas tienen agua?
26. ¿Puede el agua mover los materiales para hacer cristales dentro de la cueva?
27. ¿En esta área las cuevas están secas adentro?
28. ¿Cambian de forma las cuevas con los años?
29. ¿Pueden cambiar las cuevas durante el transcurso de nuestra vida?
30. ¿Están cambiando las cuevas a la misma vez que nosotros envejecemos?
31. ¿Están cambiando las cuevas más lento de lo que nosotros envejecemos?
32. ¿Están cambiando las cuevas más rápido de lo que nosotros envejecemos?
33. ¿Pueden las piedras cambiar el sabor del agua?
34. ¿Pueden las piedras hacer el agua más limpia?
35. ¿Pueden las piedras mantener el agua limpia?
36. ¿El agua que viene del pozo es más segura para tomar que la que viene del río?
37. ¿El agua que viene del pozo es más segura para tomar que la que viene del acueducto?
38. ¿Pueden las piedras cambiar de forma?
39. ¿Puede ayudar el viento a aumentar en número de las piedras en tierra firme?
40. ¿Puede ayudar un huracán a aumentar el número de las piedras?
41. ¿Puede ayudar el pasto a aumentar en número de las piedras?
42. ¿Tienen todas las piedras el mismo origen?
43. ¿Todas las piedras tienen el mismo color?
44. ¿El agua que esta debajo de la tierra es la misma que el agua que viene de la lluvia?

45. ¿Las piedras crecen?

46. ¿Las piedras paren?

47. ¿La forma de las piedras me dice su edad?

48. ¿El tamaño de las piedras me dice su edad?

49. ¿El color de las piedras me dice su edad?

50. ¿Están cambiando las piedras últimamente más rápido de lo normal?

51. ¿Están cambiando las piedras últimamente más lento de lo normal?

52. ¿Están las piedras echas de diferentes materiales?

53. ¿Son las piedras color claras mejores para cocinar en un fogón?

54. ¿Son las piedras color obscuras mejores para cocinar en un fogón?

55. ¿Las piedras se mueven?

56. ¿Las piedras se mueven dentro del agua mejor que en la tierra firme?

57. ¿Las piedras son masculinas?

58. ¿Las piedras son femeninas?

59. ¿Hacen las piedras el agua más pura?

60. ¿Se pueden conectar las cuevas con otras cuevas?

61. ¿Se pueden conectar las cuevas con la playa?

62. ¿Fueron las cuevas importantes para mis ancestros?

63. ¿Las cuevas tienen mensajes de parte de mis ancestros?

64. ¿Las cuevas tienen que protegerse?

65. ¿Hay cuevas que conectan con ríos?

66. ¿Existen cuevas con ojos de agua?

67. ¿Existen cuevas con bocas de agua?

68. ¿Las piedras paren en el agua?

69. ¿Las piedras paren fuera del agua?

70. ¿Las piedras envejecen?

71. ¿Las cuevas envejecen?

72. ¿Existen formaciones dentro de las cuevas parecen senos botando leche?

73. ¿Cuándo llueve fuera de la cueva estas formaciones crecen?

APPENDIX F

SCRIPT TO RECRUIT PARTICIPANTS FOR OUR STUDY

English version of the script

I am a graduate student under the direction of Professors Dr. Steven Semken and Dr. Elizabeth Brandt in the School of Earth and Space Exploration (SESE) at Arizona State University (ASU). I am conducting a research study of the cultural geological knowledge of Puerto Rico and Dominican Republic.

I am recruiting individuals to complete free-list forms, which will take approximately one (1) hour.

Your participation in this study is voluntary. If you have any questions concerning the research study, please call me at (802) 777-8859 or e-mail me at angel.a.garcia@asu.edu.

Spanish version of the script

Soy un estudiante graduado bajo la dirección de los Profesores Dr. Steven Semken and Dr. Elizabeth Brandt en la Escuela Exploratoria Terrestre y Espacial (SESE por sus siglas en inglés) la cual es parte de la Universidad Estatal de Arizona (ASU por sus siglas en inglés). Como estudiante e investigador estoy en desarrollo de un estudio sobre el conocimiento geológico-cultural de Puerto Rico y Republica Dominicana.

Estoy reclutando individuos para completar formas de “free-list”, que toma un tiempo aproximado de una (1) hora.

La participación en este estudio es voluntaria. Si tiene una pregunta que concierne con este estudio, favor de comunicarse conmigo a través de mi numero telefónico: (802) 777-8859 o mi correo-electrónico: angel.a.garcia@asu.edu.

APPENDIX G

DEMOGRAPHICS FOR THE CULTURAL CONSULTANTS IN PUERTO RICO AND DOMINICAN REPUBLIC

Cultural Consultant ID	Sex	Age	Time Residing in the Location of the Interview	Occupation (original)	Occupation (Edited)
CC01	m	78	56	retirado	Retired
CC02	m	75	48	retirado	Retired
CC03	f	58	58	retirada	Retired
CC04	f	56	16	retirada	Retired
CC05	f	57	57	retirada	Retired
CC06	f	48	10	voluntaria	Retired
CC07	m	64	64	retirado	Retired
CC08	m	62	62	agricultor	Agricultor
CC09	f	21	21	estudiante	Student
CC10	m	70	70	retirado	Retired
CC11	f	65	1	ama_casa	Housekeeper
CC12	f	50	32	ama_casa	Housekeeper
CC13	m	55	55	comerciante	Self employed
CC14	m	62	62	retirado	Retired
CC15	f	19	3	estudiante	Student
CC16	f	80	73	ama_casa	Housekeeper
CC17	f	52	52	ama_casa	Housekeeper
CC18	m	72	72	retirado	Retired
CC19	f	67	67	ama_casa	Housekeeper
CC20	m	64	40	retirado	Retired
CC21	f	51	51	ama_casa	Housekeeper
CC22	m	62	62	artesano	Artesan
CC23	f	58	41	ama_casa	Housekeeper
CC24	m	70	30	retirado	Retired
CC25	f	69	30	retirada	Retired
CC26	m	59	59	retirado	Retired
CC27	m	64	50	retirado	Retired
CC28	f	60	60	maestra_retirada	Retired
CC29	f	60	60	maestra_retirada	Retired
CC30	m	47	41	gerencia_contabilidad	Accountant
CC31	f	49	47	maestra	Teacher
CC32	m	23	1	construccion	Construction
CC33	f	72	72	retirada	Retired
CC34	m	75	75	comerciante	Self employed
CC35	m	59	59	retirado	Retired
CC36	f	59	30	manufacturera	Manufacturing
CC37	m	40	36	handyman	Self employed
CC38	f	43	16	comerciante	Self employed
CC39	m	34	13	gobierno	Public
CC40	f	45	45	ama_casa	Housekeeper
FW0201	m	22	22	estudiante	Student
FW0202	m	49	49	agricultor	Agricultor

Cultural Consultant ID	Sex	Age	Time Residing in the Location of the Interview	Occupation (original)	Occupation (Edited)
FW0203	m	28	28	turismo	Hotel Industry
FW0204	m	38	38	empleado_privado	Self employed
FW0205	m	43	43	empleado_privado	Self employed
FW0206	m	44	39	areas_verdes	Gardener
FW0207	m	69	69	guardaparque	Park Ranger
FW0208	m	43	43	restaurante	Restaurant
FW0209	m	56	40	artesano	Artesan
FW0210	m	44	10	hoteleria	Hotel Industry
FW0211	m	48	48	agricultor	Agricultor
FW0212	m	48	48	transportacion	Self employed
FW0213	m	22	22	aeropuerto	Airport
FW0214	f	77	77	ama_casa_retirada	Housekeeper
FW0215	m	22	0	empresa_privada	Self employed
FW0216	m	30	30	hoteleria	Hotel Industry
FW0217	f	19	1	estudiante	Student
FW0218	m	59	59	ganadero	Cowboy
FW0219	m	47	47	agricultor	Agricultor
FW0220	m	71	30	agricultor	Agricultor
FW0221	f	69	56	ama_de_casa	Housekeeper
FW0222	f	98	98	retirada	Retired
FW0223	f	57	57	comerciante	Self employed
FW0224	m	80	80	agricultor_ganadero	Agricultor
FW0225	f	55	35	ama_casa	Housekeeper
FW0226	m	45	45	jornalero	Agricultor
FW0227	m	45	45	agricultor	Agricultor
FW0228	m	70	20	agricultor	Agricultor
FW0229	m	68	60	agricultor	Agricultor
FW0230	m	57	57	agricultor	Agricultor
FW0231	f	78	51	ama_casa	Housekeeper
FW0232	f	60	30	ama_casa	Housekeeper
FW0233	m	64	64	pintor	Painter
FW0234	m	76	76	agricultor	Agricultor
FW0235	m	59	59	agricultor	Agricultor
FW0236	m	48	48	agricultor	Agricultor
FW0237	m	78	78	agricultor	Agricultor
FW0238	f	76	76	ama_casa	Housekeeper
FW0239	m	80	37	guardaparques	Park Ranger
FW0240	m	78	56	educacion_puertero	Park Ranger

APPENDIX H

CULTURAL CONSENSUS QUESTIONNAIRE TABULATED PER CONSULTANT

Dominican Republic

	Q32	Q33	Q34	Q35	Q36	Q38	Q39	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55	Q56	Q57	Q58	Q59	Q60	Q61	Q62
FW0201	0	1	1	1	1	1	1	0	1	0	0	0	0	1	0	1	1	0	0	0	1	0	1	0	1	0	0	1	1
FW0202	0	0	1	1	1	1	0	1	1	0	1	0	1	1	1	0	1	1	0	0	1	0	1	0	1	0	1	1	1
FW0203	0	0	1	1	1	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	1	1	1
FW0204	0	1	0	1	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	0	1	0	1	1	1	1	0	1	1
FW0205	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	1	1	1	0	1	1
FW0206	0	1	1	1	1	1	0	0	1	0	1	0	1	0	0	0	0	0	0	1	0	1	0	0	1	0	0	1	1
FW0207	0	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	1	0	1	0	0	0	1	1	1	0	1	1	1
FW0208	0	1	1	1	1	1	1	0	1	1	0	0	0	1	1	0	0	0	0	0	1	0	1	0	1	1	1	1	1
FW0209	0	1	1	1	1	1	1	1	1	0	0	0	0	1	0	1	1	1	0	1	1	0	1	0	1	0	1	1	1
FW0210	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1
FW0211	1	1	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	1	0	1	0	1	1	1	0	0	1	1
FW0212	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	1	1	1	1	0	1	1
FW0213	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	1	0	1	1	1	0	0	1	1
FW0214	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
FW0215	0	1	0	0	0	0	1	0	1	1	0	0	0	0	1	1	0	1	0	1	1	1	0	0	1	0	1	0	1
FW0216	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	1
FW0217	0	1	0	0	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	1	1	0	0	0
FW0218	0	0	1	1	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	1	1	1	1	0	1	0	0	1	1
FW0219	0	0	1	1	1	1	1	0	1	1	0	0	0	1	1	1	1	0	0	0	1	0	1	1	1	0	1	1	1
FW0220	0	0	1	1	1	1	1	0	1	1	0	0	0	1	1	1	1	0	0	0	1	0	1	1	1	0	1	1	1
FW0221	0	0	1	1	1	1	1	0	1	1	0	0	0	1	1	1	1	0	0	0	1	0	1	0	0	0	0	1	1
FW0222	0	1	1	1	1	0	1	0	0	0	0	0	0	1	1	1	1	1	0	0	1	0	1	0	0	0	1	1	1
FW0223	0	1	1	1	1	0	1	0	0	0	0	0	0	1	1	1	0	1	0	0	1	0	1	0	0	0	1	1	1
FW0224	0	1	1	1	1	1	0	0	0	1	0	0	0	1	0	0	1	1	0	1	1	1	0	0	0	0	1	1	0
FW0225	0	0	1	1	1	1	1	0	1	1	0	1	0	1	1	0	1	1	0	0	1	0	1	1	1	0	0	1	1
FW0226	0	0	1	1	1	1	1	0	1	0	0	0	1	1	1	1	0	0	0	1	1	1	0	0	1	0	1	1	1
FW0227	0	0	1	1	1	1	0	0	1	1	0	0	1	1	0	1	1	1	0	1	1	0	1	0	0	1	0	1	1
FW0228	0	0	1	1	1	1	1	0	0	1	0	0	0	1	1	0	1	1	0	0	0	0	1	0	0	1	1	1	1
FW0229	0	1	1	1	1	1	1	0	1	1	0	0	0	1	1	1	0	0	0	1	1	0	1	0	0	0	1	0	1
FW0230	0	0	1	1	1	1	1	0	1	1	0	0	0	1	1	1	1	1	0	0	1	0	1	1	1	0	0	1	1
FW0231	0	1	1	1	1	1	0	0	0	0	0	0	0	1	0	0	1	1	0	1	1	1	0	0	1	0	0	1	0
FW0232	0	1	0	0	1	1	1	0	0	1	0	0	0	1	1	0	0	0	0	0	1	1	0	0	0	0	1	1	1
FW0233	0	0	0	1	1	1	1	0	1	1	0	0	0	1	1	0	0	0	0	0	1	1	0	0	1	0	1	0	1
FW0234	0	0	0	1	1	1	1	0	1	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1
FW0235	0	1	1	1	0	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	1	1	1	0	0	0	0	1	1
FW0236	0	0	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0	0	0	1	1	0	0	1	0	1	0	1
FW0237	0	0	1	1	1	1	0	0	1	1	0	0	0	1	0	1	1	1	0	1	1	0	1	0	0	0	0	1	0
FW0238	0	0	1	1	1	1	0	0	1	1	0	0	0	1	0	1	1	1	0	1	1	0	1	0	0	1	0	1	0
FW0239	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1
FW0240	0	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	1	0	1	1	1	0	1	1	1

Q30	Q31
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	Q63	Q64	Q65	Q66	Q67	Q68	Q69	Q70	Q71	Q72	Q73
FW0201	1	1	1	1	1	1	1	0	0	1	1
FW0202	1	1	1	1	1	1	1	1	1	1	1
FW0203	1	1	1	1	1	1	1	0	0	0	1
FW0204	1	1	1	1	0	1	1	1	1	1	0
FW0205	1	1	1	1	1	1	1	0	1	1	1
FW0206	1	1	0	1	0	0	1	1	0	0	0
FW0207	1	1	1	1	1	1	1	0	0	1	0
FW0208	1	1	1	1	1	1	1	1	0	1	1
FW0209	1	1	1	1	1	1	1	0	0	1	1
FW0210	1	1	1	1	1	1	1	1	1	1	1
FW0211	1	1	1	1	1	1	1	0	0	0	1
FW0212	1	1	1	1	1	1	1	0	0	1	1
FW0213	1	1	1	1	1	1	1	0	0	0	1
FW0214	0	0	0	0	0	1	0	1	0	0	0
FW0215	1	1	1	1	1	1	1	0	0	1	1
FW0216	1	1	1	1	1	1	1	0	0	0	0
FW0217	0	1	1	1	1	0	1	0	0	0	1
FW0218	1	1	1	1	1	0	1	0	0	1	0
FW0219	1	1	1	1	1	1	1	1	1	1	1
FW0220	1	1	1	1	1	1	1	1	1	1	1
FW0221	1	1	1	1	1	1	1	1	1	1	1
FW0222	1	1	1	1	0	1	1	1	1	1	1
FW0223	1	1	1	1	0	0	0	1	1	1	1
FW0224	0	1	1	1	0	0	0	0	1	0	0
FW0225	1	1	1	1	1	1	1	1	1	1	1
FW0226	1	1	1	1	1	1	1	1	1	1	1
FW0227	1	0	0	0	0	1	1	0	0	1	1
FW0228	0	1	1	1	1	1	1	1	0	1	0
FW0229	1	1	0	1	1	1	1	1	1	1	1
FW0230	1	1	1	1	1	1	1	1	0	1	1
FW0231	0	1	1	1	1	1	0	0	0	0	0
FW0232	1	0	1	1	1	1	1	1	1	1	1
FW0233	0	1	1	1	0	1	0	0	1	0	0
FW0234	1	1	1	1	1	1	1	0	1	0	0
FW0235	0	1	1	1	1	1	0	0	0	0	1
FW0236	0	1	1	0	1	1	1	1	1	1	1
FW0237	0	1	1	1	1	1	1	0	0	1	1
FW0238	0	1	1	1	1	1	1	0	0	1	1
FW0239	1	1	1	1	1	1	1	1	1	1	1
FW0240	1	1	1	1	1	1	1	1	1	1	1

Puerto Rico

	Q34	Q35	Q36	Q38	Q39	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55	Q56	Q57	Q58	Q59	Q60	Q61	Q62	Q63	Q64	Q65	Q66
CC01	1	1	1	1	1	0	1	1	0	0	0	1	0	1	0	0	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1
CC02	1	1	1	1	1	0	1	1	0	0	1	1	0	1	0	0	1	0	1	0	1	0	1	1	1	1	1	1	1	1	1
CC03	1	1	1	1	1	1	1	1	0	0	0	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1
CC04	1	1	1	0	1	1	1	1	0	0	0	1	0	1	1	1	0	1	1	1	0	0	1	0	0	1	1	1	1	1	1
CC05	1	1	1	1	1	0	1	1	0	0	0	1	1	1	0	1	1	0	1	0	1	0	1	0	0	1	1	1	1	1	1
CC06	1	1	1	1	1	0	0	1	0	0	0	1	0	1	0	0	0	0	1	0	0	1	1	0	0	1	1	1	1	1	1
CC07	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	0	1	1	1	0	0	1	1	1	1	1	1
CC08	1	1	1	1	1	1	1	0	0	0	1	1	0	1	1	0	0	0	0	0	1	0	1	0	1	1	1	0	1	1	1
CC09	1	1	0	1	1	1	1	1	0	0	1	1	0	0	0	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1
CC10	1	1	1	1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	1	1
CC11	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	1	0	0	1	1	1
CC12	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	1	1	0	1	1	1
CC13	1	0	1	1	0	0	1	1	1	0	1	1	0	1	1	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1
CC14	1	1	1	1	0	0	0	1	1	0	1	0	0	0	1	0	0	0	1	0	0	1	1	1	1	1	1	1	1	1	1
CC15	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	1	1	1	1
CC16	1	1	0	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1
CC17	1	1	0	1	1	1	1	1	0	0	1	0	0	0	0	0	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1
CC18	1	1	0	1	1	1	1	0	1	0	1	1	1	1	1	1	1	0	1	0	1	0	1	0	1	1	0	1	1	0	1
CC19	1	1	0	1	1	1	1	1	1	0	0	1	1	1	1	1	1	0	1	1	1	1	0	0	1	1	0	1	1	1	1
CC20	1	1	0	1	1	0	1	1	0	0	1	1	0	0	1	0	0	0	1	0	1	1	1	0	0	1	1	1	1	1	1
CC21	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	0	1	1	1	0	1	1	0	0	1	1	1	1	1	1
CC22	1	1	0	1	1	1	1	1	0	1	0	1	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1
CC23	1	1	0	1	1	1	1	1	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	1	0	0	1	1
CC24	1	1	0	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	0	1	1	1	0	0	1	1	1	1	1	1
CC25	1	1	0	0	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	0	1	1	1	0	0	1	1	1	1	1	1
CC26	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	1	1	1	1	1	1
CC27	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	1	1	1	1
CC28	1	1	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1
CC29	1	1	0	0	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1
CC30	1	1	1	0	1	0	1	1	0	0	1	1	0	1	1	1	1	0	1	0	1	1	1	0	1	1	1	1	1	1	1
CC31	1	1	1	1	1	1	1	1	0	0	1	1	0	1	1	1	1	0	1	1	0	1	1	0	0	1	1	1	1	1	1
CC32	1	1	1	1	1	1	0	0	1	0	1	1	0	1	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
CC33	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	0	1	0	1	0	0	1	1	1	1	1	1
CC34	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	1	0	1	1	1	1	0	1	1	1	1	1	1
CC35	1	1	0	0	1	1	1	1	0	0	0	0	1	1	0	0	1	0	1	0	1	1	1	0	0	1	1	1	1	1	1
CC36	1	1	0	0	1	1	1	1	0	0	0	0	1	1	1	1	1	0	1	0	1	1	1	0	0	1	1	1	1	1	1
CC37	1	1	1	0	1	0	1	1	0	0	1	0	1	1	0	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1
CC38	1	1	1	1	1		0	0	1	0	1	0	1	1	0	1	0	1	0	1	1	1	1	0	1	1	1	1	1	1	1
CC39	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	1	0	1	0	0	1	1	0	0	1	1	0	1	1	1
CC40	1	1	1	1	1	1	1	1	0	0	1	1	1	0	0	0	1	0	1	0	0	1	1	0	0	1	1	1	1	1	1

Cultural Consensus Analysis Results in Puerto Rico

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33
CC01	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
CC02	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1
CC03	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC04	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1
CC05	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	0	1	1	0	1	0	1
CC06	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	1
CC07	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
CC08	1	1	0	1	0	1	0	0	0	0	1	1	1	0	1	0	1	0	0	0	1	1	1	1	1	1	0	1	1	0	1	1	1
CC09	1	1	1	1	1	1	1	0	0	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
CC10	1	1	1	0	1	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	0	1	0	1	0	1	0	0
CC11	1	1	1	0	1	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	0	1	0	1	0	1	0	0
CC12	1	1	1	0	1	0	0	0	0	1	1	1	1	1	1	1	1	0	0	1	0	1	1	0	1	0	1	0	1	0	1	0	0
CC13	1	1	1	1	1	1	0	0	1	1	1	1	1	0	1	1	1	0	1	0	1	1	1	1	1	1	0	1	1	0	1	0	1
CC14	0	1	1	0	1	0	0	0	1	1	1	1	0	1	1	0	0	1	0	0	0	1	1	1	1	1	0	1	1	0	1	0	1
CC15	1	1	0	1	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	1	0	1	0	1
CC16	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	1	1
CC17	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	1	1	1	0	1	1
CC18	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	1	1	1	1	1	0	0	0	1
CC19	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	0	1	0	1	1	1
CC20	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1	0	1
CC21	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0	1	0	1	0	1	0	1	1	0	1	0	0	1	0	1
CC22	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	0	1	1	1	1	1	0	1	0	1
CC23	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	0	0	1	1	1	1	1	1	1	1	0	1	0	1
CC24	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1
CC25	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1
CC26	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	0	0	0	1	0	1	0	1	0	1	0	1	0	0
CC27	1	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	0	0	0	1	0	1	0	1	0	1	0	1	0	0
CC28	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1
CC29	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1
CC30	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1
CC31	1	1	1	1	1	1	1	0	0	1	1	1	1	0	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	0	1
CC32	1	1	1	1	0	1	1	0	0	1	1	1	1	0	1	0	1	0	0	1	0	1	0	1	1	1	1	1	1	0	0	0	0
CC33	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	0	1	1	0	1	1	1	1	0	1	0	1	0	1	1
CC34	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	0	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1
CC35	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	0	1	1	1	1	0	1	1	1	0	1	1
CC36	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	0	1	1	0	1	1	1	1	0	1	1	1	0	1	1
CC37	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	0	1	1	0	1	0	1
CC38	0	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	0	1	0	0	1	1	1	1	1	1	1	1	0	1	0	1
CC39	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1
CC40	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1

	Q67	Q68	Q69	Q70	Q71	Q72	Q73
CC01	1	1	1	0	0	0	1
CC02	1	1	1	0	0	0	1
CC03	1	1	1	1	1	1	1
CC04	1	1	1	0	0	1	0
CC05	1	1	1	1	1	1	1
CC06	1	1	1	1	1	1	1
CC07	1	1	1	1	1	1	1
CC08	1	1	0	0	0	0	0
CC09	1	1	1	1	1	1	1
CC10	1	1	1	0	0	1	1
CC11	1	1	1	0	0	1	1
CC12	1	1	1	0	0	1	1
CC13	1	1	1	0	0	1	1
CC14	1	1	0	0	1	1	1
CC15	1	0	1	0	0	0	1
CC16	1	1	1	0	0	1	1
CC17	1	1	1	0	0	1	1
CC18	1	1	1	1	0	0	0
CC19	1	1	1	1	0	1	0
CC20	1	1	1	0	0	0	0
CC21	1	1	1	1	1	1	1
CC22	1	1	1	0	1	1	1
CC23	1	1	1	0	0	1	1
CC24	1	1	0	1	1	1	1
CC25	1	1	1	1	1	1	1
CC26	1	1	1	0	0	1	0
CC27	1	1	1	0	0	0	0
CC28	1	1	1	1	1	1	1
CC29	1	1	1	1	1	1	1
CC30	1	1	1	1	0	1	1
CC31	1	0	0	0	0	1	1
CC32	1	1	1	0	0	1	1
CC33	1	1	1	1	1	1	1
CC34	1	1	1	1	1	1	1
CC35	1	1	1	0	0	1	1
CC36	1	1	1	0	0	1	1
CC37	1	1	1	0	1	1	1
CC38	1	1	1	0	1	1	1
CC39	1	1	1	1	1	1	1
CC40	1	1	1	1	1	1	1

APPENDIX I

CULTURAL CONSENSUS QUESTIONNAIRE ANALYSIS

Dominican Republic

IMPORTANT: Agreement among some respondents was not calculable, either because there was no variance in their responses, or had too many missing values. The correlations have been set to zero, but the correct thing to do is to drop these respondents and rerun the data. UCINET 6.627 Copyright (c) 1992-2016 Analytic Technologies

No. of negative competencies: 1

Largest eigenvalue: 13.005

2nd largest eigenvalue: 2.947

Ratio of largest to next: 4.413

The large eigen ratio indicates good fit to the consensus model. However, there are some negative competence scores, which indicates lack of fit.

Competence Scores:

	1

1	0.000
2	0.733
3	0.647
4	0.656
5	0.469
6	0.693
7	0.352
8	0.534
9	0.760
10	0.797
11	0.672
12	0.410
13	0.384
14	0.382
15	-0.014
16	0.444
17	0.459
18	0.283
19	0.408
20	0.775
21	0.808
22	0.801
23	0.577
24	0.533
25	0.315
26	0.735
27	0.708
28	0.568
29	0.608
30	0.397
31	0.752
32	0.352
33	0.473
34	0.443
35	0.615
36	0.465
37	0.322
38	0.669
39	0.685
40	0.709

Answer Key Sheet

1	0.00
2	1.00
3	1.00
4	1.00
5	1.00
6	1.00
7	1.00
8	1.00
9	0.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	0.00
18	1.00
19	0.00
20	1.00
21	0.00
22	1.00
23	1.00
24	1.00
25	1.00
26	1.00
27	1.00
28	1.00
29	1.00
30	1.00
31	0.00
32	0.00
33	0.00
34	0.00
35	1.00
36	1.00
37	1.00
38	1.00
39	1.00
40	0.00
41	1.00
42	1.00
43	0.00
44	0.00

45	0.00
46	1.00
47	1.00
48	1.00
49	1.00
50	0.00
51	0.00
52	0.00
53	1.00
54	0.00
55	1.00
56	0.00
57	1.00
58	0.00
59	1.00
60	1.00
61	1.00
62	1.00
63	1.00
64	1.00
65	1.00
66	1.00
67	1.00
68	1.00
69	1.00
70	1.00
71	1.00
72	1.00
73	1.00

Puerto Rico

IMPORTANT: Agreement among some respondents was not calculable, either because there was no variance in their responses, or had too many missing values. The correlations have been set to zero, but the correct thing to do is to drop these respondents and rerun the data. UCINET 6.627 Copyright (c) 1992-2016 Analytic Technologies

No. of negative competencies: 0

Largest eigenvalue: 17.220

2nd largest eigenvalue: 3.664

Ratio of largest to next: 4.699

The large eigen ratio and the lack of negative competence scores indicates a good fit to the consensus model.

Competence Scores:

	1
1	0.000
2	0.747
3	0.755
4	0.793
5	0.726
6	0.791
7	0.641
8	0.863
9	0.472
10	0.741
11	0.461
12	0.466
13	0.484
14	0.674
15	0.356
16	0.164
17	0.564
18	0.564
19	0.633
20	0.637
21	0.744
22	0.620
23	0.622

24	0.604
25	0.830
26	0.858
27	0.360
28	0.318
29	0.868
30	0.809
31	0.852
32	0.744
33	0.538
34	0.718
35	0.728
36	0.626
37	0.643
38	0.717
39	0.591
40	0.793

Answer Key Sheet

1	0.00
2	1.00
3	1.00
4	1.00
5	1.00
6	1.00
7	1.00
8	1.00
9	0.00
10	1.00
11	1.00
12	1.00
13	1.00
14	1.00
15	1.00
16	1.00
17	1.00
18	1.00
19	0.00
20	1.00
21	1.00
22	1.00
23	1.00
24	1.00

25	1.00
26	1.00
27	1.00
28	1.00
29	1.00
30	1.00
31	0.00
32	1.00
33	0.00
34	1.00
35	1.00
36	1.00
37	1.00
38	1.00
39	1.00
40	1.00
41	1.00
42	1.00
43	0.00
44	0.00
45	1.00
46	1.00
47	0.00
48	1.00
49	1.00
50	1.00
51	1.00
52	0.00
53	1.00
54	0.00
55	1.00
56	1.00
57	1.00
58	0.00
59	1.00
60	1.00
61	1.00
62	1.00
63	1.00
64	1.00
65	1.00
66	1.00
67	1.00
68	1.00
69	1.00

70	1.00
71	1.00
72	1.00
73	1.00

APPENDIX J

CULTURAL CONSENSUS QUESTIONNAIRE ANSWER KEY

Fecha: Coordenadas de GPS:

Información que necesitamos para el estudio. Por favor, entienda que no se le pedirá numero de identificación, nombre o dirección.

Edad:

Lugar de nacimiento:

Sexo (genero): ☐Masculino ☐Femenino

¿En que país usted nació?

¿Cuantos años lleva viviendo en este lugar?

¿Cuál es su ocupación actual?

Conteste las siguientes preguntas haciendo una marca dentro del circulo. Las letras significan lo siguiente: C = cierto y F = falso.

74. ¿Puede el agua almacenarse en las piedras?

- o C
- o F

75. ¿Puede el agua viajar a través de las piedras?

- o C
- o F

76. ¿Puede la acción del agua hacer que las piedras se hagan más pequeñas con el tiempo?

o C

o F

77. ¿Puede la actividad humana cambiar los paisajes que observamos?

o C

o F

78. ¿Puede la acción del agua cambiar el paisaje que observamos?

o C

o F

79. ¿Puede la acción del agua hacer crecer las piedras en número?

o C

o F

80. ¿Puede la acción del agua hacer crecer las piedras en tamaño?

o C

o F

81. ¿Son todas las piedras que veo iguales?

o C

o F

82. ¿Son las piedras que veo alrededor de mi propiedad solamente de esta región?

o C

o F

83. ¿Existe una relación única entre las plantas que observo a mi alrededor con las piedras?

o C

- F

84. ¿El agua corre debajo de la tierra?

- C
- F

85. ¿Puede la acción del agua romper la piedra para crear cuevas?

- C
- F

86. ¿Son las cuevas importantes para mí?

- C
- F

87. ¿Son las cuevas importantes para mis vecinos?

- C
- F

88. ¿Son las cuevas importantes para mi familia?

- C
- F

89. ¿Es el agua que debajo de la tierra la misma que encuentro en el río?

- C
- F

90. ¿Puedo observar como las piedras cambian en tamaño durante el transcurso de nuestra vida?

- C
- F

91. ¿Pueden las piedras crecer en tamaño más rápido de lo que nosotros crecemos en tamaño?

o C

o F

92. ¿Pueden crecer las piedras más lento de lo que nosotros crecemos?

o C

o F

93. ¿Podemos nosotros alterar el crecimiento de las piedras?

o C

o F

94. ¿Puede el agua formar cristales dentro de las cuevas?

o C

o F

95. ¿Las cuevas están vivas?

o C

o F

96. ¿Tienen las cuevas vida adentro?

o C

o F

97. ¿Las piedras están vivas?

o C

o F

98. ¿En esta área las cuevas tienen agua?

o C

o F

99. ¿Puede el agua mover los materiales para hacer cristales dentro de la cueva?

o C

o F

100. ¿En esta área las cuevas están secas adentro?

o C

o F

101. ¿Cambian de forma las cuevas con los años?

o C

o F

102. ¿Pueden cambiar las cuevas durante el transcurso de nuestra vida?

o C

o F

103. ¿Están cambiando las cuevas a la misma vez que nosotros envejecemos?

o C

o F

104. ¿Están cambiando las cuevas más lento de lo que nosotros envejecemos?

o C

o F

105. ¿Están cambiando las cuevas más rápido de lo que nosotros envejecemos?

o C

o F

106. ¿Pueden las piedras cambiar el sabor del agua?

- C
- F

107. ¿Pueden las piedras hacer el agua más limpia?

- C
- F

108. ¿Pueden las piedras mantener el agua limpia?

- C
- F

109. ¿El agua que viene del pozo es más segura para tomar que la que viene del río?

- C
- F

110. ¿El agua que viene del pozo es más segura para tomar que la que viene del acueducto?

- C
- F

111. ¿Pueden las piedras cambiar de forma?

- C
- F

112. ¿Puede ayudar el viento a aumentar en número de las piedras en tierra firme?

- C

- F

113. ¿Puede ayudar un huracán a aumentar el número de las piedras?

- C
- F

114. ¿Puede ayudar el pasto a aumentar el número de las piedras?

- C
- F

115. ¿Tienen todas las piedras el mismo origen?

- C
- F

116. ¿Todas las piedras tienen el mismo color?

- C
- F

117. ¿El agua que esta debajo de la tierra es la misma que el agua que viene de la lluvia?

- C
- F

118. ¿Las piedras crecen?

- C
- F

119. ¿Las piedras paren?

- C
- F

120. ¿La forma de las piedras me dice su edad?

o C

o F

121. ¿El tamaño de las piedras me dice su edad?

o C

o F

122. ¿El color de las piedras me dice su edad?

o C

o F

123. ¿Están cambiando las piedras últimamente más rápido de lo normal?

o C

o F

124. ¿Están cambiando las piedras últimamente más lento de lo normal?

o C

o F

125. ¿Están las piedras echas de diferentes materiales?

o C

o F

126. ¿Son las piedras color claras mejores para cocinar en un fogón?

o C

o F

127. ¿Son las piedras color obscuras mejores para cocinar en un fogón?

o C

o F

128. ¿Las piedras se mueven?

o C

o F

129. ¿Las piedras se mueven dentro del agua mejor que en la tierra firme?

o C

o F

130. ¿Las piedras son masculinas?

o C

o F

131. ¿Las piedras son femeninas?

o C

o F

132. ¿Hacen las piedras el agua más pura?

o C

o F

133. ¿Se pueden conectar las cuevas con otras cuevas?

o C

o F

134. ¿Se pueden conectar las cuevas con la playa?

o C

o F

135. ¿Fueron las cuevas importantes para mis ancestros?

o C

o F

136. ¿Las cuevas tienen mensajes de parte de mis ancestros?

o C

o F

137. ¿Las cuevas tienen que protegerse?

o C

o F

138. ¿Hay cuevas que conectan con ríos?

o C

o F

139. ¿Existen cuevas con ojos de agua?

o C

o F

140. ¿Existen cuevas con bocas de agua?

o C

o F

141. ¿Las piedras paren en el agua?

o C

o F

142. ¿Las piedras paren fuera del agua?

o C

o F

143. ¿Las piedras envejecen?

o C

o F

144. ¿Las cuevas envejecen?

o C

o F

145. ¿Existen formaciones dentro de las cuevas parecen senos botando leche?

o C

o F

146. ¿Cuándo llueve fuera de la cueva estas formaciones crecen?

o C

o F

APPENDIX K

AGREEMENT CALCULATIONS AMONG CULTURAL CONSULTANTS

Dominican Republic

Cultural consultant	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	**1**	0.417	0.417	0.333	0.417	0.278	0.389	0.556	0.611	0.417	0.389	0.389	0.389	0.056	0.25	0.389	0.361	0.444	0.556	0.583	0.611
3	0	0.417	**1**	0.389	0.306	0.611	0.139	0.417	0.528	0.528	0.611	0.194	0.139	0.139	-0.139	0.167	0.25	0	0.194	0.472	0.5	0.472
4	0	0.417	0.389	**1**	0.25	0.444	0.25	0.306	0.583	0.528	0.333	0.417	0.361	0.361	0.083	0.333	0.583	0.444	0.25	0.417	0.444	0.417
5	0	0.333	0.306	0.25	**1**	0.472	0.222	0.278	0.5	0.278	0.472	0.333	0.389	0.333	-0.056	0.139	0.111	0.083	0.056	0.389	0.361	0.333
6	0	0.417	0.611	0.444	0.472	**1**	0.139	0.472	0.528	0.639	0.556	0.361	0.417	0.361	-0.306	0.278	0.194	0.111	0.139	0.528	0.556	0.528
7	0	0.278	0.139	0.25	0.222	0.139	**1**	0.278	0.222	0.278	0.139	0.278	0.222	0.278	0.278	0.25	0.389	0.194	0.333	0.167	0.194	0.222
8	0	0.389	0.417	0.306	0.278	0.472	0.278	**1**	0.333	0.5	0.472	0.389	0.333	0.333	0	0.139	0.278	-0.028	0.222	0.444	0.472	0.389
9	0	0.556	0.528	0.583	0.5	0.528	0.222	0.333	**1**	0.611	0.528	0.333	0.333	0.278	-0.111	0.417	0.444	0.25	0.222	0.556	0.583	0.556
10	0	0.611	0.528	0.528	0.278	0.639	0.278	0.5	0.611	**1**	0.639	0.333	0.278	0.278	-0.111	0.472	0.444	0.306	0.333	0.5	0.528	0.5
11	0	0.417	0.611	0.333	0.472	0.556	0.139	0.472	0.528	0.639	**1**	0.306	0.25	0.25	-0.25	0.278	0.139	0	0.083	0.528	0.556	0.472
12	0	0.389	0.194	0.417	0.333	0.361	0.278	0.389	0.333	0.333	0.306	**1**	0.833	0.889	0.056	0.25	0.278	0.306	0.056	0.222	0.25	0.222
13	0	0.389	0.139	0.361	0.389	0.417	0.222	0.333	0.333	0.278	0.25	0.833	**1**	0.944	0.056	0.194	0.222	0.306	0.056	0.222	0.25	0.222
14	0	0.389	0.139	0.361	0.333	0.361	0.278	0.333	0.278	0.278	0.25	0.889	0.944	**1**	0.111	0.194	0.278	0.306	0.056	0.222	0.25	0.222
15	0	0.056	-0.139	0.083	-0.056	-0.306	0.278	0	-0.111	-0.111	-0.25	0.056	0.056	0.111	**1**	-0.139	0.167	0.194	0.167	0.056	0.028	0.056
16	0	0.25	0.167	0.333	0.139	0.278	0.25	0.139	0.417	0.472	0.278	0.25	0.194	0.194	-0.139	**1**	0.472	0.278	0.194	0.306	0.278	0.25
17	0	0.389	0.25	0.583	0.111	0.194	0.389	0.278	0.444	0.444	0.139	0.278	0.222	0.278	0.167	0.472	**1**	0.417	0.333	0.222	0.25	0.222
18	0	0.361	0	0.444	0.083	0.111	0.194	-0.028	0.25	0.306	0	0.306	0.306	0.306	0.194	0.278	0.417	**1**	0.25	0.083	0.056	0.083
19	0	0.444	0.194	0.25	0.056	0.139	0.333	0.222	0.222	0.333	0.083	0.056	0.056	0.056	0.167	0.194	0.333	0.25	**1**	0.278	0.306	0.333
20	0	0.556	0.472	0.417	0.389	0.528	0.167	0.444	0.556	0.5	0.528	0.222	0.222	0.222	0.056	0.306	0.222	0.083	0.278	**1**	0.972	0.889
21	0	0.583	0.5	0.444	0.361	0.556	0.194	0.472	0.583	0.528	0.556	0.25	0.25	0.25	0.028	0.278	0.25	0.056	0.306	0.972	**1**	0.917
22	0	0.611	0.472	0.417	0.333	0.528	0.222	0.389	0.556	0.5	0.472	0.222	0.222	0.222	0.056	0.25	0.222	0.083	0.333	0.889	0.917	**1**
23	0	0.417	0.5	0.389	0.194	0.5	0.083	0.194	0.472	0.583	0.444	0.028	-0.028	-0.028	-0.194	0.222	0.25	0.056	0.194	0.472	0.5	0.528
24	0	0.389	0.361	0.361	0.222	0.306	0.167	0.111	0.444	0.5	0.306	0	0	0	-0.111	0.306	0.333	0.25	0.278	0.389	0.417	0.444
25	0	0.167	0.25	0.194	-0.056	0.139	0.278	0.111	0.167	0.222	0.083	-0.111	-0.222	-0.167	0	0.083	0.111	-0.028	0.278	0.222	0.25	0.278
26	0	0.472	0.556	0.444	0.417	0.611	0.139	0.361	0.528	0.528	0.611	0.306	0.306	0.306	-0.083	0.222	0.194	0.111	0.25	0.583	0.611	0.583
27	0	0.528	0.5	0.389	0.306	0.444	0.472	0.361	0.528	0.583	0.556	0.194	0.194	0.194	-0.083	0.444	0.306	0.167	0.361	0.528	0.556	0.528
28	0	0.472	0.333	0.389	0.306	0.389	0.306	0.25	0.361	0.472	0.333	0.139	0.194	0.139	0.139	0.111	0.194	0.056	0.25	0.417	0.444	0.528
29	0	0.417	0.444	0.444	0.361	0.333	0.083	0.417	0.583	0.361	0.333	0.083	0.139	0.083	0.083	0.111	0.194	0	0.25	0.528	0.556	0.583
30	0	0.306	0.167	0.167	0.083	0.167	0.028	0.139	0.361	0.361	0.278	0.083	0.139	0.139	-0.028	0.278	0.25	0.222	0.139	0.306	0.333	0.361
31	0	0.5	0.583	0.472	0.333	0.583	0.111	0.389	0.611	0.611	0.639	0.333	0.278	0.278	-0.167	0.417	0.278	0.194	0.222	0.556	0.583	0.556
32	0	0.278	0.306	0.306	0	0.139	0.333	0.222	0.167	0.278	0.139	0.056	-0.056	0	0.167	0.139	0.222	0.083	0.333	0.167	0.194	0.222
33	0	0.278	0.194	0.361	0.222	0.25	0.167	0.056	0.5	0.333	0.25	0.222	0.222	0.222	0	0.361	0.167	0.25	0.111	0.389	0.361	0.389
34	0	0.25	0.222	0.389	0.306	0.278	0.194	0.139	0.361	0.25	0.222	0.083	-0.028	0.028	0.083	0.333	0.25	0.167	0.25	0.417	0.389	0.361
35	0	0.5	0.361	0.361	0.333	0.306	0.389	0.444	0.444	0.389	0.25	0.222	0.167	0.222	0.167	0.194	0.389	0.194	0.444	0.5	0.472	0.556
36	0	0.444	0.194	0.472	0.111	0.25	0.278	0.167	0.333	0.444	0.194	0.389	0.278	0.333	0.111	0.417	0.389	0.361	0.278	0.167	0.194	0.278
37	0	0.278	0.139	0.306	-0.056	0.083	0	0.056	0.111	0.222	0.194	0.056	0.111	0.111	0.111	0.194	0.167	0.361	0.167	0.278	0.306	0.278
38	0	0.556	0.361	0.417	0.167	0.417	0.167	0.333	0.389	0.556	0.306	0.111	0.111	0.111	0.111	0.25	0.278	0.194	0.389	0.556	0.583	0.667
39	0	0.583	0.333	0.389	0.25	0.444	0.25	0.306	0.472	0.583	0.333	0.139	0.194	0.139	0.083	0.222	0.25	0.222	0.361	0.528	0.556	0.639
40	0	0.389	0.694	0.417	0.444	0.639	0.111	0.5	0.5	0.667	0.917	0.222	0.167	0.167	-0.222	0.25	0.167	0.028	0.167	0.556	0.583	0.5

Cultural consultant	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.417	0.389	0.167	0.472	0.528	0.472	0.417	0.306	0.5	0.278	0.278	0.25	0.5	0.444	0.278	0.556	0.583	0.389
3	0.5	0.361	0.25	0.556	0.5	0.333	0.444	0.167	0.583	0.306	0.194	0.222	0.361	0.194	0.139	0.361	0.333	0.694
4	0.389	0.361	0.194	0.444	0.389	0.389	0.444	0.167	0.472	0.306	0.361	0.389	0.361	0.472	0.306	0.417	0.389	0.417
5	0.194	0.222	-0.056	0.417	0.306	0.306	0.361	0.083	0.333	0	0.222	0.306	0.333	0.111	-0.056	0.167	0.25	0.444
6	0.5	0.306	0.139	0.611	0.444	0.389	0.333	0.167	0.583	0.139	0.25	0.278	0.306	0.25	0.083	0.417	0.444	0.639
7	0.083	0.167	0.278	0.139	0.472	0.306	0.083	0.028	0.111	0.333	0.167	0.194	0.389	0.278	0	0.167	0.25	0.111
8	0.194	0.111	0.111	0.361	0.361	0.25	0.417	0.139	0.389	0.222	0.056	0.139	0.444	0.167	0.056	0.333	0.306	0.5
9	0.472	0.444	0.167	0.528	0.528	0.361	0.583	0.361	0.611	0.167	0.5	0.361	0.444	0.333	0.111	0.389	0.472	0.5
10	0.583	0.5	0.222	0.528	0.583	0.472	0.361	0.361	0.611	0.278	0.333	0.25	0.389	0.444	0.222	0.556	0.583	0.667
11	0.444	0.306	0.083	0.611	0.556	0.333	0.333	0.278	0.639	0.139	0.25	0.222	0.25	0.194	0.194	0.306	0.333	0.917
12	0.028	0	-0.111	0.306	0.194	0.139	0.083	0.083	0.333	0.056	0.222	0.083	0.222	0.389	0.056	0.111	0.139	0.222
13	-0.028	0	-0.222	0.306	0.194	0.194	0.139	0.139	0.278	-0.056	0.222	-0.028	0.167	0.278	0.111	0.111	0.194	0.167
14	-0.028	0	-0.167	0.306	0.194	0.139	0.083	0.139	0.278	0	0.222	0.028	0.222	0.333	0.111	0.111	0.139	0.167
15	-0.194	-0.111	0	-0.083	-0.083	0.139	0.083	-0.028	-0.167	0.167	0	0.083	0.167	0.111	0.111	0.111	0.083	-0.222
16	0.222	0.306	0.083	0.222	0.444	0.111	0.111	0.278	0.417	0.139	0.361	0.333	0.194	0.417	0.194	0.25	0.222	0.25
17	0.25	0.333	0.111	0.194	0.306	0.194	0.194	0.25	0.278	0.222	0.167	0.25	0.389	0.389	0.167	0.278	0.25	0.167
18	0.056	0.25	-0.028	0.111	0.167	0.056	0	0.222	0.194	0.083	0.25	0.167	0.194	0.361	0.361	0.194	0.222	0.028
19	0.194	0.278	0.278	0.25	0.361	0.25	0.25	0.139	0.222	0.333	0.111	0.25	0.444	0.278	0.167	0.389	0.361	0.167
20	0.472	0.389	0.222	0.583	0.528	0.417	0.528	0.306	0.556	0.167	0.389	0.417	0.5	0.167	0.278	0.556	0.528	0.556
21	0.5	0.417	0.25	0.611	0.556	0.444	0.556	0.333	0.583	0.194	0.361	0.389	0.472	0.194	0.306	0.583	0.556	0.583
22	0.528	0.444	0.278	0.583	0.528	0.528	0.583	0.361	0.556	0.222	0.389	0.361	0.556	0.278	0.278	0.667	0.639	0.5
23	**1**	0.694	0.25	0.389	0.444	0.278	0.389	0.222	0.417	0.139	0.361	0.222	0.194	0.306	0.25	0.306	0.278	0.472
24	0.694	**1**	0.222	0.306	0.472	0.306	0.306	0.306	0.389	0.056	0.333	0.194	0.278	0.389	0.278	0.333	0.306	0.333
25	0.25	0.222	**1**	0.25	0.139	0.25	0.306	0.028	0.167	0.778	0.167	0.361	0.333	0.222	0.056	0.389	0.417	0.111
26	0.389	0.306	0.25	**1**	0.5	0.389	0.444	0.333	0.806	0.306	0.361	0.278	0.417	0.25	0.25	0.417	0.5	0.639
27	0.444	0.472	0.139	0.5	**1**	0.333	0.278	0.389	0.472	0.139	0.472	0.389	0.528	0.361	0.361	0.361	0.444	0.583
28	0.278	0.306	0.25	0.389	0.333	**1**	0.444	0.167	0.417	0.25	0.194	0.111	0.417	0.139	0.028	0.639	0.722	0.361
29	0.389	0.306	0.306	0.444	0.278	0.444	**1**	0.167	0.472	0.306	0.25	0.278	0.472	0.25	0.139	0.583	0.556	0.361
30	0.222	0.306	0.028	0.333	0.389	0.167	0.167	**1**	0.361	-0.083	0.417	0.222	0.194	0.028	0.472	0.25	0.222	0.306
31	0.417	0.389	0.167	0.806	0.472	0.417	0.472	0.361	**1**	0.278	0.278	0.194	0.333	0.333	0.278	0.444	0.472	0.667
32	0.139	0.056	0.778	0.306	0.139	0.25	0.306	-0.083	0.278	**1**	0.056	0.25	0.333	0.333	0.111	0.389	0.417	0.167
33	0.361	0.333	0.167	0.361	0.472	0.194	0.25	0.417	0.278	0.056	**1**	0.417	0.333	0.278	0.389	0.167	0.194	0.278
34	0.222	0.194	0.361	0.278	0.389	0.111	0.278	0.222	0.194	0.25	0.417	**1**	0.417	0.25	0.306	0.306	0.222	0.306
35	0.194	0.278	0.333	0.417	0.528	0.417	0.472	0.194	0.333	0.333	0.333	0.417	**1**	0.333	0.056	0.5	0.528	0.278
36	0.306	0.389	0.222	0.25	0.361	0.139	0.25	0.028	0.333	0.333	0.278	0.25	0.333	**1**	0.167	0.333	0.306	0.167
37	0.25	0.278	0.056	0.25	0.361	0.028	0.139	0.472	0.278	0.111	0.389	0.306	0.056	0.167	**1**	0.167	0.083	0.278
38	0.306	0.333	0.389	0.417	0.361	0.639	0.583	0.25	0.444	0.389	0.167	0.306	0.5	0.333	0.167	**1**	0.861	0.389
39	0.278	0.306	0.417	0.5	0.444	0.722	0.556	0.222	0.472	0.417	0.194	0.222	0.528	0.306	0.083	0.861	**1**	0.361
40	0.472	0.333	0.111	0.639	0.583	0.361	0.361	0.306	0.667	0.167	0.278	0.306	0.278	0.167	0.278	0.389	0.361	**1**

Puerto Rico

Cultural consultant	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0.5	0.528	0.5	0.25	0.306	0.556	0.5	0.611	0.472	0.472	0.444	0.528	0.444	0.389	0.556	0.389	0.556
3	0.472	0.556	0.528	0.222	0.278	0.528	0.472	0.639	0.5	0.5	0.472	0.556	0.417	0.361	0.583	0.417	0.583
4	0.472	0.722	0.694	0.167	0.111	0.75	0.694	0.694	0.556	0.389	0.639	0.667	0.417	0.472	0.583	0.417	0.583
5	0.556	0.528	0.611	0.306	0.306	0.611	0.611	0.667	0.694	0.361	0.556	0.472	0.444	0.5	0.611	0.389	0.5
6	0.444	0.639	0.722	0.25	0.25	0.778	0.667	0.722	0.583	0.361	0.611	0.528	0.5	0.5	0.667	0.444	0.667
7	0.333	0.528	0.5	0.25	0.194	0.5	0.444	0.5	0.472	0.472	0.444	0.528	0.556	0.5	0.389	0.389	0.611
8	0.389	0.917	0.889	0.139	0.083	0.833	0.722	0.778	0.694	0.417	0.778	0.806	0.556	0.611	0.556	0.444	0.722
9	0.389	0.306	0.278	0.194	0.25	0.333	0.333	0.389	0.417	0.417	0.333	0.361	0.222	0.222	0.278	0.222	0.333
10	0.333	0.694	0.722	0.139	0.083	0.722	0.611	0.667	0.583	0.417	0.5	0.583	0.556	0.556	0.444	0.333	0.611
11	0.417	0.167	0.25	0.556	0.556	0.25	0.25	0.361	0.222	0.444	0.194	0.222	0.139	0.083	0.361	0.417	0.417
12	0.417	0.167	0.25	0.5	0.5	0.306	0.306	0.361	0.222	0.389	0.194	0.222	0.194	0.139	0.306	0.417	0.417
13	0.389	0.194	0.278	0.528	0.528	0.333	0.278	0.389	0.25	0.417	0.222	0.25	0.222	0.167	0.333	0.389	0.389
14	0.417	0.444	0.472	0.278	0.222	0.528	0.583	0.639	0.556	0.5	0.361	0.444	0.361	0.361	0.472	0.472	0.528
15	0.278	0.194	0.167	0.25	0.194	0.222	0.278	0.278	0.25	0.306	0.111	0.194	0.111	0.111	0.333	0.444	0.333
16	0.139	-0.056	0.028	0.389	0.444	0.028	0.028	0.083	0.111	0.167	0.028	0.056	0.028	0.028	0.083	0.194	0.083
17	0.306	0.5	0.417	0.333	0.278	0.417	0.361	0.417	0.389	0.333	0.417	0.333	0.528	0.472	0.472	0.361	0.417
18	0.306	0.5	0.417	0.333	0.278	0.417	0.361	0.417	0.389	0.333	0.417	0.333	0.528	0.472	0.472	0.361	0.417
19	0.417	0.611	0.583	0.111	0.167	0.583	0.583	0.528	0.389	0.389	0.528	0.5	0.306	0.361	0.361	0.417	0.528
20	0.444	0.583	0.556	0.194	0.139	0.611	0.611	0.5	0.417	0.306	0.444	0.472	0.444	0.5	0.389	0.389	0.5
21	0.444	0.583	0.667	0.417	0.417	0.611	0.5	0.667	0.583	0.417	0.389	0.472	0.389	0.389	0.444	0.389	0.611
22	0.444	0.472	0.5	0.361	0.306	0.5	0.5	0.5	0.528	0.306	0.556	0.472	0.278	0.333	0.556	0.5	0.556
23	0.667	0.528	0.556	0.306	0.306	0.556	0.5	0.444	0.472	0.194	0.389	0.417	0.278	0.333	0.389	0.333	0.556
24	**1**	0.417	0.444	0.361	0.361	0.5	0.5	0.444	0.417	0.306	0.278	0.306	0.278	0.333	0.444	0.444	0.5
25	0.417	**1**	0.861	0.111	0.056	0.806	0.75	0.694	0.667	0.333	0.75	0.778	0.583	0.639	0.528	0.417	0.694
26	0.444	0.861	**1**	0.194	0.139	0.889	0.833	0.833	0.694	0.361	0.667	0.694	0.556	0.611	0.611	0.444	0.722
27	0.361	0.111	0.194	**1**	0.944	0.194	0.194	0.194	0.222	0.278	0.028	0.056	0.139	0.083	0.25	0.306	0.306
28	0.361	0.056	0.139	0.944	**1**	0.139	0.139	0.139	0.167	0.222	0.028	0	0.083	0.028	0.194	0.25	0.25
29	0.5	0.806	0.889	0.194	0.139	**1**	0.889	0.833	0.694	0.361	0.667	0.639	0.556	0.611	0.611	0.444	0.667
30	0.5	0.75	0.833	0.194	0.139	0.889	**1**	0.778	0.583	0.25	0.611	0.583	0.556	0.611	0.611	0.444	0.667
31	0.444	0.694	0.833	0.194	0.139	0.833	0.778	**1**	0.75	0.417	0.611	0.583	0.5	0.556	0.667	0.444	0.611
32	0.417	0.667	0.694	0.222	0.167	0.694	0.583	0.75	**1**	0.444	0.528	0.5	0.472	0.528	0.528	0.361	0.583
33	0.306	0.333	0.361	0.278	0.222	0.361	0.25	0.417	0.444	**1**	0.306	0.444	0.306	0.25	0.361	0.472	0.361
34	0.278	0.75	0.667	0.028	0.028	0.667	0.611	0.611	0.528	0.306	**1**	0.806	0.556	0.611	0.5	0.389	0.556
35	0.306	0.778	0.694	0.056	0	0.639	0.583	0.583	0.5	0.444	0.806	**1**	0.472	0.528	0.417	0.417	0.583
36	0.278	0.583	0.556	0.139	0.083	0.556	0.556	0.5	0.472	0.306	0.556	0.472	**1**	0.944	0.444	0.222	0.444
37	0.333	0.639	0.611	0.083	0.028	0.611	0.611	0.556	0.528	0.25	0.611	0.528	0.944	**1**	0.444	0.222	0.389
38	0.444	0.528	0.611	0.25	0.194	0.611	0.611	0.667	0.528	0.361	0.5	0.417	0.444	0.444	**1**	0.722	0.556
39	0.444	0.417	0.444	0.306	0.25	0.444	0.444	0.444	0.361	0.472	0.389	0.417	0.222	0.222	0.722	**1**	0.5
40	0.5	0.694	0.722	0.306	0.25	0.667	0.667	0.611	0.583	0.361	0.556	0.583	0.444	0.389	0.556	0.5	**1**

Cultural consultant	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	**1**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	**1**	0.972	0.694	0.556	0.667	0.5	0.556	0.5	0.556	0.417	0.417	0.444	0.583	0.278	0.194	0.417	0.417	0.472	0.444	0.611	0.333	0.444
3	0	0.972	**1**	0.667	0.528	0.639	0.472	0.583	0.528	0.583	0.444	0.389	0.417	0.611	0.306	0.167	0.444	0.444	0.5	0.417	0.639	0.361	0.417
4	0	0.694	0.667	**1**	0.639	0.639	0.472	0.75	0.306	0.694	0.278	0.222	0.25	0.5	0.306	0	0.444	0.444	0.444	0.528	0.472	0.583	0.472
5	0	0.556	0.528	0.639	**1**	0.611	0.444	0.556	0.389	0.389	0.25	0.25	0.278	0.472	0.222	0.028	0.361	0.361	0.417	0.444	0.556	0.611	0.556
6	0	0.667	0.639	0.639	0.611	**1**	0.611	0.722	0.333	0.556	0.361	0.361	0.389	0.472	0.222	0.139	0.25	0.25	0.472	0.444	0.556	0.5	0.5
7	0	0.5	0.472	0.472	0.444	0.611	**1**	0.556	0.222	0.5	0.25	0.306	0.333	0.472	0.278	0.083	0.306	0.306	0.306	0.333	0.5	0.389	0.444
8	0	0.556	0.583	0.75	0.556	0.722	0.556	**1**	0.333	0.722	0.25	0.25	0.278	0.472	0.167	0.028	0.472	0.472	0.583	0.556	0.611	0.5	0.5
9	0	0.5	0.528	0.306	0.389	0.333	0.222	0.333	**1**	0.278	0.417	0.361	0.333	0.472	0.222	0.306	0.139	0.139	0.361	0.278	0.444	0.222	0.222
10	0	0.556	0.583	0.694	0.389	0.556	0.5	0.722	0.278	**1**	0.25	0.25	0.278	0.472	0.222	0.028	0.528	0.528	0.417	0.5	0.556	0.333	0.444
11	0	0.417	0.444	0.278	0.25	0.361	0.25	0.25	0.417	0.25	**1**	0.889	0.861	0.389	0.472	0.389	0.167	0.167	0.222	0.194	0.417	0.25	0.194
12	0	0.417	0.389	0.222	0.25	0.361	0.306	0.25	0.361	0.25	0.889	**1**	0.917	0.389	0.361	0.444	0.167	0.167	0.278	0.306	0.417	0.139	0.306
13	0	0.444	0.417	0.25	0.278	0.389	0.333	0.278	0.333	0.278	0.861	0.917	**1**	0.361	0.333	0.417	0.25	0.25	0.194	0.222	0.444	0.167	0.333
14	0	0.583	0.611	0.5	0.472	0.472	0.472	0.472	0.472	0.472	0.389	0.389	0.361	**1**	0.528	0.222	0.278	0.278	0.444	0.417	0.583	0.472	0.361
15	0	0.278	0.306	0.306	0.222	0.222	0.278	0.167	0.222	0.222	0.472	0.361	0.333	0.528	**1**	0.083	0.083	0.083	0.083	0.167	0.278	0.389	0.167
16	0	0.194	0.167	0	0.028	0.139	0.083	0.028	0.306	0.028	0.389	0.444	0.417	0.222	0.083	**1**	0.056	0.056	0.111	-0.028	0.194	0.083	0.194
17	0	0.417	0.444	0.444	0.361	0.25	0.306	0.472	0.139	0.528	0.167	0.167	0.25	0.278	0.083	0.056	**1**	1	0.333	0.361	0.472	0.361	0.361
18	0	0.417	0.444	0.444	0.361	0.25	0.306	0.472	0.139	0.528	0.167	0.167	0.25	0.278	0.083	0.056	1	**1**	0.333	0.361	0.472	0.361	0.361
19	0	0.472	0.5	0.444	0.417	0.472	0.306	0.583	0.361	0.417	0.222	0.278	0.194	0.444	0.083	0.111	0.333	0.333	**1**	0.639	0.528	0.361	0.417
20	0	0.444	0.417	0.528	0.444	0.444	0.333	0.556	0.278	0.5	0.194	0.306	0.222	0.417	0.167	-0.028	0.361	0.361	0.639	**1**	0.444	0.389	0.444
21	0	0.611	0.639	0.472	0.556	0.556	0.5	0.611	0.444	0.556	0.417	0.417	0.444	0.583	0.278	0.194	0.472	0.472	0.528	0.444	**1**	0.389	0.556
22	0	0.333	0.361	0.583	0.611	0.5	0.389	0.5	0.222	0.333	0.25	0.139	0.167	0.472	0.389	0.083	0.361	0.361	0.361	0.389	0.389	**1**	0.444
23	0	0.444	0.417	0.472	0.556	0.5	0.444	0.5	0.222	0.444	0.194	0.306	0.333	0.361	0.167	0.194	0.361	0.361	0.417	0.444	0.556	0.444	**1**
24	0	0.5	0.472	0.472	0.556	0.444	0.333	0.389	0.389	0.333	0.417	0.417	0.389	0.417	0.278	0.139	0.306	0.306	0.417	0.444	0.444	0.444	0.667
25	0	0.528	0.556	0.722	0.528	0.639	0.528	0.917	0.306	0.694	0.167	0.167	0.194	0.444	0.194	-0.056	0.5	0.5	0.611	0.583	0.583	0.472	0.528
26	0	0.5	0.528	0.694	0.611	0.722	0.5	0.889	0.278	0.722	0.25	0.25	0.278	0.472	0.167	0.028	0.417	0.417	0.583	0.556	0.667	0.5	0.556
27	0	0.25	0.222	0.167	0.306	0.25	0.25	0.139	0.194	0.139	0.556	0.5	0.528	0.278	0.25	0.389	0.333	0.333	0.111	0.194	0.417	0.361	0.306
28	0	0.306	0.278	0.111	0.306	0.25	0.194	0.083	0.25	0.083	0.556	0.5	0.528	0.222	0.194	0.444	0.278	0.278	0.167	0.139	0.417	0.306	0.306
29	0	0.556	0.528	0.75	0.611	0.778	0.5	0.833	0.333	0.722	0.25	0.306	0.333	0.528	0.222	0.028	0.417	0.417	0.583	0.611	0.611	0.5	0.556
30	0	0.5	0.472	0.694	0.611	0.667	0.444	0.722	0.333	0.611	0.25	0.306	0.278	0.583	0.278	0.028	0.361	0.361	0.583	0.611	0.5	0.5	0.5
31	0	0.611	0.639	0.694	0.667	0.722	0.5	0.778	0.389	0.667	0.361	0.361	0.389	0.639	0.278	0.083	0.417	0.417	0.528	0.5	0.667	0.5	0.444
32	0	0.472	0.5	0.556	0.694	0.583	0.472	0.694	0.417	0.583	0.222	0.222	0.25	0.556	0.25	0.111	0.389	0.389	0.389	0.417	0.583	0.528	0.472
33	0	0.472	0.5	0.389	0.361	0.361	0.472	0.417	0.417	0.417	0.444	0.389	0.417	0.5	0.306	0.167	0.333	0.333	0.389	0.306	0.417	0.306	0.194
34	0	0.444	0.472	0.639	0.556	0.611	0.444	0.778	0.333	0.5	0.194	0.194	0.222	0.361	0.111	0.028	0.417	0.417	0.528	0.444	0.389	0.556	0.389
35	0	0.528	0.556	0.667	0.472	0.528	0.528	0.806	0.361	0.583	0.222	0.222	0.25	0.444	0.194	0.056	0.333	0.333	0.5	0.472	0.472	0.472	0.417
36	0	0.444	0.417	0.417	0.444	0.5	0.556	0.556	0.222	0.556	0.139	0.194	0.222	0.361	0.111	0.028	0.528	0.528	0.306	0.444	0.389	0.278	0.278
37	0	0.389	0.361	0.472	0.5	0.5	0.5	0.611	0.222	0.556	0.083	0.139	0.167	0.361	0.111	0.028	0.472	0.472	0.361	0.5	0.389	0.333	0.333
38	0	0.556	0.583	0.583	0.611	0.667	0.389	0.556	0.278	0.444	0.361	0.306	0.333	0.472	0.333	0.083	0.472	0.472	0.361	0.389	0.444	0.556	0.389
39	0	0.389	0.417	0.417	0.389	0.444	0.389	0.444	0.222	0.333	0.417	0.417	0.389	0.472	0.444	0.194	0.361	0.361	0.417	0.389	0.389	0.5	0.333
40	0	0.556	0.583	0.583	0.5	0.667	0.611	0.722	0.333	0.611	0.417	0.417	0.389	0.528	0.333	0.083	0.417	0.417	0.528	0.5	0.611	0.556	0.556

APPENDIX L

INSTITUTIONAL REVIEW BOARD APPROVAL

FOR HUMAN-SUBJECTS RESEARCH

EXEMPTION GRANTED

Steven Semken
Earth and Space Exploration, School of (SESE)
480/965-7965
semken@asu.edu

Dear Steven Semken:

On 9/8/2014 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Ethnogeological study in Puerto Rico and Hispaniola.
Investigator:	Steven Semken
IRB ID:	STUDY00001361
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• V2Consent Form Social Behavioral Study English.pdf, Category: Consent Form; • V3Garcia_Angel_A_Jr HRP-503PROTOCOL SOCIAL.docx, Category: IRB Protocol; • FinalSCRIPT GRAND TOURS English.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Semken cover letter.pdf, Category: Other (to reflect anything not captured above); • Letter from Cacike Baracutei.pdf, Category: Other (to reflect anything not captured above); • AA Garcia statement.pdf, Category: Other (to reflect anything not captured above); • FinalSCRIPT FREELIST English.pdf, Category: Participant materials (specific directions for them); • V2 RECRUITMENT SCRIPT English.pdf, Category: Recruitment Materials;