Heritage Interpretation Versus the Greatest Crisis the National Park Service has Ever Known

Bryan R. Petryl

Utah State University

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HERITAGE INTERPRETATION VERSUS THE GREATEST CRISIS THE NATIONAL PARK SERVICE HAS EVER KNOWN

By

Bryan R. Petrtyl

A paper submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

Recreation Resource Management

Approved:

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UTAH STATE UNIVERSITY
Logan, Utah

2013
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“Unless someone like you cares a whole awful lot, nothing is going to get better. It's not”

Dr. Seuss
The Lorax

I would like to thank Dr. Steven Burr, Associate Professor at Utah State University, for providing me with assistance and funding during my Master’s project. I would also like to thank Blair Larsen, Geology Lecturer at Utah State University, and Dr. Christopher Monz, Associate Professor at Utah State University, for the valuable help they provided. In addition I would like to thank Todd Stoeberl, Chief of Interpretation at Wrangell St. Elias National Park & Preserve, for providing me with employment during the project as well as greatly helping me with my National Park Service career. I would also like to thank Paul Ollig, Deputy Chief of Interpretation for Field Operations at Yosemite National Park, Dr. Joshua Samuels, Chief of Paleontology at John Day Fossil Beds National Monument, and Michelle Ordway, Education Specialist at John Day Fossil Beds National Monument, for providing expertise and guidance throughout my internship at John Day Fossil Beds National Monument.

Finally, a special thanks goes to the National Park Service Climate Change Response Program and the National Council for Science and Environment for providing me with the internship needed to complete this project.
The greatest trick is to create the greatest crisis society has ever known without anyone recognizing it as such. In a society that mainly works with a sudden crises mentality, a problem whose negative effects are slowly spread out over decades and centuries is very easy to ignore, no matter how dire those effects will be in the long run. This trick is made all the more potent by occurring in a society that must witness destruction before it acts in a substantial manner; if visible destruction wrought by the crisis only occurs when it is too late to do anything about it, then the consequences could potentially lead to society’s collapse. Climate Change comes extremely close to being this greatest trick; propagated by a society that generally no longer finds the importance of providing for the needs of future generations through the preservation of natural resources and natural areas relevant, climate change is all too easily ignored or given importance much lower than necessary because its visible consequences only occur in this medium. Unfortunately a disconnect between humans and their survival needs prevents recognition of these resources as something more than a luxury; they are items humans require for survival. The salmon fisheries of Alaska, the breadbasket of the Great Plains, the rangelands of the West, these are all outcomes of previous climate changes; what happens to U.S. society if the current climate change leads to an environment that puts these ecosystems at a disadvantage, or, worse yet, leads to their end? While this might seem like the spoutings of a doom and gloom prophet or conspiracy theorist, one only needs to look to the fossil record to find evidence this outcome is not only possible, similar if not worse outcomes have occurred before! It seems that an old saying, slightly modified for the correct context, holds true: those who do not know (geologic) history are doomed to repeat it.

However, there is hope; if society can be made aware of the severity of the consequences of climate change, it can at least prepare for these outcomes, if not reduce them. What better way to do this in U.S. society than by revealing how something this society treasures is threatened by climate change. Something that has been repeatedly called “America’s best idea.”
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INTRODUCTION

The concept of “wicked problems” emerged as a result of planning problems; Rittle and Weber (1973) developed the concept largely in response to the difficulties in trying to solve planning and policy problems. Unlike problems faced in the traditional sciences, the problems of their fields had no solution, which lead to frustration by both managers and the public, and a need for science to acknowledge and understand this new problem type. Over the last forty years, wicked problems have come to be understood as a part of all social sciences; thus, they are also a part of all agencies that manage social goods, including land management agencies. The common ground connecting the two (social sciences and social agencies) upon which wicked problems lie, is they involve multiple stakeholders who have different opinions about a given problem and its solutions, and these problems have solutions that cannot be tested and revised, or deemed right or wrong (Munneke, Andriessen, Kanselaar, & Kirschner, 2006). Thus, wicked problems are ill-defined and they rely upon judgment for resolution (Rittle & Weber, 1973). Note the inclusion of the word resolution in the previous sentence instead of the word solution; “Social problems are never solved. At best they are only re-solved over and over again” (Rittle & Weber, 1973, p. 160). This is perhaps the main attribute that differentiates them from the “tame” problems normally found in the non-social sciences. However, this attribute is not the only one; ten characteristics of wicked problems have been proposed. These characteristics were first stated by Rittle and Weber (1973) and are as follows: (1) There is no definitive formulation of a wicked problem; (2) Wicked problems have no stopping rule; (3) Solutions to wicked problems are not true-or-false, but good-or-bad; (4) There is no immediate and no ultimate test of a solution to a wicked problem; (5) Every solution to a wicked problem is a one-shot operation; every attempt counts significantly; (6) Wicked problems do not have an enumerable set of potential solutions, nor is there a well-described set of permissible operations; (7) Every wicked problem is
essentially unique; (8) Every wicked problem can be considered to be a symptom of another problem; (9) The existence of a discrepancy representing a wicked problem can be explained in numerous ways. The choice of explanation determines the nature of the problem's resolution; and (10) The planner has no right to be wrong. Ultimately, the wicked problem concept is best seen by examining a specific wicked problem; its attributes will be in sharp contrast compared to the attributes of a tame problem (Brooks & Champ, 2006). By far the best example of a wicked problem in current society is anthropogenic climate change; its attributes have evolved the wicked problem concept from the domain of planning into the domain of every person currently living, as well as into the lives of hundreds of millions who have yet to be born.

Wicked Problem of Climate Change

Climate change is a wicked problem primarily because it cannot be solved, only resolved, and even this is doubtful because of the extreme difficulty involved. At its core, climate change resolution depends on a significant portion of American society changing their behavior; unfortunately there are numerous, nearly insurmountable roadblocks currently preventing this from occurring. First, a 2010 report conducted by the Yale Project on Climate Change Communication found only 63% of Americans believe global warming is happening, while 19% believe it is not occurring, and 19% do not know (Leiserowitz & Smith, 2010). In addition, only 50% of Americans believe global warming is caused “mostly by human activities” (Leiserowitz & Smith, 2010). While at first glance this appears potentially positive, scientific theory has recognized beliefs are only the beginning step in a chain of several events that usually (not always) leads to behavior change (Ajzen, 1991). This is problematic because scientific research has highlighted behavior change by the public is needed to resolve the issue; a 2007 report by the Intergovernmental Panel on Climate Change (IPCC) determined, “There is very high confidence that the global average net effect of human activities since 1750 has been one of warming” (p.
They defined the term “very high confidence” as meaning at least a nine out of ten chance of occurring. Additionally, the report concluded, “Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG (greenhouse gas) concentrations” (IPCC, 2007, p. 39), with very likely defined as a ninety percent chance of occurring. Hence, it is safe to say the current climate change is one of anthropogenic origins; as such, in order to resolve it, human activities must change, which requires behavior to change, which requires a chain of events that starts with changing beliefs. Therefore, even if 100% of Americans believed in climate change and believed that it was primarily caused by human activities, a considerable effort would still be needed to turn those beliefs into actions that would resolve the problem.

An additional roadblock related to belief in anthropogenic climate change is the public’s perception of the science of climate change. There is a strong consensus among scientists that earth’s climate is currently changing and human based activity is contributing to it; Anderegg, Prall, Harold, and Schneider (2010) found “97-98% of the climate researchers most actively publishing in the field support the tenets of ACC (anthropogenic climate change) outlined by the Intergovernmental Panel on Climate Change” (p. 1); a review by Hamilton (2010) revealed several additional studies that came to the same result. However, the report “Knowledge of Climate Change across Global Warming’s Six Americans” by Leiserowitz and Smith (2010) reveals a discrepancy with this consensus and the public’s view of the consensus among scientists. The report classified U.S. society into six audiences based on their response to global warming: alarmed, concerned, cautious, disengaged, doubtful, and dismissive, and discovered the highest level of concern categories (alarmed, concerned, and cautious) contained the highest percentage of people who believe “most scientists think global warming is happening,” whereas the categories with the least amount of concern (doubtful and dismissive) believe “there is a lot of disagreement among scientists about whether or not global warming is happening” (Leiserowitz
& Smith, 2010). Contributing to this discrepancy, and thereby to the wickedness of the climate change problem, is the media, including journalists and news reporters. They actively promote skepticism of climate change and its causes as decisively stated by Boykoff and Boykoff (2007):

...US mass-media have misrepresented the top climate scientific perspective regarding anthropogenic climate change. Moreover, the mass-media have allowed a small group of climate-change contrarians or ‘climate skeptics’ to emerge from conservative think tanks to proliferate and amplify their “denial discourse” that “global warming is not scientifically provable or that it is not a serious issue. (p. 1193)

Thirdly, many of the individuals who accept anthropogenic climate change believe the problem is so overwhelming and/or the actions required to combat it are so imposing that only a small percentage of people are actually taking steps to reduce climate change, which leads to an increase in the severity of its harmful impacts. The final roadblock, and perhaps the worst one of all, is the percentage of people who do not act to reduce climate change because they fail to understand its consequences. A 2011 survey of the American public by Leiserowitz, Maibach, Roser-Renouf, and Smith found more than half (53%) of the respondents think global warming will only harm them a little or not at all, nearly half (49%) belief global warming will harm their families only a little or not at all, and over half (58%) either do not know how global warming will harm people in the U.S. or think it will harm them only a little (23%) or not at all (17%). In addition, over 40% of respondents either do not know if global warming will harm future generations or think it will only harm them a little (10%) or not at all (12%) (Leiserowitz et al., 2011). These results strongly indicate there is not a good understanding of the potential impacts and consequences of climate change.

Therefore, because of these numerous roadblocks in the path leading to a resolution of climate change, many of which echo the ten characteristics laid out by Rittle and Weber, climate change is an example of a wicked problem. Furthermore, it is on the verge of creating a whole new category of problems that are even more difficult to address than wicked problems, for not only does climate change not have a solution, it also probably does not have an achievable
resolution. However, this Master’s project will still attempt to contribute to its resolution. While it would be easier to address a more simple but still Masters worthy problem, the consequences of climate change are far too great for one to ignore, especially when they threaten a societal treasure that also happens to be the subject of many peoples’ life’s work.

Climate Change: A National Park Service Problem

Considered to have started in 1872 with the passage of the Yellowstone Act and the establishment of Yellowstone National Park, the national parks were called “the best idea we (America) ever had” by writer Wallace Stegner (1948, p. 137), a statement oft repeated. However, the ideals underlying this idea are somewhat murky for most people, even though they have changed little since the beginning. Set aside to be “a public pleasuring ground,” as specifically stated in its organic act, most assume Yellowstone was reserved for a national park because the only viable commercial value of its land appeared to be tourism; this same reason is given as being behind the establishment of many of the first national parks (Runte, 1977; Wellman & Probst, 2004). As such, enjoyment and tourism are often considered the founding ideals of the national parks; however, a deeper examination reveals another ideal often overlooked, preservation. The Yellowstone Act of 1872 itself contains the sentence “regulations shall provide for the preservation, from injury or spoliation, of all timber, mineral deposits, natural curiosities, or wonders within said park, and their retention in their natural condition” (Sec 2). Thus, this ideal for national parks has been established by Congress from the very beginning as it was specifically mentioned in the first national park organic act. In addition, the Act also states the Secretary of the Interior "shall provide against the wanton destruction of the fish and game found within said park, and against their capture or destruction for the purposes of merchandise or profit" (Sec 2), which provides evidence that contradicts the widely held view of Congress only creating the park because the land had no monetary value, and consequently, its
main ideal was to be tourism. Further evidence is provided by the reaction of Congress to the threat of resources being illegally used by private, commercial operators, including shepherders and cattle ranchers grazing their livestock in the park and hunters poaching the rich wildlife for market purposes (i.e. market hunters). If the main reason the park was set aside was the land being deemed worthless, then Congress should have viewed this newly found commercial value as an appropriate use. Instead, they ordered the U.S. Calvary to protect the parks (Wellman & Probst, 2004) and when it was recognized that a permanent organization was needed to manage the parks, passed the 1916 Organic Act that created the National Park Service (NPS); as such, it should be clear Congress has included the ideal of preservation since the very beginning of the national park idea.

The NPS’s mission, as established in the Organic Act, is: “to conserve the scenery and the natural and historic objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations” (The National Park Service Organic Act, 1916, para. 1). Thus, the NPS is often considered to have a dual mandate to both provide for recreation and for preservation of resources, which, as one would assume, often conflicts with one another. However, a deep examination of materials reveals a seldom known truth; the NPS has one primary mandate, preservation, and one secondary mandate, recreation. This was established, and has been consistently maintained, by not only the Federal Court System, but also by several acts of Congress. Further evidence is found in the General Management Plans of most national parks; even parks that are often considered to be highly developed, parks such as Yosemite and Zion, abide by a 90/10 rule; 90% of the park is left undeveloped and/or managed as wilderness, while only 10% or less is actually developed. This is not to imply the NPS dismisses the importance of recreation, but rather to show the weight placed on preserving resources by the NPS and by the entities in the Federal Government the NPS answers to. Consequently, this mandate established
in the Organic Act drives almost all functions of the NPS in some way, shape, or form and serves as a constant reminder of the responsibility it has to American society; in accordance, not achieving this mandate is viewed as a failure of the agency by both its employees and by the public. As such, any challenges that threaten the NPS’s ability to abide by its mandate must be overcome; however, as time has passed, these challenges have greatly increased in number, diversity, and complexity, especially as science reveals a more complete understanding of the consequences of humans interacting with the environment. More and more, these challenges are considered great threats to NPS resources, with the ability to cause significant harm to them, preventing their preservation. A great example is the growing number of items that fall underneath the category of external threats; these are human actions that both occur outside of NPS boundaries and negatively impact the cultural, historical, or natural resources of NPS sites. These items include air pollution, water pollution, spread of exotic and invasive species, and habitat loss and fragmentation. The greatest of all these threats, both external and otherwise, also happens to be one of the most difficult of wicked problems to resolve, climate change; this threat will prevent the NPS from, at least, meeting its mandate of resource protection if action is not taken soon. As current director of the NPS Jonathan Jarvis said, “I believe climate change is fundamentally the greatest threat to the integrity of our national parks that we have ever experienced” (NPS, 2010, p. 1). In agreement, a NPS report published in 2010 titled Climate Change Response Strategy stated, “global climate change threatens the integrity of our national parks. It challenges the NPS mission to leave park resources unimpaired for future generations unlike any threat in our history” (p. 3).

Climate change is already a current real and pervasive threat for NPS natural, historical, and cultural resources and that threat will only become worse as time passes. Current and future outcomes include: increased severity, frequency, and size of wildfires; outbreaks of pests, pathogens, disease, and nonnative species invasion; loss or relocation of native species; altered
vegetation patterns; and ocean warming and acidification, which causes damage to and loss of wildlife habitat (NPS, 2010). In addition, some of the impacts wrought by climate change will damage and destroy some of the NPS’s cultural and historical resources, in addition to its natural resources. This will primarily occur as a result of rising sea levels; climate change is increasing the volume of ice melted each year from a variety of sources, including glaciers and icefields. “Since 1993 sea level has been rising at a rate of about 3 millimeters per year” (National Snow and Ice Data Center, 2009, para. 1); if global sea levels rise by one meter, more than two million square kilometers of land will be flooded globally. Rising sea levels will affect land management agencies; the NPS found it will affect “cultural and historic features, coastal archeological sites, and park infrastructure, resulting in damage to and the loss of some coastal resources” (NPS, 2010, p. 5). In addition to rising sea levels, other climate change impacts that have significant potential to destroy historical and cultural resources include thawing permafrost and an increase in the frequency, duration, and size of wildfires (NPS, 2010). Consequently, the harmful impacts of climate change will not only impact the ecosystems of NPS sites, but also historical and archeological features, which will greatly affect visitors of NPS sites, and significantly reduce managers’ abilities to meet the mandates of the NPS Organic Act.

**National Park Service Climate Change Response Strategy**

The first steps forward in a potential resolution of the harmful impacts of climate change on NPS managed lands lie in the NPS developing and implementing a new management approach that provides guidance to its employees about this issue. This new approach is necessary because the current NPS management approach used to resolve most of its threats is to manage how NPS visitors behave in NPS sites; this conflicts with the wicked problem of anthropogenic climate change because its negative impacts can only be stopped with a large percentage of society (not just NPS visitors) changing their behavior, and these behavior changes must occur throughout a
person’s life, not just when they are in NPS sites. Thus, it requires the NPS to develop and implement new management approaches that utilize different tools, tools that create long term behavior changes in at least American society. In addition, if there is any hope of stopping climate change from preventing the NPS to meet its mandate of resource protection, these tools must be able to change people’s day-to-day behavior, especially their home, school, and work behavior. In accordance, the NPS has developed a different management approach for climate change, which is presented in a report titled *Climate Change Response Strategy* (2010). Its purpose is to “provide direction to our agency and employees to address the impacts of climate change” (NPS, 2010, p. 3), and contains four integrated components that serve as a guide to actions in addressing the impacts of climate change: science, adaptation, mitigation, and communication.

The goals of the science component include developing and applying climate change science, collaborating with scientists from other organizations and agencies in order to advance climate change science, and to conduct studies and resource monitoring activities necessary to support the other components in the response strategy (NPS, 2010). The purpose of the adaptation component is to provide adaptation planning, promote ecosystem resilience, protect facilities and infrastructure, and to preserve cultural heritage (NPS, 2010). The mitigation component has the overall goal of limiting NPS greenhouse gas emissions and incorporating mitigation practices into NPS operations, which will lower the Agency’s carbon footprint (NPS, 2010). The goals of the last component, communication, include increasing the NPS’s climate change knowledge and understanding, distributing this knowledge throughout the agency, and leading by example in terms of communicating sustainable practices to the public (NPS, 2010). The final goal for the communication component is to “provide external communications about the implications of climate change and the National Park Service response” (NPS, 2010, p. 22); it is in this goal where the purpose of this paper and corresponding Master’s project lies.
The component of communication includes interpretation as one of its objectives; specifically, it tasks interpretation with creating “interpretive products and programs that educate general audiences about the impacts of climate change and climate friendly technologies and practices” (NPS, 2010, p. 22). However this is the only one out of forty-seven objectives that specifically mentions interpretation; since interpretation is one of the few tools available to the NPS that can target the problem of climate change and not just its symptoms, it is the author’s opinion the Climate Change Response Strategy does not give interpretation the respect it is due. Heritage, or resource, interpretation (hereafter referred to as “interpretation”) is “a mission-based communication process that forges emotional and intellectual connections between the interests of the audience and meanings inherent in the resource” (National Association for Interpretation, 2007, Interpretation, para. 1). The National Park Service defines interpretation as “a catalyst in creating opportunities for the audience to form their own intellectual and emotional connections with the meanings and significance inherent in the resource” (Interpretive Development Program, n.d., para. 3). It has been seen by management, for quite some time, as a tool that can be used to both raise visitors’ awareness and to have them voluntarily reduce their inappropriate behavior (Ballantyne & Uzell, 1999). Interpretation is especially well suited to creating the behavior changes needed to combat anthropogenic climate change; it is one of the few items that can accomplish the necessity of affecting behavioral beliefs, which creates changes in behavior, and it can affect the majority of U.S. society’s population, including people who do not visit NPS sites, through the use of interpretive media such as websites, podcasts, and videos. Thus, interpretation meets the requirements of an item that can provide a potential resolution to climate change; as such, it should serve as a major part of the NPS’s new management approach. Perhaps the best way of showing the importance of using interpretation in the resolution of climate change is to put it to the test.
LITERATURE REVIEW

Due to the nature of the previously mentioned goal of providing evidence for the need to increase the importance of interpretation in the NPS Climate Change Response Strategy, it is imperative to have a good grasp of the literature relevant to interpretation, with a focus on its history, purpose, and direct effects on people; in addition, a theoretical basis of the mechanisms by which interpretation can affect behavior needs to be examined and understood, and a conceptual model developed that will ensure the main goal of the project is met.

Interpretation History

In the grand scheme of things, the field of interpretation is a new profession not only in terms of formal organization but even in terms of its first practitioner. Its beginnings lie with certain popular writers and speakers who “encouraged the public to take an interest in scenic, scientific, and cultural resources found on public lands” (Brewer, 2006, p. 81). The use of the term “interpretation” with the meaning of creating connections between a person and a resource did not occur until 1871 when John Muir, while in Yosemite Valley, wrote “I’ll interpret the rocks, learn the language of flood, storm, and avalanche” (Ortiz, 2007). While the NPS recognizes this as the first use of interpretation with its modern definition, however, in this instance, the term still more strongly suggests understanding rather than communication (Mackintosh, 1986, Before NPS, para. 2). Along similar lines, if the definition of interpreter is loosened, then the first interpreters can be considered to be the U.S. Calvary men stationed in Yellowstone National Park beginning in 1886 (Mackintosh, 1986, Before NPS, para. 3); some of these soldiers explained thermal features to visitors, as well as topics including ornithology, zoology, and botany (Knudson, Cable, & Beck, 2003). Also occurring at Yellowstone National Park during the 1880s were the Wylie Camps. This company, run by William Wylie, offered tent
shelters and guided tours; in addition, the job of employees was to “serve guests, to entertain them, and to interpret to them” (Knudson et al., 2003, p. 107). These camps hired teachers to give lectures and campfire programs to Yellowstone visitors (Mackintosh, 1986), which is considered to be the origin of this popular type of interpretation program. The first person to be referred to as a park interpreter was an early assistant to the Superintendent of Yellowstone National Park named George Henderson (Ortiz, 2007). During the more than twenty years he spent in Yellowstone, he “posted signs about the natural and cultural sites of interest, wrote educational and informational articles, gave tours, and provided entertainment among the world renowned geysers by reading poetry and telling stories” (Ortiz, 2007, p.12).

Perhaps the first person to meet the modern definition of an interpreter was Enos Mills; considered the father of interpretation, he led people on tours of Rocky Mountain National Park starting in 1889 and therefore, can be considered as one of the first nature guides. In 1920, he wrote a book titled *Adventures of a Nature Guide*; this book describes the techniques he used on his tours, techniques that would become the foundation of the field of interpretation (Berkler, 2009). He “insisted that nature guiding should be more inspirational than informational” (Knudson et al., 2003, p. 108), and created a formula for the best nature guiding. Enos Mills established Longs Peak Inn near Estes Park Colorado in 1901 and licensed young women employed by local hotels to nature-guide during its existence. Also in the early 1900s, interpretation began to spread from interpreting just natural resources to interpreting cultural and historical resources as well. In 1905, Frank Pinkley, while working at Casa Grande Ruin Reservation became a pioneer in cultural resource interpretation when he displayed and explained artifacts recovered from one of the ruin’s archeological excavations (Mackintosh, 1986). Overall, this earliest time period in the history of interpretation reveals its foundation lies in the hard work of several key figures who presented the meanings inherent in resources by guiding visitors on trails and sites, giving talks and programs, and by creating displays. Those who also created
training programs for guides, such as Enos Mills, “became gatekeepers to the history of interpretation and defined key moments” (Brewer, 2006, p. 82). Eventually, these training programs became more formalized, primarily within the realm of the National Park Service; Yellowstone and Yosemite National Parks led the way in this endeavor. In the 1920s, Dr. Harold C. Bryant established and directed the Yosemite Free Nature Guide Service. “The program included daily guided hikes, evening campfire talks, and lectures at Camp Curry illustrated by motion pictures” (Mackintosh, 1986, The Park Service Assumes Responsibility, para. 6). In addition, the Yosemite School of Natural History was established at the same time; it had the purpose of training students, who had spent at least two years in college, to be park naturalists, primarily by using field observation and identification (Ortiz, 2007). At Yellowstone National Park, Milton P. Skinner became the NPS’s first official park naturalist, the forerunner of today’s interpretation park ranger (Mackintosh, 1986); he gave lectures, conducted field trips, and created natural history bulletins.

Starting in the late 1920s and early 1930s, interpretation programs began to take advantage of the latest technology, a characteristic that remains with them today. Mesa Verde, Yosemite, Yellowstone, Grand Canyon, Sequoia and several battlefield parks created guided automobile caravans where “the interpreter in the park car leading the procession sometimes broadcast(ed) to his followers via a rooftop loudspeaker” (Mackintosh, 1986, Audiovisual Innovations, para. 2). In addition, park naturalists began to accompany private tour operators located within national park sites including private flight companies over Grand Canyon National Park and deep sea fishing operators in Acadia National Park (Mackintosh 1986), a practice continued today by interpretation park rangers in several NPS sites.

Interpretation as the modern professional field known today is a result of events starting in the late 1950s. In 1955, at the request of the NPS, writer Freeman Tilden created the first formal interpretation training manual for NPS interpreters, *Interpreting Our Heritage.*
Considered the father of modern interpretation, Freeman Tilden developed this book from research he performed, including participating as an interpreter, which he then integrated into six fundamental principles. *Interpreting Our Heritage* presents these principles in a unique way that makes them still relevant today; this book is not written in the format of a text book (presentation of information for education) or a how-to-guide (application of information in the related field), but rather in a somewhat unique, more abstract style. Tilden presents his six principles and then uses a multitude of examples to both reveal the principle and to reveal the concepts and components of each principle. Explanations in the format of more conventional means such as definitions, facts, or theories, are limited or not included (although this does vary from principle to principle). The consistent use of this abstract style by Tilden allows his principles to be relevant in current times without modification because of the interaction it forces upon the reader. It is up to reader to draw information from the examples that relates to the interpretation principle being presented and to determine (most of the time) how he/she will apply it. The reader performs this interaction in the context most familiar to him/her, which is the society the reader claims as his/her own. Therefore, Tilden’s principles are related to the reader in the context of current time without the need for modification; as such this book is not only considered relevant sixty-five years later, it is still used by the National Park Service as a training manual for its interpreters.

The 1960s saw additional work performed by the NPS in the advancement of the field of interpretation; in 1962 they addressed some of interpretation’s shortcomings by developing ten interpretive objectives, including the following:

1. Seek, develop, and test new methods, new interpretive tools, and new techniques.
2. Adapt those which prove effective and are appropriate to the concept of National Park interpretation, but resist the temptation to promote the novel for the sake of novelty.
3. Raise the standards of recruitment and selection so as to obtain men of high competence and high potential as interpreters, with special emphasis on broad
training in natural history, history and archeology coupled with great communications skills.

4. Provide a progression of interpretive opportunities—in addition to, and above the common denominator level—to meet the needs of the better informed, more experienced, and the more seriously interested visitor. . . . (Mackintosh, 1986, Interpreting Interpretation, para. 10).

The result of these fruits of labor, and from others outside the NPS, was the establishment of two interpretation professional organizations, the Association of Interpretive Naturalists and the Western Interpreters Association; they combined in 1988 and became the National Association for Interpretation (NAI) (Berkler, 2009). NAI is the largest organization for interpreters with members in thirty-three countries; it provides resources and support for interpreters, including a certified, well evaluated training program that has been described “as a crucial step in the professionalization of interpretation” (Brewer, 2006, p. 82). In addition, several authors and researchers expanded on Freeman Tilden’s six principles by creating new principles, including Larry Beck and Ted Cable’s fifteen principles for interpreting nature and culture, which were first published in 1998 in the book Interpreting for the 21st Century: Fifteen Guiding Principles for Interpreting Nature and Culture.

The most recent action in the history of interpretation has been the creation and expansion of the Interpretive Development Program (IDP) by the National Parks Service, and, later, the Eppley Institute for Parks and Public Lands, a University of Indiana outreach program. The IDP is a formal training and certification program for NPS interpreters based on the following three tenets: resources possess meanings and have relevance, visitors seek something of value for themselves, and interpretation facilitates a connection between the interests of the visitor and the meanings of the resource (Chen, Wang, & Larsen, 2000). As such, the NPS is considered to have “recently taken the lead in advancing interpretive theory and establishing principles for effective interpretive practice(s)” (Chen et al., 2000, p. 340).
Interpretive Theory and Principles

Throughout this history of interpretation, its primary purpose has more or less stayed the same; to “translate the meanings of artifacts, collections, events, and physical resources into a language that helps visitors understand these resources” (Interpretive Development Program, n.d., para. 1). This translation leads to connections between resources and visitors, which leads to the ultimate intent of interpretation that was so eloquently written in a NPS administrative manual:

“Through interpretation, understanding; through understanding, appreciation; through appreciation, protection” (as cited in Tilden, 1977, p. 65).

Fortunately there are a variety of theories, principles, and techniques (hereafter known as interpretation tools) available to interpreters to help them in this task. The foundational structure of these items is Freeman Tilden’s (1977, p. 34) six principals of interpretation:

1. Any interpretation that does not somehow relate to what is being displayed or described to something within the personality or experience of the visitor will be sterile.

2. Information, as such is not interpretation. Interpretation is revelation based upon information. But they are entirely different things. However, all interpretation includes information.

3. Interpretation is an art, which combines many arts whether the materials presented are scientific, historical, or architectural. Any art is in some degree teachable.

4. The chief aim of interpretation is not instruction, but provocation.

5. Interpretation should aim to present a whole rather than a part and must address itself to the whole man rather than any phase.

6. Interpretation addressed to children (say, up to the age of twelve) should not be a dilution of the presentation to adults, but should follow a fundamentally different approach. To be at its best it will require a separate program.

While all of these principles are crucial in the development of effective interpretation programs, a few are also extremely important in the context of this paper. The fourth principle of provocation is one example; provocation, in the context of interpretation, is defined as stimulating “the reader or hearer toward a desire to widen his horizon of interests and knowledge, and to gain an understanding of the greater truths that lie behind any statement of fact” (Tilden, 1977, p. 59).
Research shows that if interpretation is going to influence visitors’ attitudes, it “will depend mainly on how much it provokes the visitor to think about the information it presents…” (Ham, 2007, p. 42). This principle helps to reveal Tilden’s very forward thinking; it has since gained strong scientific support from the constructivist theory. As Ham (2009) stated, “Tilden was thinking like a constructivist when he wrote ‘not instruction, but provocation’” (p. 51). This theory involves “building new knowledge, values, and beliefs on each individual’s earlier constructs of knowledge and values” (Knudson et al., 2003, p. 110). In addition, “it recognizes that people learn in different ways” (Knudson et al., 2003, p. 110), and “build on what they know and have experienced” (Knudson et al., 2003, p. 110). Finally, the constructivist theory or approach postulates “that learners play an active role in learning situations and construct learning regarding such experiences” (Ballantyne & Uzell, 1999, p. 66). In the context of principle four, the constructivist approach recognizes people derive meaning from new information by being active participants in the learning process. Provocation is a powerful way of engaging the audience and provides a strong mechanism through which they can become active in the learning process. Therefore, interpretation that provokes has a greater chance of affecting the audience, including changing their behavior; thus, it will be more successful in meeting the ultimate intent of interpretation. This provocation, and the constructivist theory by extension, is best integrated into interpretation programs through the use of a theme statement, which is the take-home message an interpreter imparts on the audience of a program.

From a broader viewpoint, constructivist theory has another important lesson; interpreters who wish to impact visitor learning experiences must recognize and address that visitor learning "extends the focus from the exhibition or experience itself to include the visitor who interprets, understands, and imposes meaning on the displays, often within a social context" (Ballantyne & Uzell, 1999, p. 66). Since constructivist theory recognizes meaning is dependent on visitor interactions and social action instead of being contained within a specific resource (object),
interpreters can create meaning for visitors (Ballantyne & Uzell, 1999). Without this scientific basis, interpreters would have limited impact on visitors appreciating the resource; the interpreter would be at the mercy of the resource and if the visitor found meaning in it or not, and thus, if they appreciated it or not. As such, constructivist theory is a fundamental tool that must be used in interpretation programs if the ultimate intent of interpretation is to be obtained.

Another principle of Tilden that is of extra significance to this paper is number one, relating the interpretation program to the visitor. In order for a message to be persuasive and change attitudes (i.e. more than just received), the information in the message must relate to the audience and the audience “must be both motivated and able to process perceived merits of the information provided” (Petty, McMichael, & Brannon, 1992, p. 3). This principle is supported by the current theory of the elaboration likelihood model of persuasion (ELM); it states there are two routes through which persuasion can occur, the central route and the peripheral route (Knudson et al., 2003). “The ‘central route’ involves effortful cognitive activity whereby the person draws upon prior experience and knowledge to scrutinize and evaluate the issue-relevant arguments presented in the communication” (Petty et al., 1992, p. 3). Consequently, interpretation messages communicated to visitors must be relevant to some part of their previous knowledge or experiences if the message is to be not just received but also acted upon, thus creating behavior change. In addition, Kohl (2005) argued interpretation can act through the elaboration likelihood mood to reduce visitor impacts; as such, if interpretation messages are relevant there is some scientific support for this leading to behavior change, which ties to the crucial part of protection in the ultimate intent of interpretation.

Interpretation tools have grown exponentially since Tilden first wrote these principles. The NPS has played a large part in this as a result of creating the IDP, which provides formal training and certifications for interpreters. Perhaps the most important tool to come out of this program is the interpretive equation, a simple working method that ensures the ultimate intent of
interpretation is achieved. This equation is: (Knowledge of the Resource + Knowledge of the Audience) multiplied by Interpretive Technique equals Interpretive Opportunities (Larson, 2003); in graphic form, the equation is: \((KR + KA) \times AT = IO\). Knowledge of the resource is defined as “a comprehensive collection of facts and information relevant to the resource” (Larson, 2003, Knowledge of the Resource, para. 2). This includes the history of the resource (administrative and resource management history), information about past and present uses and issues, current conditions, the reasons why it is important and relevant enough to be preserved, and the meanings and values of the resource (Larson, 2003). Knowledge of the audience refers to understanding an audience based on a diversity of aspects in order to make the interpretation being performed relevant and meaningful to as many people as possible. These aspects include: characteristics, interests, expectations and multiple points of view including psychological, social, cultural, economic, political, religious, historical and philosophical influences and perspectives, (Interpretive Development Program, 2008). Appropriate techniques facilitate opportunities for intellectual and emotional connections to resource meanings by involving/engaging the audience and by providing access to resource meanings (NPS Interpretive Development Program, 2004). Interpretive opportunities are “an opportunity for the audience to form their own intellectual and emotional connections to the meanings and significance inherent in the resource. The interpreter creates the opportunity; the visitor makes the connection...” (NPS Interpretive Development Program, 2004, para. 5). The importance of this equation is that it provides a way to identify the elements of successful interpretation and it helps to visualize the relationship between these elements (Larsen, 2003); therefore, it greatly enhances the probability of the ultimate intent of interpretation being achieved.

One last important interpretation tool is relating the unfamiliar to the familiar, a concept which is strongly grounded in theory. This concept seeks to connect the new information being presented to people’s “personal experience, thoughts, hopes, way of life, social position or
whatever else” (Tilden, 1977, p. 38). Through this connection, the information becomes relevant and more easily remembered. Relating the unfamiliar to the familiar is supported by the cognitive map theory. “Cognitive map theory is one way to explain how people obtain information, divide the stimuli into simplified units and organize it in relation to past experiences” (Morgan, 2009, para. 2). Hence, if the information of the interpretive program relates to past experiences, it has a better chance of being comprehended, which leads to a better chance it is remembered and assigned meaning. In terms of the ultimate intent of interpretation, this is the “appreciation” part; if appreciation is thought of as a positive attitude and this positive attitude is directed by the visitor to a behavior change that is desired by the interpreter, then the process of relating the unfamiliar to the familiar, can lead to protection (Ham, 2009), thus achieving the ultimate intent.

**Direct Effects of Interpretation**

Despite these numerous tools, and the relatively long history during which theories, principles, and frameworks were developed, interpretation still struggles with directly affecting people; I have only been able to find support for three concepts that interpretation can directly affect: meaning making, motivations, and learning. Interpretation’s direct effects on motivation and meaning making are intertwined; however, they are different as shown by their definitions. Motivation is defined as providing with a reason to act in a certain way; it is something that causes a person to act in a specific manner (Merriam-Webster, 2011). Meaning making is defined as the act of an individual taking an object (for example NPS resources) or experience and putting it into personal perspective, so they can identify with it in a way that is profound and enduring (Ham, 2002). It creates bonds between individuals and an object or experience, which helps them to see its importance (Ham, 2002). Interpretation directly affects motivations and meaning making in several ways, but the principle support comes from the interpretive concept of
a theme statement. Theme statements are “a succinct, central message about a topic of interest that a communicator wants to get across to an audience” (National Association for Interpretation, 2007, Interpretive Theme, para. 1). It is the main point of an interpretation presentation and the concept around which it is organized; therefore, it is the specific message to be understood by the audience and taken away with them (Beck & Cable, 2002). A theme statement is important because when information is presented in a thematic style, it is more meaningful, becomes easier to follow, and is more likely to be remembered (Ham, 1992). Miller (1956) argued people can only remember seven, plus or minus two, items; as such, by using theme statements, people organize information into chunks (Beck & Cable, 2002) instead of pieces. Themes allow people to remember concepts as their seven, plus or minus two, items instead of facts, facts that may or may not have a context or meaning, thus meaning making is enhanced. Also, the proper construction of a theme statement joins a tangible object with its intangible meanings; these intangibles are often universal concepts. As cited in Chen (2003, p. 27), Larson (1997) discovered the most effective interpretation programs “have one thing in common, they provide opportunities that develop a link between the tangible resource (i.e. person, place, object, event, or other concretely understood phenomena) and a universal concept;” theme statements are the vessel in which this is accomplished. As such, the importance of universal concepts is relevant when examining the effects of theme statements; “universal concepts increase the likelihood that visitors will be able to relate to or be interested in the meanings discussed” (Chen, 2003, p. 27). They increase the opportunities a visitor has to connect, both emotionally and intellectually, with the meanings inherent in a significant resource. Therefore, by incorporating universal concepts, themes have another way in which they affect meaning making, connecting visitors to the resource. Finally, theme statements affect motivation; “when an interpreter’s theme is strong and s/he delivers it in a way that motivates the audience to focus on it and process it, it provokes the audience to think and make meanings related to what is being presented” (Ham, 2007, p. 46).
Implicit in this statement is not only that themes create meaning making, but also that interpreters can motivate visitors, at least in the context of motivating them to understand the theme through the use of delivery style. One additional way interpretation can affect motivation is presented in Athman and Monroe (2004), who found “a variety of environment-based program formats and settings seem to be effective in improving achievement motivation” (p. 20); thus interpretation (as an environmental-based program) has the potential to motivate visitors to achieve their goals, which could include items such as increasing environmental stewardship and protecting NPS sites.

Finally, interpretation directly affects learning in people; this concept is unique compared to the other direct effects in that there are two different domains through which this effect occurs: learning environments and information. As defined in Mosby’s Medical Dictionary (2009), learning environments are “the sum of the internal and external circumstances and influences surrounding and affecting a person's learning” (para. 1). This includes the setting of a location and the manner in which information is presented. Most importantly, learning environments affect learning; this effect can be positive or negative and can greatly impact an individual. As such, they influence how other interpretation tools will be perceived, the effectiveness of these tools, and people’s acceptability to changing their beliefs. If people feel the learning environment is hostile, they will be defensive about, and consequently unwilling, to change their beliefs. If they feel the learning environment is receptive, they will be more open to changing their beliefs. Interpretation directly affects the learning environment by creating it; the setting an interpreter chooses, how they present their information, the words they say, their body language, and the control they have over the larger group, all directly comprise the learning environments of their audience. This is supported by numerous educational theories including: constructivism, learning styles, and proster. Proster theory has found “learners need to feel secure and at ease for effective
learning to take place” (Knudson et al., 2003, p. 139). Interpreters play a large role in creating this; therefore, interpretation directly affects learning environments.

Information is defined as “the communication or reception of knowledge or intelligence” (Merriam-Webster, 2011, para. 1). Interpretation directly affects information by providing it to visitors; this information is often new or stimulates recall in individuals; consequently, it directly affects them. This is in accordance with the fundamental principles of interpretation created by Tilden; specifically principle number two which states “information, as such, is not interpretation. Interpretation is revelation based upon information. But they are entirely different things. However all interpretation includes information” (Tilden, 1977, p. 34).

As cited in Beck and Cable (2002), the National Park Service summarized this as interpretation should make a connection between tangibles (information) and intangibles (non-information) instead of just presenting facts; this connection creates revelation in the audience. In this context, tangibles are “items that are concrete, that can be touched or seen” (Beck & Cable, 2002); whereas, intangibles “cannot be perceived by the senses” (Beck & Cable, 2002). Additionally, Beck and Cable (2002) incorporated this concept in principle number nine of the fifteen interpretation principles they presented in their book. This principle states “interpreters must concern themselves with the quantity and quality (selection and accuracy) of information presented. Focused, well-researched interpretation will be more powerful than a longer discourse” (Beck & Cable, 2002, p. 8).

The ability for interpretation to affect learning, primarily in the form of new knowledge and knowledge retention, is well documented in several scientific studies. The most recent study in this category occurred in 2011 by Benton; it studied the effectiveness of interpretation to convey cultural resource management (CRM) to visitors at three NPS sites that interpret indigenous people. These three sites were Bandelier National Monument in New Mexico, Fort Smith National Historic site in Arkansas, and Ocmulgee National Monument in Georgia. The
results of the study showed visitors retained some knowledge after partaking in interpretation programs, including a Ocmulgee visitor who “spoke about spreading the word, keeping the message going, and similar terms as part of CRM” (Benton, 2011, p. 95). In another study, Novey and Hall (2006) evaluated the effects of interpretation audio tours on visitors at Carlsbad Caverns National Park in New Mexico. Using pretest and posttest surveys, as well as observations, they examined “knowledge gain caused by using an audio tour as opposed to traditional print and visual media” (Novey & Hall, 2006, p. 264). A 12 question quiz was given each time; the results showed an increase in the amount of questions correctly answered by audio tour users from 5.7 to 10 and an increase in the amount of questions correctly answered by visitors who only viewed interpretive signs in the cave from 6.2 to 8.4. “Both gains were statistically significant, and the difference between audio users and nonusers was significant at the posttest, p<.0005” (Novey & Hall, 2006, p. 269); thus interpretation increased knowledge in this study. Additional support for interpretation increasing learning can be found in Madin & Fenton (2010), Tubb (2003), Brody and Tomkiewicz (2002), and Schänzel and McIntosh (2000).

One important item missing from the list of items interpretation can directly affect is behavior; “Interpretation cannot force people to change their behavior, rather it seeks to persuade voluntary behavior change” (Orams, 1995, p. 89). Since the purpose of this project is to change behavior, which will reduce climate change impacts and assist the NPS in protecting its resources, this appears to be a significant concern. However, this concern is easily addressed; research has shown interpretation can indirectly affect behavior by altering items such as people’s beliefs, attitudes, and motivations, which has led to short term and long term behavior changes. This ability is greatly strengthened by combing interpretation with scientifically supported theories that seek to explain behavior change. Since the 1950s, scientists in the field of interpretation have utilized a variety of external theories in order to develop effective interpretation practices and to better understand interpretation outcomes (Chen, 2003); these theories include: moral
development, learning styles, cognitive development, theory of reasoned action, theory of
planned behavior, and the concepts of motivation, persuasion, and information processing.
Overall, research suggests interpretation and behavioral influence can be linked based on the
extent to which visitors both identify with the interpretation material and are provoked to think
about it; this can lead to changes in beliefs, which can lead to changes in attitudes and ultimately
behavior (Munro, Morrison-Saunders, & Hughes, 2008). This path is consistent with one of the
before mentioned theories, the theory of planned behavior; thus by incorporating this theory,
interpretation can indirectly affect behavior.

Theory of Planned Behavior

Researched and developed by Icek Ajzen in 1991, the theory of planned behavior (TPB)
is an extension of Fishbein and Ajzen’s theory of reasoned action (Ajzen, 1991), which argues
behavioral intention is determined by subjective norms (perceptions of social pressures) and
attitude toward the behavior (Belleau, Summers, Xu, & Pinel, 2007). The TPB incorporates this
theory and addresses its limitation of not “dealing with behaviors over which people have
incomplete volitional control” (Ajzen, 1991, p. 181) by adding the construct of “actual behavior
control,” which refers to the skills, resources, and other items a person needs in order to perform a
given behavior. Hence, this theory is “designed to predict and explain human behavior in specific
contexts” (Ajzen, 1991, p. 181). It is built around the main premise of an individual’s intention to
perform a given behavior; these intentions explain the likelihood of a behavior being performed
(Ajzen, 1991). These intentions are a function of three basic determinants: attitude toward the
behavior, subjective norms, and perceived behavior control (Ajzen, 2005). Attitudes toward the
behavior is “the individual’s positive or negative evaluation of performing the particular behavior
of interest” (Ajzen, 2005, p. 118). A subjective norm “is the person’s perception of social
pressure to perform or not perform the behavior under consideration” (Ajzen, 2005, p. 118).
Perceived behavioral control is “the sense of self-efficacy or ability to perform the behavior of interest” (Ajzen, 2005, p. 118). In accordance with the theory’s attempt to explain behavior (not just predict it), the three basic determinants of behavior intention are themselves determined by the antecedent of beliefs, specifically salient beliefs. These are beliefs that first come to mind in a situation; they are a person’s most accessible beliefs (Sutton et al., 2003). Each basic determinant of intention has its own salient belief that is the primary origin of that determinant. Behavioral beliefs are assumed to influence attitudes toward the behavior, normative beliefs constitute the underlying determinants of subjective norms, and control beliefs provide the basis for perceptions of behavior control (Ajzen, 1991). Behavioral beliefs are defined as beliefs that are formed “about an object by associating it with certain attributes, i.e., with other objects, characteristics, or events” (Ajzen, 1991, p. 191). Normative beliefs are defined as “the likelihood that important referent individuals or groups approve or disapprove of performing a given behavior” (Ajzen, 1991, p. 195). Control beliefs are a set of beliefs “that deal with the presence or absence of
requisite resources and opportunities” (Ajzen, 1991, p. 196). By breaking down behavior into the components of intention, determinants, and beliefs, the TPB reveals behavior can be indirectly affected through directly affecting these components; thus despite interpretation being unable to achieve behavior changes through direct means, it can still achieve it by using indirect means, specifically, by directly affecting intentions, determinants, and beliefs.

**Interpretation and the Theory of Planned Behavior**

The ability to integrate the TPB and interpretation with the goal of greatly increasing the probability of behavior change has been recognized by researchers since the mid-1990s; as such, there is a body of literature detailing this integration available for review. Perhaps the preeminent work is a paper published by Ham and Krumpe in 1996; while this was not the first published work to discuss an interpretation and TPB framework, it was the first to thoroughly examine the theoretical concepts inherent in a successful integration of the two; numerous studies that have since followed have used these concepts as the basis of their research. Ham and Krumpe (1996) examined the available literature, and discovered “a fundamental premise emerging from these theoretical frameworks, and borne out by research on persuasive communication” (p. 17). In order for interpretation to change behavior, it is required that behavioral intention is first changed, which requires a change in its three antecedents: attitude about the behavior, subjective norm, and perceived behavior control (Ham & Krumpe, 1996); these antecedents are the determinants in the TPB. In order for these antecedents to change, “communication messages must produce a change in the problematic behavioral, normative, or control beliefs that are salient to the behavior in question” (Ham & Krumpe, 1996, p. 17). Thus, in order for interpretation to change attitudes, which is necessary for behavior change, it must do more than increase visitor knowledge (Ham, 2007). Instead, in order for interpretation to change attitudes one of the following must occur.
First, the topic of the interpretation program contains ideas that are new and/or fascinating to visitors;

While they can only understand the interpreter’s new ideas in the context of what they already know and think, the ideas themselves are new enough that the attitudes visitors form about them are, for all intents and purposes, a first impression. (Ham, 2007, p. 43)

Thus in this instance, interpretation changes attitude by creating them; because no prerequisites are required for this to occur “there is reason to believe that on-site interpretation can achieve an immediate impact on attitudes and related behaviors” (Ham, 2007, p. 45). An additional way, and the one with the strongest scientific support, interpretation can change attitudes is by addressing the pertinent beliefs that separate the doers from the non-doers in terms of partaking in a specific behavior. If the beliefs that prevent a desired behavior from occurring can be identified, then interpretation can target those beliefs, which in turn changes attitudes and can ultimately lead to behavior change (Ham, 2007). Finally, interpretation can change attitudes through the use of theme statements that are strongly relevant to the audience; this provokes them to think about the theme. “Theme-related thinking impacts beliefs about the interpreter’s topic, which, in turn, can impact attitudes and ways of behaving that are consistent with those beliefs” (Ham, 2007, p. 46).

It is interesting to note Kohl (2005) discovered interpretation can change attitudes without first changing beliefs by utilizing approaches “such as conditioning, cuing, source credibility or attractiveness (especially with reference to park personnel), rewards, and others” (p. 36).

However, Ham (2009) noted while this may be true in some instances, “To strongly (emphasis added) influence an attitude about something (an attitude object), a communicator must first influence the beliefs a person holds about that same thing” (p. 53). This conclusion was obtained through examining the results of his personal research, including a 2007 study in the Sawtooth Wilderness that had the purpose of lessoning camping impacts by using the TPB to design messages, and through examining the results in the research of others. Ham (2009) concluded:
Interpretation that provokes the formation of positive beliefs about the outcomes of a
given behavior will result in a positive attitude about that behavior. When this occurs, the
likelihood that a visitor will engage in the desired behavior (if presented the opportunity)
is significantly enhanced. (p. 54)

This theoretical basis of the integration of interpretation and the TPB, primarily by utilizing the
construct of attitudes, established by Ham and Krumpe in 1996, and further expanded by Ham in
2007 and 2009, has been well tested, as will be seen in the following review of the more recent
literature about this topic.

Widner and Roggenbuck (2000) researched the removal of petrified wood from Petrified
Forest National Park in northeast Arizona; this damage is considered non-repairable and
significant with an estimated twelve tons of petrified wood removed from the park each year.
Several interventions are in place in the park to stop this from occurring; however, none have
proven successful. Therefore, the purpose of Widner and Roggenbuck’s study was to “develop,
implement, and test the effectiveness of various interpretive methods to deter the theft of petrified
wood from the park” (2000, p. 2). They used two main interventions, an on-site uniformed
volunteer and an interpretive sign that was developed using several attitude-behavior change
theories, including the TPB. The sign’s photographs and text were designed to prime the
appropriate and applicable attitude that would lead to the desired behavior change of not
removing petrified wood (Widner & Roggenbuck, 2000). Data was collected using on-site
observation of visitor behavior by the researchers after each intervention and then compared to a
no intervention control, which was determined to give an accurate estimate of the theft rate.
Overall, results revealed “interventions significantly lowered theft over the control condition”
(Widner & Roggenbuck, 2000, p. 9); thus, in this study, the combination of interpretation and the
TPB could be considered successful because it produced the intended behavior change.

Ballantyne and Hughes (2004) developed a study to examine visitors’ role in creating
nuisance birds, birds that frequently harass visitors, in Brisbane Forest Park in Australia. Bird
feeding by visitors has become a common practice in the picnic areas of the park; consequently, when visitors do not feed the birds, they are harassed, leading to attacks and injuries. The purpose of the research was to “design warning signs that address visitors’ beliefs and behaviors in picnic areas” (Ballantyne & Hughes, 2004, p. 238), with the goal of determining the most persuasive message. Experiment design was based on three theories, including the TPB, and consisted of collecting data from two locations within the park in a series of stages. The first stage can be viewed as the salient belief identification stage; a self-administered questionnaire was given to visitors with the purpose of examining visitors’ attitudes, beliefs, and behaviors in relation to bird feeding (Ballantyne & Hughes, 2004). Stage two used the information obtained from stage one, as well as information from each of the three theories, to create interpretation signs that warned visitors about the danger of feeding wild birds in picnic areas. The first sign, called Sign A, was specifically based on the TPB and classified the beliefs identified in stage one as behavioral, normative or control beliefs (Ballantyne & Hughes, 2004). In a somewhat unusual twist when compared to similar studies, stage three consisted of examining the persuasiveness of each sign by pasting mock versions of the signs onto cards and giving them to visitors along with a self-administered questionnaire designed to guide their evaluation of each sign. Results indicated each developed sign was persuasive; as such, they were all regarded as effective (Ballantyne & Hughes, 2004). This study suggests that when interpretation and the TPB are combined, visitors can be persuaded into changing their beliefs and attitudes, which can lead to behavior change; as such, this study provides evidence that the two can be successfully combined.

Lee and Moscardo (2005) conducted a study at the Kingfisher Bay Resort and Village (KBRV) on Fraser Island in Queensland, Australia in 2000. The purpose of their study was to “investigate the effects of experiences in ecotourism accommodation on visitors’ environmental attitudes and behavioral intentions” (Lee & Moscardo, 2005, p. 550); they used a framework developed from the TPB to guide their research. The study incorporated several stages and
analyses; the primary instruments used were pre-visit and post-visit surveys of guests. In accordance with recommendations on quasi-experimental design, the pre-visit survey sampled a different group of visitors than the post-visit survey, with 242 surveys obtained from the pre-visit group and 396 surveys obtained from the post-visit group (Lee & Moscardo, 2005). Of primary importance to this paper were the results gathered from a series of questions designed to measure the differences between guests who read or used a visitor information sheet on environmental management actions and programs at the resort and those who did not. They found:

Respondents with higher levels of involvement in environmental actions at KBRV were also more likely to have read or used the guest information brochure with 78% of the high involvement group reporting that they had read or used the sheet. (Lee & Moscardo, 2005, p. 559).

In addition, their results indicated environmentally responsible behavior at the resort was associated with both awareness of environmental management practices and positive environmental attitudes. Thus, this study provides two important pieces of data relevant to utilizing the TPB with interpretation; first, something as simple as written information can lead to behavior change, probably by influencing attitudes, and second, there is an association between environmental attitudes and environmental behavior, which reinforces the very important attitudes to behavior pathway in the TPB.

Powell and Ham (2008) incorporated key components of the TPB and key components of the “enjoyable, relevant, organized, and thematic” interpretation framework in devising a communication strategy used by an ecotourism operator, Lindblad Expeditions. The purpose of the research was to examine if this communication strategy could influence tourists’ philanthropic salient beliefs in the context of contributing monetarily to conservation in the Galapagos Islands, as well its effects on tourists’ knowledge of and attitudes toward Galapagos National Park. They used a range of oral and visual interpretive media to target these beliefs, and evaluated their effectiveness with pre- and post-visit questionnaires. “Results indicated the interpretation
strategy was successful in producing significant impacts in all these areas,” (Powell & Ham, 2008, p. 484) including significant impacts in attitudes toward and behavioral intentions of conservation philanthropy. Thus, this study provides evidence that the TPB and interpretation can be successfully combined, with the outcome being more effective interpretation.

Reigner and Lawson (2009) explored visitor behavior in Haleakala National Park; specifically the behavior of exploring and visiting pools located in the Pools of Ohe`o area. They utilized a condensed and adapted version of the TPB, as well as elements of moral development theory, in the construction of two persuasive communication messages (Reigner & Lawson, 2009). The experiment design consisted of multiple stages; first was the construction of the two messages. This was followed by the use of an informal survey to determine salient beliefs; the beliefs were then used in the final stage where “Behavioral, normative, and control beliefs, as well as visitors’ behavior intentions regarding exploration of the pools were measured using a survey” (Reigner & Lawson, 2009, p. 29). While the messages used in this study were educational and informative messages, it still contains important results highly relevant to research that combines interpretation and the TPB. First, visitor beliefs were influenced by the persuasive messages, as compared to the control, and this led to an observed difference in behavior; visitors exposed to messages traveled to the pools less often than visitors not exposed to the messages (Reigner & Lawson, 2009). Also, Reigner & Lawson (2009) determined the TPB was useful in understanding visitor behavior and evaluating the efficacy of persuasive messages in the context of resource protection, thus adding to the scientific support of using the TPB in this manner. In conclusion, Reigner & Lawson (2009) stated “results of this study suggest TPB provides a valid model of visitor behavior at the pools and a useful framework for assessing the efficacy of persuasive messages…” (p. 42). This study supports the use of persuasive of messages in achieving behavior change by changing beliefs.
Hughes, Ham, and Brown (2009) studied problematic visitor behavior at two Australian parks; they incorporated the TPB in the development of interpretation signs targeted at the problem behaviors of visitors feeding birds in Yarra Ranges National Park, and dog walkers not keeping their dogs on leashes in Yellagonga Regional Park. The TPB was also used in developing a multi-stage methodology for their study; these stages included measurement of salient visitor beliefs using questionnaires and evaluation of the interventions (interpretation signs) that targeted the salient beliefs. Their results suggested “More than 90% of first-time visitors at Badger Weir did not feed the birds, while at Yellagonga Regional Park, the intervention led to a 19% increase in walkers keeping their dogs on leashes” (Hughes et al., 2009, p. 51). Hughes et al. (2009) concluded “In terms of an experimental evaluation of applying theory-based messages targeting a range of visitor behaviors, it is apparent that the theory and methodology in this study were successful” (p. 51). As such, this study provides evidence of the successful combination of the TPB and interpretation in terms of both methodology and results.

Lastly, in 2010, Brown, Ham and Hughes conducted research in Mt. Field National Park in Tasmania that examined the problematic visitor behavior of littering, as well as a desire by managers to encourage visitors to pick up any litter they encounter in the park. While littering is not the most challenging of behaviors to change, this study does provide some valuable insight. This includes some consensus in experiment design for research using interpretation and the TPB. Similar to the Ballantyne and Hughes (2004) study, the experiment design was based on the TPB and consisted of a series of stages that were identified as the belief elicitation phase, the belief measurement phase and the intervention evaluation phase (Brown et al., 2010); thus this study is a good example of how to integrate the TPB and interpretation in a research experiment. In accordance, the researchers determined the primary purpose of the research “was to evaluate the success of strategically designed communication interventions aimed at increasing compliance with the target behavior and to establish the extent to which the constructed messages impacted
visitors’ salient beliefs about the behavior” (Brown et al., 2010, p. 885). The belief elicitation stage utilized open-ended questions based on TPB’s belief categories in a semi-structured interview format; in the second stage of the experiment, the salient beliefs obtained in the first stage were evaluated using a questionnaire with the purpose of finding beliefs that would have “the greatest persuasion potential in a communication intervention” (Brown et al., 2010, p. 887). Results of these stages revealed the targeted salient belief should be “setting a good example for others;” in accordance, two messages were developed with this purpose and placed on a simply designed sign located near an area in the park identified has having a high litter problem. In stage three, the effectiveness of the sign was evaluated by making observations of visitor behavior under alternating control and treatment issues and by administering a questionnaire to randomly chosen visitors (Brown et al., 2010). Results indicated the messages were successful in influencing visitor behavior; each one impacted the target belief by provoking people to think about the message. In addition, they found evidence of the targeted belief leading to a change in attitudes, which provides support to this pathway in the TPB. Brown et al. (2010) concluded the study “demonstrated how the reasoning of well-established psychological theory can be applied to optimize the effectiveness of persuasive interpretive campaigns to address the littering problem in protected areas” (p. 894); therefore, it provides strong support to the concept of interpretation changing behavior by integrating it with the TPB.

These studies, and others that utilized the TPB with interpretation, have been instrumental in showing the two can be combined together; since research strongly supports the combination is successful, interpretation has a mechanism through which it can change behavior. Thus, it has a way to achieve its ultimate intent, which, in the context of this paper, is to use understanding and appreciation to target salient beliefs in order to persuade visitors to protect national parks by reducing their climate change contributing behaviors. However, these studies have also made something else clear, while there is some uniformity in the experiment design,
there is little consensus in the framework needed to combine interpretation and the TPB. Furthermore, each study was performed from a researcher’s point of view, with minimal consideration for the people who actually create and present interpretation products as their life’s work. If interpretation is going to change behavior using the TPB, it cannot be a one or two time occurrence when a researcher has the time, desire, and funding to create an interpretation product. Instead, it is something that must be ongoing and utilized on a nearly daily basis; therefore, a framework needs to be developed that integrates interpretation with the TPB in a manner that makes it possible, given limited resources and experience with experiment design, for career interpreters to use.
INTERPRETATION-THEORY OF PLANNED BEHAVIOR

FRAMEWORK

With this purpose in mind, I utilized information obtained from the literature review, as well as my ten years of experience as a NPS interpreter, to develop a framework (figure two) that was used in the creation of interpretation products at John Day Fossil Beds National Monument in eastern Oregon and Wrangell-St. Elias National Park and Preserve in southeastern Alaska in 2012. This Interpretation-Theory of Planned Behavior (I-TPB) framework is an integration of the three direct effects of interpretation with Ajzen’s theory of planned behavior. An overview of interpretation tools that link interpretation’s direct effects to the theory is provided in table one. The TPB was used as the foundation of the I-TPB framework for several reasons; first, it has been well tested and supported in the scientific literature (see Armitage & Conner, 2001 and Hardeman et al., 2002 for TPB literature reviews). Second, while not all aspects of the theory have been supported in every study, far more often than not it has proved to be useful in at least explaining part of the behavior of interest. Third, it has proven to be highly adaptable in that a diversity of fields and subjects have incorporated the theory in their studies. Finally, as previously reviewed, this theory has been used in the interpretation field in a variety of studies (Ballantyne & Packer, 2006; Powell & Ham, 2008; Madin & Fenton, 2004; and Ham, 2007); together, these reasons provide strong evidence for the validity of using the TPB as the basis of a scientifically rigorous framework. However, it is only valid if the TPB is used correctly; a previous interpretation study which utilized this theory raised an issue that could impact the successful use of it in this Master’s project. Hughes, et al. (2009) recommended that in order to create strong persuasive communication interventions (i.e. change visitor behavior), “identifying the salient beliefs that actually underlie the visitor behavior in the specific setting” (p. 51) by using a belief elicitation phase is a necessity. Furthermore, “intuiting the beliefs, or guessing at them based on
personal experience or the results of studies conducted elsewhere, will almost certainly render the messages based on them error prone if not completely ineffective” (Hughes et al., 2009, p. 51). This implies that if the TPB is to be successfully integrated in interpretation studies, knowledge of beliefs at the specific study site must be known. However, this was the result of one study and it examined specific behavior at specific locations; therefore it is highly uncertain how applicable this recommendation is in the context of a widespread and diverse issue such as climate change. This is not to dismiss the recommendation, but rather acknowledge that in a different context it needs modification. As such, existing salient beliefs related to climate change must be incorporated into any interpretation efforts seeking to change visitors’ climate change impacting behavior. However, because NPS site specific salient belief studies are hard to come by, and because this issue extends far beyond any specific site boundaries, knowledge of salient beliefs will have to come from non-site specific sources, such as Lorenzoni and Pidgeon (2006) and Leiserowitz et al. (2011), which I feel is an appropriate substitute. In support, Reigner and Lawson (2009) also used informal means in order to determine salient beliefs in their study and were successful in achieving behavior change.

What contributes the most to allowing the successful integration of interpretation and the TPB in this framework is the utilization of a path to explain and predict behavior, from beliefs to determinants to intention to behavior. If interpretation can directly affect any one of the three listed belief categories, then it can indirectly change people’s behavior. The I-TPB framework provides this mechanism; specifically, it reveals pathways through which the direct effects of interpretation- meaning making, motivations, and the two domains of learning: learning environments and information- can influence the three beliefs of the TPB by utilizing a variety of interpretation tools. For example, the interpretive tool of the theme statement, which interpreters can use to directly affect meaning making and motivations, also “expresses a belief about a thing, whether it be a behavior, event, person, or object. By nature, communication that develops a
theme advocates a belief” (Ham & Krumpe, 1996, p. 18). Thus, by advocating beliefs, theme statements are one way in which the direct effects of interpretation can be translated into behavior change through the TPB. The interpretation tools listed in table one provide additional pathways for the direct effects of interpretation to influence the beliefs of the TPB. As Reigner and Lawson (2009) discovered, beliefs, specifically behavioral and normative, are significant predictors of behavior intent; as such, beliefs are the most important construct to be combined with the direct effects of interpretation in order to achieve behavior change. One important note, if it is found in the future that interpretation directly affects other concepts, the framework can be expanded to include these new items.

**Conceptual Framework**

Because of the high overlap in the interpretation tools (techniques, principles, and concepts) that affect each of the three beliefs in the TPB, it is best to present the I-TPB framework from the standpoint of the concepts interpretation directly effects: meaning making, motivations, and the two domains of learning: learning environments and information.

While at first glance these effects appear quiet different, and thus, do not equate as concepts belonging on the same plane in a framework, a review of the literature strongly suggests a hierarchical order amongst them, at least when these direct effect concepts are examined in the context of interpretation. This hierarchical order is not required for interpretation to create one of its direct effects, and therefore, for that direct effect to change beliefs in the I-TPB framework, but it can enhance the ability of interpretation to do so. In addition, this order does exist in some occurrences, which provides warranted support for the clustering of the diverse “interpretation directly effects” concepts, as well as provides a mechanism to differentiate their plane of appearance in the I-TPB framework. As such, the interpretation direct effect that appears first, second, third, and fourth in the framework is a non-required prerequisite for the second, third, and
fourth interpretation direct effect (shown by dashed, grey arrows in figure two). For example, providing certain information (the second interpretation direct effect) in an interpretation program also opens the doors for meaning making (interpretation direct effect three) to occur; however, information is not required for this direct effect. Interpretation can directly affect meaning making simply through the setting of the interpretation product, which can stimulate memory recall; through the use of the senses, such as the use of touch to share the stickier than glue “slime” of the banana slug or the use of taste to share the unique flavor of the sassafras leaf; and through resource immersion. In sum, the direct effects of interpretation appear in the following order on the I-TPB framework: learning environment, information, meaning making, and
Table 1: Tools Linking Interpretation’s Direct Effects with TPB Beliefs

<table>
<thead>
<tr>
<th>Interpretation’s Direct Effects</th>
<th>Behavioral Beliefs</th>
<th>Normative Beliefs</th>
<th>Control Beliefs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information</strong></td>
<td>Tilden’s 2nd Principle, Beck &amp; Cable’s 9th Principle, Cognitive Learning Domain</td>
<td>Tilden’s 2nd Principle, Beck &amp; Cable’s 9th Principle, Cognitive Learning Domain</td>
<td>Tilden’s 2nd Principle, Beck &amp; Cable’s 9th Principle, Cognitive Learning Domain</td>
</tr>
</tbody>
</table>

Motivation as one outcome of interpretation directly affecting meaning making is supported by its definition, which states motivation is a reason to act; new meanings provide one with new reasons to act, such as how a harmful but preventable resource impact can negatively affect a loved one or cherished item, thus interpretation directly affecting meaning making (the process of creating meaning) can also lead to an increase in the audience’s motivation. Poria, Reichel, and Biran (2006), in their examination of motivation and expectations of heritage site visitors, found a body of work from a literature review where the meanings assigned to an artifact are noted as having an impact on people’s behavior. As such, they hypothesized “the different
meanings assigned by tourists to the heritage on display are associated with their motivations”
(Poria, et al., 2006, p. 172). Furthermore, the results of their study suggests the interest in a visit
to a heritage site corresponds positively with visitor perception of the site as part of their own heritage; the greater this meaning of significance to one’s past, the more motivated the person was to visit the site. In addition, research into camping motivations and involvement by Kyle, Absher, and Hammitt (2006) reveals the specific action of engaging in camping reaffirms respondents’ sense of self; thus, as meaning in the form of personal identity is increasingly derived from camping, so too is motivation to participate in the activity increased. Support for meaning making to lead to influences in motivation is also found in Anthram and Monroe (2004); their research into environmental-based education on students’ achievement motivations provides a harmonious result where previous research, qualitative data, and quantitative data all support “improving student motivation through instruction … is tied to topics and problems that naturally interest students” (Anthram & Monroe, 2004, p. 21). Teachers who facilitate connections between students’ prior experiences and knowledge to the current curriculum and to the real world, as well as facilitate connections between students’ personal lives and the curriculum, will increase students’ achievement motivation (Anthram & Monroe, 2004.) Therefore, motivation is achieved when students create meaning through the connection of new information (curriculum) to relevancy in personal lives and to prior knowledge and experiences. This form of meaning making falls under the definition of cognitive map theory, which also binds the third interpretation direct effect of information into its place on the hierarchy.

Meaning making itself can be one outcome of interpretation directly affecting information, as supported by the cognitive map theory, which states new information is divided and organized in relation to prior experiences (Morgan, 2009). Therefore, connections are made between old and new information, with a strong possibility of the new information being included in or altering preexisting meanings or the new information being used to create new meanings.
As such, interpretation that directly affects information, such as providing new knowledge and increasing knowledge retention, will also facilitate meaning making in accordance with this well supported theory. Ballantyne, Packer, and Beckmann (1998) concluded messages that are most learned from and paid attention to are a result of an individual creating personal meaning out of those messages through connecting them to personal life experiences. Thus, new information, if it is personably relatable, can create meaning. Kyle, et al., (2006) researched the relationship between motivation and enduring involvement in campers; their measure of centrality, the degree to which a line of behavior is a result of personal investments, indicated it was only positively influenced by learning. Hence, those with the most desire to learn about the natural environment also were those who placed the highest importance on camping in their lives. This underscores one way in which learning about the environment, such as obtaining new information, can create meaning; if individuals have prior experiences highly central to their lives (such as camping) that new information can be connected to, than meaning will be derived from this information, creating a desire to learn more. Kyle, et al., (2006) discovered this result did not change amongst the three different settings used in the study, which varied considerably in the recreation experience provided, but consisted of the same activity of camping in a national forest.

This connection between learning and the environment in which learning takes place has been well studied and provides for the location of the fourth interpretation direct effect of learning environment in the hierarchy. Interpretation’s ability to directly affect information is often impacted by the learning environment; the selected setting, the use of knowledge of the audience, and the atmosphere created are the primary ways through which interpreters and interpretation products directly affect learning environments. This, in turn, can influence information obtainment, processing, and retention by the audience. While theory, tool development, and evaluation assessments permeates this body of literature, a few studies have produced quantifiable results that measure the role of the physical learning environment in the
ability for a person to learn. In Brooks (2010) study of the impacts of learning environments on teaching and learning, results “demonstrate clearly that the formal physical environment in which students take their courses has a significant impact on measurable student learning outcomes” (p. 1); specifically, the learning environment impacted students ability to obtain and retain information as quantified by their ACT scores. Hanrahan (1998) explored the effects of the learning environment on students’ motivation and learning in a Year 11 biology class. Results provided strong evidence that factors of the learning environment, including types of activities used, internal and external distractions, and autonomy, impede learning even when students’ motivation is high (Hanrahan, 1998). Both student interviews and surveys revealed information obtainment and retention were negatively impacted by learning environment factors, such as distractions that impeded concentration (Hanrahan, 1998). Thus, any interpretation product that directly affects the learning environment also has a strong chance of directly affecting the flow of information to the audience.

This scientific basis underlying the first section of the I-TPB framework provides the necessary separation of the direct effects of interpretation into a more acceptable conceptual model; it provides a hierarchy that separates each direct effect into a different plane while not requiring one direct effect to occur before a different interpretation direct effect can occur. However, in order for the framework to be successful in its goal of melding interpretation with the TPB, with the ultimate purpose of interpretation changing behavior, then current scientific research must support each link between the interpretation direct effects and the three TPB beliefs proposed in the I-TPB framework (as shown by solid, colored arrows in figure two).

The direct effect of meaning making affects all three TPB beliefs through a broad concept known as relating the unfamiliar to the familiar. As previously stated, this concept seeks to connect the new information being presented to people’s “personal experience, thoughts, hopes, way of life, social position or whatever else” (Tilden, 1977, p. 38). Multiple interpretation tools
incorporate this concept; these tools are: cognitive map theory; tangibles, intangibles, and universal concepts; Tilden’s first principle of interpretation; Tilden’s second principle of interpretation; and relating unfamiliar to familiar. For the sake of continuity, these items are redefined below.

“Cognitive map theory is one way to explain how people obtain information, divide the stimuli into simplified units and organize it in relation to past experiences” (Morgan, 2009, para. 2). Tangibles are “items that are concrete, that can be touched or seen” (Beck & Cable, 2002, p. 24); whereas, intangibles “cannot be perceived by the senses” (Beck & Cable, 2002, p. 24). Universal concepts are intangibles that can be related to (understood) by a broad and diverse amount of individuals (Beck & Cable, 2002); they transcend cultural boundaries. Tilden’s first interpretation principle states “Any interpretation that does not somehow relate what is being displayed or described to something within the personality or experience of the visitor will be sterile” (Tilden, 1977, p. 34). Tilden’s second principle states “Information, as such, is not interpretation. Interpretation is revelation based upon information. But they are entirely different things. However, all interpretation includes information” (Tilden, 1977, p. 34).

These tools affect behavioral beliefs through connecting familiar objects with other items that are unfamiliar; these unfamiliar items then become associated with the familiar objects, allowing beliefs about the unfamiliar items to be formed. This closely parallels the definition of behavioral beliefs; as such meaning making can affect it. These tools affect normative beliefs through relating the unfamiliar to the familiar in the context of groups. Specifically, important groups unknown to the audience can be related to groups known by the audience, an unfamiliar message communicated by a specific group can be related to a familiar message, and impacts created by an unfamiliar problem can be related to how it impacts the familiar groups a person identifies with. These items all create beliefs in an individual about the behavior a group would or would not approve of; thus meaning making affects normative beliefs. Finally, these tools
affect control beliefs by relating resources and opportunities people need, but feel they do not have (the unfamiliar) to the familiar resources and opportunities they do have. Specifically, unfamiliar outcomes can be related with familiar behaviors, unfamiliar uses of resources and opportunities can be related to familiar resources and opportunities, and unfamiliar outcomes can be related with familiar opportunities. These items generate new control beliefs in people (hopefully, these beliefs are they do have the requisite resources and opportunities); hence meaning making affects it.

The examination of motivations in the context of interpretation has limited scientific study; consequently, support was found only for motivation directly affecting behavioral beliefs. The interpretation tools that can be used to create this effect are the ELM and theme statements. The ELM is an example of a theory used by interpreters that originated outside of the interpretation field; it comes from the field of social psychology. The ELM “provides a fairly general framework for organizing, categorizing, and understanding the basic processes underlying the effectiveness of persuasive communications” (Petty & Cacioppo, 1986, p. 125). As previously mentioned, it finds there are just two distinct routes to persuasion, the central route and the peripheral route (Petty & Cacioppo, 1986). The central route is a result of “a person’s careful and thoughtful consideration of the true merits of the information presented in support of an advocacy” (Petty & Cacioppo, 1986, p. 125); whereas the peripheral route is the result of “some simple cue in the persuasion context (e.g., an attractive source) that induced change without necessitating scrutiny of the true merits of the information presented” (Petty & Cacioppo, 1986, p. 125). The likelihood people will think about a message and its arguments is determined by a person’s motivation and ability to evaluate the communication presented (Petty & Cacioppo, 1986). If the person is motivated and able to process the merits of the message, the person is following the central route of persuasion (Knudson et al., 2003). This is crucial because “the result of following this central route of persuasion forms an attitude that is clearly integrated into
the person’s belief system” (Knudson et al., 2003, p. 68). Also, such attitudes “are long lasting, predictive of behavior and resistant to change” (Knudson et al., 2003, p. 68). In other words, the central route of persuasion changes the belief of behavior and its corresponding determinant of attitude toward the behavior. Thus, the opportunity to act upon motivation is a critical element of an interpretation program that results in participant behavior change (Orams, 1995). The concept of motivation also affects behavioral beliefs by using the tool of a theme statement; themes motivate people to think about and process them and their associated items. Since theme statements relate objects (tangible) to their meanings (intangible), this can be viewed as assigning attributes to an object, which is how behavioral beliefs are formed. Thus, themes motivate people to think about their behavioral beliefs, meaning it affects them.

Each domain of the concept of learning directly affects beliefs through a variety of interpretation tools. The domain of learning environments affects all three beliefs using the tools of: modalities, affective learning domain, knowledge of the audience, learning styles theory, culture cognition, and proster theory. Modalities are a way in which people process and learn information, retain it, and recall it; there are four modalities: visual, auditory, kinesthetic, and symbolic/abstract (Knudson et al., 2003). The affective learning domain is a domain in which people process, learn, retain, and recall information by relating it to one’s feelings; learning occurs in an individual at the emotional level (Knudson et al., 2003). Knowledge of the audience refers to understanding an audience based on a diversity of aspects in order to make the interpretation being performed relevant and meaningful to as many people as possible; these aspects include: characteristics, interests, expectations and multiple points of view including psychological, social, cultural, economic, political, religious, historical and philosophical influences and perspectives, (Interpretive Development Program, 2008). Learning styles theory suggests “that different individuals learn in different ways and that students can succeed if they learn according to their own styles” (Knudson et al., 2003, p. 137). Cultural cognition concerns
how people react to scientific evidence on societal risks; they endorse whichever position reinforces their connection to others with whom they share important commitments. This influence by a group on an individual’s values is known as culture cognition (Kahan, 2010). Finally, proster theory states the human brain acts aggressively, not passively; “through intensely aggressive action, the brain steadily makes sense of the world by extracting patterns from huge amounts of input” (Knudson et al., 2003, p. 139).

These tools affect behavioral beliefs, normative beliefs, and control beliefs simply by creating opportunities for learning to be enhanced, for the information presented to be learned by a greater number of people, for the information presented to be thought about and retained, and for learning to be more fun than stressful (thus wanting it to continue). This means the other interpretation tools used by an interpreter to impact beliefs have a greater chance of being effective; i.e. the message will stick. Therefore, if beliefs are to be affected through interpretation, care and thought must go into the learning environment for this outcome will only occur in an appropriate atmosphere; hence not only does the learning environment effect all three beliefs, it can lay a claim to having the greatest effect of any of the domains or concepts interpretation directly affects.

The domain of information directly affects only normative beliefs and control beliefs; the interpretation tools used to accomplish this are: Tilden’s second principle of interpretation, Beck and Cable’s ninth principle of interpretation, and the cognitive learning domain. In the interest of continuity, these items will be redefined here, except Tilden’s second principle, which was stated earlier in this section. Beck and Cable’s ninth principle is “Interpreters must concern themselves with the quantity and quality (selection and accuracy) of information presented. Focused, well-researched interpretation will be more powerful than a longer discourse” (Beck & Cable, 2002, p. 8). The cognitive learning domain is a domain in which people use the rational mind to process, learn, retain, and recall information (Knudson et al., 2003).
These tools affect normative beliefs by defining interpretation as containing information; if the information presented concerns specific group opinions and beliefs about appropriate behavior or if the information presented describes a group that an individual was unsure about, then this information impacts normative beliefs. Because of this, an individual is now better able to judge if a group would approve or disapprove of a given behavior and is better able to determine the names of these groups; thus information makes people reexamine their normative beliefs, which means it affects them. These tools affect control beliefs also by defining interpretation as containing information; if the information presented concerns resources and opportunities, then the information impacts control beliefs. With this new information, people are able to better judge if they have the requisite resources and opportunities (perhaps by revealing alternatives or by revealing how to use existing items in different ways) needed to behave in a certain manner, which causes them to rethink their control beliefs; therefore, information directly affects control beliefs.

Field Framework

Due to the amount of information presented in the above I-TPB framework, simplification is necessary in order for it to be applied successfully in the field; specifically, the amount of interpretation tools required for its implementation needs reduction. As such, a field framework (figure three) has been developed; this framework identifies a reduced list of specific interpretation tools (shown in the overlaid insert in figure three) to be used during its implementation into interpretation programs. This list was obtained by examining the tools that link interpretation’s direct effects to the TPB beliefs (table one), which revealed five common tools (highlighted in yellow in table one): relating unfamiliar to familiar, themes, modalities of learning, learning domain, and cultural cognition. They act as vessels through which interpretation can achieve its ability of directly affecting meaning making, motivations, and the
two domains of learning: learning environments and information. As identified in the conceptual I-TPB framework, these direct effects of interpretation impact the three beliefs, behavioral, normative, and control, which are the beginning constructs of the TPB and can lead to behavior change. By utilizing just five tools, the implementation of the I-TPB is significantly eased and less costly from a resource standpoint to use.

However, the field framework does provide an opportunity for an interpreter to expand the amount of tools utilized; if the training and ability of the interpreter, available resources, and other constraints allow for it, these five tools can be expanded to nine, which strengthens the connection between interpretation and TPB, thus increasing the probability of a program creating
behavior change. This expansion is obtained by connecting both the cognitive and affective learning domains, instead of just one, to each of the three beliefs, and by connecting each one of the four modalities of learning: visual, auditory, kinesthetic, and symbolic, to each of the three beliefs, instead of connecting just one modality to them. Thus, the five interpretive tools reduce the complexity of the framework without sacrificing validity, and at the same time provide a way to strengthen it; in addition, they contain several characteristics that make them more appropriate to use than the other tools in table one.

First, they cover every avenue in which the direct effects of interpretation and the beliefs of the TPB are connected. As shown in table one, the interpretation direct effects of “meaning making” and “learning environments” affect each one of the three TPB beliefs, the interpretation direct effect of “motivation” affects behavioral beliefs, and the interpretation direct effect of “information” affects normative and control beliefs. Thus, there are nine avenues through which the direct effects of interpretation and the beliefs of the TPB are intertwined; at least one of the
five tools chosen for the field framework is applicable to each avenue, which is shown in table two. In addition, upon further examination of the tool of culture cognition and the TPB construct of normative beliefs, it was determined the two closely mirrored each other; thus, in order to further reduce the complexity of the framework, if the other tools adequately addressed normative beliefs, it was assumed those tools could be used as a substitute for cultural cognition. As such, an interpretive program only requires four tools to be used by an interpreter in order for the field I-TPB framework to be incorporated.

Second, the five tools are relatively well known to interpreters; this is important because it reduces both the amount of training involved as well as the amount of confusion. As previously mentioned, the tools of themes and relating the unfamiliar to the familiar are valuable interpretation tools directly taught during most interpretation training sessions. The tools of learning domain and modalities of learning contain the same basic premise found within the interpretation concept “knowledge of the audience” in the interpretive equation, which is almost always taught during interpretation training sessions; furthermore, the tool of modalities of learning is increasingly directly taught in interpretation training sessions underneath the title of learning environments. As to targeting normative, behavioral, and control beliefs, this is something interpreters do with every program for, as the previous discussion of interpretive tools revealed, this is how interpreters accomplish the ultimate intent of interpretation. Thus, field interpreters can easily incorporate the five tools, as well as the three beliefs, in their programs, which makes the field framework much more likely to be utilized. Finally, the five tools can be highly effective as is evident in both the previously reviewed scientific studies and in the multiple ways to incorporate them into interpretation programs, which will be discussed in the results section.
PROJECT FORMULATION

John Day Fossil Beds National Monument

The necessary resources for the implementation of this Master’s project were obtained by applying for and receiving a George Melendez Wright Climate Change Internship. Started in 2010, this internship and fellowship program has the purpose of combining undergraduate and graduate students with NPS managers, scientists, and educators to work on issues related to climate change. The internship program is jointly sponsored by the NPS Climate Change Response Program and the National Council for Science and Environment. The purpose of the program is to “support adaptation to and mitigation of the effects of climate change on lands administered by the National Park Service” (Climate Change Response Program, 2011, para. 3). The location of the internship was John Day Fossil Beds National Monument near Kimberly, Oregon in the east-central section of the state.

John Day Fossil Beds National Monument (JODA) contains 14,000 acres spread out over three distinct units: Sheep Rock, Painted Hills, and Clarno. These units reside within the John Day River Basin, which is part of the Blue Mountain physiographic province; this is a semi-desert ecosystem with a semi-arid climate. It protects “one of the longest and most continuous records of evolutionary change and biotic relationships in North America” (John Day Fossil Beds National Monument, n.d., para. 1). The monument contains extensive plant and animal fossils that date from six to fifty-four million years in age. This unusually long time-span encompasses most of the Cenozoic era and three epochs: Eocene, Oligocene, and Miocene; as such, the fossils are primarily of mammals and flowering plants. The paleobotanical resources “are some of the most prolific and diverse to be found anywhere” (John Day Fossil Beds National Monument, n.d., Fossils, para. 3). These resources allow for the reconstruction of past ecosystems and climates in eastern Oregon; thus, the monument contains a record of ancient, natural (non-anthropogenic)
climate changes that can be compared with the current anthropogenic climate change. Therefore, JODA is an excellent location to develop climate change interpretation programs and media; in addition, it contains several unique aspects of climate change that greatly enhance its communication with visitors. Specifically, past climate changes have left behind several forms of visible evidence of their occurrence including plant and animal fossils, paleosols, and the geologic record—particularly in the form of different colored rocks.

Paleosols are ancient fossilized soils; they are an archive of past climates (Retallack, 2007). Preserved soil chemistry and other characteristics reveal the temperature, participation, vegetation, and soil nutrients that existed when they were created. Paleosols are particularly abundant in JODA and other North American locations famous for their fossil plants and mammals (Retallack, 2007). Of specific importance to interpretation is that they are colorful and easily identified in the field; as such, they can be used as an easy to find and identify symbol of climate for visitors, and when multiple colors are easily seen in one place, an easy to find and identify symbol of paleoclimate change. At JODA, paleosols both reveal warm paleoclimates were also times of high precipitation, which supports the hypothesis of CO$_2$ being the major factor controlling climate during the Cenozoic, and reveal paleoclimate data obtained from them matches the paleoclimate data that can be interpreted from plant and animal fossils of the same locations and time periods (Retallack, 2007); thus, they are an accurate symbol of climate for interpreters to use.

The fossils uncovered in JODA provide a unique look at the changes that occurred in species during a fifty million year timespan and the drivers of these changes. Two of the epochs its fossils come from, the late Eocene and the Oligocene, were critical periods in earth’s history; a major change in the world’s climate is seen in changes in land mammal species, including the entire extinction of many archaic groups (Prothero, 1985). In addition, fossil evidence suggests
“species were not passively tracking environmental changes” (Prothero, 1985, p. 399); as such faunal responses to climate crises include both speciation (creation of new species) and extinction. One particularly striking and important example occurred between thirty-eight and thirty-five million years ago; during this time period temperatures cooled and the climate dried. The mammalian response to this climate change was “increases in metatarsal/femur ratio, and thus running stride (cursoriality), in horses” (Retallack, 2007, p. 284). As the climate continued to cool and dry, the fossil record shows a shift in vegetation from a woodland ecosystem to a grassland ecosystem; mammalian response to this change was additional advances in cursoriality in herbivores, such as camels and deer-like protoceratids (Retallack, 2007), as well as a strengthening of molars in grazers. These adaptations prepared mammal species for the new ecosystem; Prothero (1985) concluded the profound climatic changes well documented in the Late Eocene and Oligocene must have affected the biota. As such, the fossil record in JODA provides strong visual evidence of the impacts of climate change on life and that it has been responsible for the extinction of species; therefore, it provides a somewhat rare opportunity for interpreters to share with visitors the actual consequences of climate change, not just the potential consequences.

The geologic record provides one last interesting piece of visual evidence of climate change; several aspects of climate, in particular precipitation, impact the types of sedimentary rocks formed during a specific time period, as well as their chemical and mineral composition. These changes can often be visually seen in their impact on rock colors; at JODA, paleosols enhance this attribute by adding their specific colors to the rock layers, which further differentiates each layer. Thus, the colors of the rocks are a visual indicator of past climates; Retallack (1991) explains further:

The transition from steamy jungles of the Eocene to the sagebrush desert of today is recorded in the change from deeply weathered, red, kaolinitic clayey paleosols of the Eocene, to the red, brown, and green smectitic paleosols of the Oligocene, to the thin,
brown calcareous paleosols of the Miocene, and to the gray, silty calcareous paleosols of the Quaternary. (p. 51)

The colorful landscapes of JODA are one of its most well-known features; therefore, interpreters can use this visual aspect to relate climate change to visitors by revealing each color, as a paleosol, represents a different climate that once existed in the area.

JODA also has one unique aspect of climate change that falls outside of the category of visual representation; it contains evidence of the causes of previous climate change events. Because of the extreme differences in ecosystems that occurred in eastern Oregon over the last fifty million years, most visitors assume these differences were a result of the North American Plate moving; specifically, the changes in ecosystems were a result of changes in the latitude of Oregon. However, this is incorrect; the paleoclimate changes revealed in JODA were a result of a variety of other factors. Reasons for the cooling and drying of the climate that took place during the Cenozoic include the rise of the Cascade Mountains and the Oregon Coast Range, the thermal isolation of Antarctica by the closing of the Drake Passage, and a reverse greenhouse effect where atmospheric carbon dioxide was reduced, primarily as a result of reduced volcanism (Retallack, 1991). Thus, interpreters have an opportunity to share with visitors that you do not need plate tectonics to have extreme changes in ecosystems and carbon dioxide has contributed to previous climate changes.

The climate change internship at JODA was created in response to this important record of paleoclimate change located within its boundaries, especially because of the unique climate change story it tells, which needs to be shared with visitors in order for them to develop a better understanding of the current event. Therefore, the internship’s purpose was to:

Research, develop, produce, and present interpretive products that incorporate a climate change message pertaining to the paleontological resources of the Monument, specifically contrasting the rates of climatic changes observed in the fossil record during the Cenozoic Era with rates of climatic change being observed today and the possible implications of these differences. (Climate Change Response Program, 2011, para. 4)
This purpose was in direct agreement with the intent of the Master’s project: to develop theoretical based interpretation products on the topic of climate change. During the internship I reported to two JODA supervisors, Paul Ollig, Chief of Interpretation, and Josh Samuels, the Chief of Paleontology. The following list of goals to be accomplished was established at the beginning of the internship:

1. Conduct a needs assessment for climate change communication projects to augment JODA’s existing non-personal interpretive program.
2. Review literature regarding JODA’s climate change story (paleoclimates and how they changed over time in North America) and develop proposal ideas for the primary climate change exhibit in the visitor center lobby.
3. Develop a climate change site bulletin suitable for the general public that addresses JODA’s site-specific climate change story and gives it a modern relevance.
4. Explore ideas for multimedia and web-based climate change communication products.

All four goals were accomplished during the internship; goals one and two were done in an informal manner, no formal products were produced, but items such as e-mails and meeting notes were created that addressed these goals. Goal three was directly addressed and a formal product was produced; lastly, goal four was greatly expanded and three items, a wayside, a video, and a podcast, were formally produced to address it. However, JODA has thus far only used one of these last three items.

**Wrangell-St. Elias National Park and Preserve**

After the internship ended at JODA, I returned to my summer seasonal position as an interpretation park ranger for Wrangell-St. Elias National Park (WRST) in southeast Alaska. This presented a great opportunity to implement the I-TPB framework in both a different location and in a personal interpretation program, as opposed to the non-personal interpretation media
developed at JODA. In addition, WRST has a unique aspect of climate change not present at JODA; it contains striking visual evidence of impacts created by the current climate change.

One great example of this evidence is the effect of climate change on the boreal forest ecosystem; this ecosystem is the primary one visitors interact with at WRST. A report by the U.S. Global Change Research Program (2009) found during the last 50 years Alaska’s annual average temperature has increased by 3.4°F Fahrenheit, with the primary increase in warmth coming during winter, where average temperatures are 6.3°F Fahrenheit warmer. These warming temperatures have had incredible ramifications for the boreal forest. One of the primary forces that keep both spruce bark beetle and spruce budworm populations in check is cold winters (U.S. Global Change Research Program, 2009). Therefore, the increasingly warmer winters have increased the population of spruce bark beetles, which has noticeably decreased the amount of living spruce trees; this affects both species of spruce, black (Picea mariana) and white (Picea glauca), that inhabit the boreal forest. Stands of dead spruce trees are visible throughout WRST, including near the main visitor center, providing visual evidence of the current climate change.

In addition, decreasing populations of spruce impacts the diversity of life in the boreal forest; numerous species in this ecosystem depend on spruce trees for their survival (Rook, 2002). One species in particular, the red squirrel (Tamiasciurus hudsonicus), has their population numbers tied directly to the populations of white spruce trees; as cited by Smith (1968), red squirrels have been witnessed gathering as much as 1000 white spruce cones in a single day to use for both their current and future food needs (Clark, 1939). Therefore, as white spruce populations decline, so do red squirrel populations. This is a concern because red squirrels are used as a food source by a variety of boreal forest predators, including red fox (Vulpes vulpes), bald eagle (Haliaeatus leucocephalus), lynx (Lynx lynx), and ermine (Mustela erminea) (Sullivan, 1995). Increasing this concern is red squirrels remain active during the winter months (Sullivan, 1995), thus they serve as an important winter food source for several predators of the boreal forest. Hence, there is a
very real potential that as red squirrel populations decline, so do the populations of these predators. Consequently, the visual evidence of the impacts of climate change on the boreal forest will increase over time as once often witnessed species become rarer and rarer to sight.

Climate change is also impacting aspen (*Populus tremuloides*) trees in the boreal forest; prior to the 1970s an insect known as the Aspen leaf miner did not exist in Alaska. As the climate has warmed, these insects have spread and made their way into the boreal forest; in 2004, aspen leaf miners were found in 584,000 acres in Alaska (Rozell, 2005). These small caterpillars feed on the inside of aspen leaves until they emerge as a tiny moth; their feeding leaves a white racetrack type pattern in the leaves, making the leaves appear silver, instead of green, from a distance (Rozell, 2005). As such, this visual evidence of climate change can be spotted both up close and from a distance. These are only a few examples of the visual consequences of climate change in WRST; the park also contains numerous shrinking glaciers, including some that have already disappeared, as well as other items. Together, these examples of visible climate change impacts in WRST provide a great opportunity for interpretation to affect climate change behavior by influencing visitor beliefs.

The primary avenue by which this was accomplished was the use of the field I-TPB framework in a PowerPoint program; seasonal interpretation rangers stationed in the Headquarters district of WRST develop a variety of interpretation programs including forty-five minute long PowerPoint programs, which are presented at a nearby privately operated lodge. During the summers of 2010 and 2011, I worked in this district and created a PowerPoint program with the central topic of glaciers and the changes they create in WRST, with the conclusion focused on the impacts of climate change on glaciers. When I returned in the summer of 2012, I altered this program in accordance with the field I-TPB framework, integrated some of the previously mentioned visual evidence of climate change in WRST examples, and presented the program throughout the summer to visitors.
## METHODOLOGY

**Table 3: Linking the 5 Interpretation Tools with TPB in a Program**

<table>
<thead>
<tr>
<th>Learning Domain</th>
<th>Behavioral Belief</th>
<th>Normative Belief (Cultural Cognition)</th>
<th>Control Belief</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive</td>
<td>Use knowledge to show attributes of an object</td>
<td>Use knowledge to show how climate change will affect groups</td>
<td>Use knowledge to show people have the ability to make a difference</td>
</tr>
<tr>
<td>Affective</td>
<td>Use emotion to show attributes of an object</td>
<td>Use emotion to show how climate change will affect groups</td>
<td>Use emotion to show people can make a difference</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modalities of Learning</th>
<th>Cognitive</th>
<th>Affective</th>
<th>Visual</th>
<th>Auditory</th>
<th>Kinesthetic</th>
<th>Symbolic</th>
<th>Cultural Cognition</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual</td>
<td>Visually (graphics, diagrams, charts) show attributes of an object</td>
<td>Visually show (graphics, diagrams, charts) groups that approve/disapprove of climate change</td>
<td>Visually show info. on how a person can make a difference with climate change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auditory</td>
<td>Aurally mention attributes of an object</td>
<td>Aurally mention groups that support climate change</td>
<td>Aurally mention info. about how a person can make a difference</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kinesthetic</td>
<td>Use touch &amp; feel to relate attributes of an object</td>
<td>Interaction (activities) with groups that support climate change</td>
<td>Provide info. using interaction about how a person can change climate change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Symbolic</td>
<td>Provide text to read that discusses attributes of an object</td>
<td>Provide text to read that shows different groups’ views on climate change</td>
<td>Provide text to read on how a person can make a difference with climate change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cultural Cognition: Incorporated using the Normative Belief cells

Themes: General Topic: referent groups will face negative consequences as a result of climate change, but you can reduce the harm with minimal sacrifice
The project was accomplished by utilizing the field version of the I-TPB framework in a variety of climate change interpretation products; specifically, it was used to help the interpretation products target human behavior attributed to increasing climate change. Four non-personal interpretation items were created at John Day Fossil Beds National Monument: a site bulletin, a small film, a wayside and a podcast. In addition, the field framework was used at Wrangell-St. Elias National Park in a personal interpretation program, a PowerPoint program. At both locations, the basic project design consisted of first reviewing pre-existing literature on visitor beliefs, which included both reviewing visitor surveys for each site (JODA & WRST) and reviewing climate change belief surveys of the American public. Second, a table of specific guidelines that linked each of the five interpretive tools to each of the three beliefs in the TPB in the context of climate change (table three) was developed. This table was the mechanism by which the field framework was incorporated into the climate change interpretation products; as long as each belief and each interpretive tool listed in the table was incorporated at least once in the manner specified by the table, then the interpretation product created was considered to have successfully integrated the framework. The interpretation products were then researched and developed using the table, and had, at least, a plan made for their implementation. The fourth and final step in the project design was an evaluation of the interpretation products created; this
turned out to be the most difficult step in the project. The primary form of evaluation was done using social media; Twitter and Facebook pages were created where visitors familiar with the interpretation products created during the project could post comments. However, this proved unsuccessful for a variety of reasons which will be discussed later in the paper. Each one of the interpretive products and the evaluation measures are discussed in detail below.

John Day Fossil Beds National Monument

Site Bulletin (Appendix B)

At the beginning of the project, a strong need was identified that is also a very probable salient belief behind the attitude of not accepting anthropogenic climate change and/or the behavior of not taking action to reduce it. Interpretation rangers working at JODA, including the education specialist who has worked at the site for several years, revealed one of the most common misconceptions visitors have is they believe the reason for the extremely different ecosystems and climate that existed in Oregon fifty million years ago was a result of Oregon being much closer to the equator. However, research has shown Oregon has changed latitude only slightly in this timespan; the reasons for its different climate and subsequent changes include a change in global ocean currents, the rise of the Himalayans and Tibetan plateau, and a reverse greenhouse effect in which high levels of carbon in the atmosphere were reduced over time causing the planet to cool significantly. Thus, it was important to have one of my interpretive materials to target this discrepancy and potential salient belief; because it does require some site specific knowledge (the former ecosystems of JODA compared to what exits now) and because of its potential to reach more JODA visitors than the other forms of media I was tasked with developing, this was chosen to be the subject of the site bulletin.

Site bulletins are an official NPS brochure whose template was developed by the Harpers Ferry Center, a NPS office tasked with the purpose of providing interpretive media and services
to national park sites. The site bulletin template consists of a single sheet of legal size paper with text, graphics, and pictures on both sides; in addition, specific rules for its headings, margins, font, and paragraph spacing have been developed. Because of this standardization, most visitors consider them to be the “official” brochure for NPS sites; in my experience, visitors are more likely to accept information written in this format than in any other brochure format a site might have, with the exception of the Unigrid System used for official park brochures (park maps). Thus, I developed the site bulletin in accordance with the standardized template using a variety of computer programs including Adobe InDesign CS5 and Adobe Photoshop CS5. In addition, following the tenets of good design, reading comprehension was limited to an eighth grade level, the reading level of the average American, and limits were placed on the amount of words used. In order to reduce printing costs for JODA, which greatly increases the probability of its distribution, both black and white and color versions of the brochure were developed.

**Wayside (Appendix C)**

One particularly concerning salient belief that I feel could be the strongest belief behind not changing behavior to reduce climate change, is the belief consequences will not be severe or they will occur so far in the future, they will not affect people’s children and grandchildren (Leiserowitz et al., 2011). As such, this belief was targeted by several of my interpretive media; John Day Fossil Beds allows you to visually see climate change and its consequences in a variety of ways. First, and foremost is the fossil record; thanks to an impressive and extremely well designed museum in the visitor center, as well as a nicely done website, visitors can visually see how the area looked during different climates. This is primarily a result of very large scale murals painted by an artist, and later photographed by a professional photographer, who worked with the paleontological scientists of the monument to create images based on scientific evidence including fossils, paleosols, and geology; thus, the murals are considered science based
renderings that accurately depict the former ecosystems of eastern Oregon according to known research. In addition to these murals, paleosols provide another form of visual evidence, which is important due to a significant percentage of visitors who do not enter visitor centers and/or look at a site’s website. The different colors of the paleosols create the colorful landscapes JODA is well known for, especially its Painted Hills Unit; by revealing to visitors these colors are visual representations of the climate that existed when they were created, and joining it with the plants and animals living during that climate, visitors can visually see climate change and its consequences.

The first interpretive media used to target this salient belief about the consequences of climate change was a wayside sign; in addition, this sign also has the purpose of limiting visitor confusion with the added intent of immediate resource protection by limiting erosion caused by social trails. The wayside is located on the Blue Basin Overlook trail, which has a Y junction that is unsigned. Consequently, visitors have a difficult time following the trail; where the stem (lower) part of the Y ends, visitors do not know they have to backtrack and pick up the branch of the Y they have not yet walked on in order to continue on the trail. Instead they are searching for the continuation of the trail at the end of the stem of the Y, which has created multiple social trails and noticeable erosion. The wayside is able to accomplish both of these purposes, impacting climate change beliefs and reducing visitor confusion, because the location of the Y junction happens to be at a spot where many different paleosols are visible and easily identified based on their color; thus, this provides an avenue through which a sign can reveal climate change and its consequences.

The wayside consists of one 36 inches wide by 24 inches tall panel on an angled horizontal base; it will be located outdoors at approximately the halfway point of the three mile Blue Basin Overlook Trail in JODA. In accordance with the tenets of good design, text was kept to a minimum and at an eighth grade reading level. In addition, the sign uses the standardized
low profile 36x24 grid template created by Harpers Ferry Center, and was made using Adobe
InDesign CS 5, Adobe Photoshop CS 5, and Adobe Lightroom 3. In addition, the background
photo was taken by the author using a digital SLR and the map produced in ArcGIS. While the
final product has not yet been produced, it is scheduled to be created and installed in the near
future.

Video (Appendix D)

The video was created with the same purpose as the wayside, to visually show climate
change and its consequences thereby targeting the salient belief of climate change not having
severe and/or relevant consequences. The video started with a written theme statement, and then
a script was built around it. I was responsible for all aspects of the video including writing the
script, choosing scene locations, filming the video (using a professional camcorder and wireless
microphone setup), acting (at least speaking) in it, and editing the video and its sound. This video
and sound editing was performed using both PC and Macintosh computers and the following
software: Adobe Premiere Pro CS 5, Adobe After Effects CS 5, Adobe Photoshop CS5, Adobe
Soundbooth CS 5, Adobe Media Encoder, Apple Final Cut Express and Microsoft Word and
Excel. It was filmed exclusively in JODA, in each one of its three districts, from January to
March 2012. In order to increase the potential audience of the film, it was kept under ten minutes
in length; specifically, it is nine minutes long. The video was posted on JODA’s YouTube page,
a link to it placed on JODA’s website, and was advertised on JODA’s social media pages.

Podcast (Appendix E)

The purpose of the podcast was to create a form of interpretive media that would address
the above identified important salient belief, the belief of climate change not having severe and or
relevant consequences, in a form that could easily travel with people, thus increasing the amount
of people exposed to the message. By creating a podcast, visitors do not have to enter the visitor center or travel on a trail, or even visit JODA’s website to receive the message; instead, they only have to download the podcast to the portable electronic device of their choosing. Intended to be a series, each podcast would have one of the easily identified by its color paleosols as their main subject; as such, anywhere the visitor sees this paleosol, even outside the monuments boundaries, they would know the climate that once existed in that location and the impacts it had on life.

However, time constraints and other issues meant only the first podcast, for the Picture Gorge Basalts, was able to be addressed and only the finalized script for it was produced, but this script was still completed in accordance with the tenets of good podcast design, such as keeping its length to less than two minutes. Therefore, this script can be easily turned into a finished podcast at a future date with minimal resources required.

Wrangell-St. Elias National Park & Preserve

PowerPoint Program (Appendix F)

Previous and current summer employment allowed for a unique opportunity, a chance to integrate the field framework with an existing interpretation program, which provided an understanding of its ease of implementation. During the summers of 2010 and 2011, I researched, developed, and presented a forty-five minute long interpretive PowerPoint program with the theme centered on how glaciers affect Wrangell-St. Elias National Park. The longer than normal conclusion consisted of revealing how glaciers were under threat from climate change and a brief examination of anthropogenic climate change. In the summer of 2012, I incorporated the field framework into the program, primarily by revising its conclusion, and then presented it at least once a week for three months to audiences that ranged in size from fifteen to seventy-five members. The primary salient belief targeted during these presentations was, once again, the misunderstanding of and/or disbelief in the consequences of climate change; additionally, the
program allowed another potential salient belief to be targeted: there is nothing a person can do to make a noticeable difference in the negative impacts of climate change. The sixty-five slide long program was also developed in accordance with several interpretive PowerPoint guidelines, including the use of interpretive pictures, having the slides themselves tell the story presented in the program, keeping animations to a minimum, and using a simple design with visually pleasing colors. Throughout this process of integration and presentation, I was able to obtain not only a better understanding of how to integrate the framework into pre-existing interpretation programs, but also a better understanding of its impacts on visitors.
### RESULTS

#### Table 4: Links between Interp. & Theory of Planned Behavior in Each Program

<table>
<thead>
<tr>
<th>Table 3 Actions</th>
<th>Cognitive</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Domain</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cognitive</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Use knowledge to show attributes of an object</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Use knowledge to show how climate change will affect groups</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Use knowledge to show people have the ability to make a difference</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>4</td>
</tr>
<tr>
<td><strong>Affective</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use emotion to show attributes of an object</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td>Use emotion to show how climate change will affect groups</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>4</td>
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<tr>
<td>Use emotion to show people can make a difference</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td><strong>Modalities of Learning</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Visual</strong></td>
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</tr>
<tr>
<td>Visually (graphics, diagrams, charts) show attributes of an object</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>4</td>
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<td>Visual Learning Strategies</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
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<td>Visually show (graphics, diagrams, charts) groups that approve/disapprove of climate change</td>
<td></td>
<td></td>
<td></td>
<td>NA</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Visually show info. on how a person can make a difference with climate change</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td>Yes</td>
<td>2</td>
</tr>
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<td><strong>Auditory</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aurally mention attributes of an object</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>Yes</td>
<td>3</td>
</tr>
<tr>
<td>Aurally mention groups that support climate change</td>
<td>NA</td>
<td>NP</td>
<td>NA</td>
<td>NP</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>Aurally mention info. about how a person can make a difference</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>Yes</td>
<td>3</td>
</tr>
<tr>
<td><strong>Kinesthetic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use touch &amp; feel to relate attributes of an object</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>3</td>
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<tr>
<td>Interaction (activities) with groups that support climate change</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
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<tr>
<td>Provide info. using interaction about how a person can change climate change</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>2</td>
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<td><strong>Symbolic</strong></td>
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<td></td>
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<td>Provide text to read that discusses attributes of an object</td>
<td>Yes</td>
<td>NA</td>
<td>Yes</td>
<td>NA</td>
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<td>Provide text to read that shows different groups’ views on climate change</td>
<td>Yes</td>
<td>NA</td>
<td>No</td>
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<tr>
<td>Provide text to read on how a person can make a difference with climate change</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
<td>Yes</td>
<td>3</td>
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A successful integration of the field I-TPB framework requires each interpretation product to incorporate each one of the four interpretive tools and three TPB beliefs listed in table three in the manner specified by it; as such each product was examined during its creation and after its completion for these items. Table four identifies these results; if the interpretation product listed in the first row included the specified action from table three listed in the first column, then “yes” was marked; if the interpretive product did not contain the action, a “no” was marked. In addition, “NA” was used where the specified action was not applicable to the interpretation product, such as visually showing attributes of an object in a podcast, and “NP” was used where the action was not permitted by the NPS site, such as aurally mentioning groups that support climate change in the video. Overall, all permitted actions were included in at least one of the interpretation products, with seven included in all five, except theme statements that

<table>
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<tr>
<th>Themes</th>
<th>Include attributes of the main object</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
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<th>5</th>
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<td></td>
<td>Include referent groups that will be harmed by climate change</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>3</td>
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<tr>
<td></td>
<td>Include a person can stop referent groups from being harmed with min. sacrifice</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Unfamiliar to Familiar</th>
<th>Relate attributes of an object to something that is familiar</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>Yes</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Relate climate change beliefs/facts/consequences to how it affects groups</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Relate info. on min sacrifice needed to change climate change to the familiar</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>3</td>
</tr>
</tbody>
</table>
included “a person can stop referent groups from being harmed (from climate change) with minimum sacrifice.” However, each interpretation product used at least one action for each of the four interpretive tools and targeted each of the three beliefs at least once; as such, all five created interpretation products are considered to have successfully integrated the field I-TPB framework.

Implementation

Site Bulletin (Appendix B)

The site bulletin, in accordance with the field framework, incorporates the four interpretive tools (the fifth tool of cultural cognition was acceptably addressed by normative beliefs) in table three and targets all three beliefs in a variety of ways. The introductory paragraph (paragraph one, Appendix B) contains the interpretive tool of a theme statement; it states “The fossils they study reveal fifty million years of changes in Oregon’s life and climate. This story contains a valuable lesson about what awaits future generations; not all species of life survive climate change.” By including the referent group “future generations” and revealing they could be harmed by climate change, this theme statement targets normative beliefs; in addition by providing information about past climate changes to reveal its attribute of extinction, the theme statement also targets behavioral beliefs. In the last paragraph underneath the heading “Watch Out for the Plates!” (paragraph four, Appendix B) an example of the interpretive tool of relating the unfamiliar to the familiar is seen in the statement: “As you might have discovered from weather reports, highs and lows affect the weather. As a result, earth’s climate changed and Oregon cooled.” These sentences relate the unfamiliar concept of global cooling as a result of the rise of the Himalayas and Tibetan Plateau to something much more familiar, high and low pressure areas, most often represented by the their first letter, H & L, on weather maps and mentioned in weather reports; as such, this important reason for climate change is easier for visitors to understand. In addition, by using information to make this comparison, theses
sentences are targeting behavioral beliefs. The first paragraph underneath the heading “Jungles, Forests, & Grasslands. Oh My!” (paragraph six, Appendix B) contains an example of the interpretive tool of learning domain:

Despite surviving for more than fifteen million years, oreodonts were unable to adapt to the new, open environment and became extinct. Currently, humans are numerous and successful, but our species has only survived for 200,000 years. How much do you think the current climate change will impact us?

This statement uses information, such as one attribute of climate change is extinction, and emotion, such as the potential fate of humans, to make connections and it also incorporates the referent group “humans” to convey its message; therefore, it uses both the affective and the cognitive learning domains as interpretative tools and targets both normative and behavioral beliefs. The last interpretive tool of modalities of learning can be found in the second paragraph underneath the heading “It’s the End of the World as We Know It!” (paragraph eight, Appendix B). It is contained within the following sentences: “Groups as different as automotive corporations and environmental groups recognize the need to reduce these emissions. John Day Fossil Beds National Monument has already taken great steps to reduce these emissions.” Since this statement contains text for people to read about referent groups, automobile corporations, environmental groups, and JODA, in the context of climate change behavior, it is an example of the symbolic modality of learning and is targeting normative beliefs.

**Wayside (Appendix C)**

The wayside, despite its limited space for text, was able to incorporate all four interpretive tools (cultural cognition, the fifth tool, was successfully incorporated by normative beliefs) in table three and target all three beliefs. The interpretive tool of a theme statement is found in the first paragraph of the text (paragraph two, Appendix C); it is “You have now seen climate change and its immense consequences on life.” Since this statement uses information to
reveal an attribute of climate change, it has consequences for life, the theme is targeting behavioral beliefs. The theme statement is also part of a second interpretative tool, modalities of learning; the sentences before it on the wayside are: “Within these beautiful layers are a diversity of fossils and paleosols, ancient fossilized soils. These items reveal the past climates of John Day Fossil Beds. Move your eyes from layer to layer.” This statement is revealing climate change to visitors visually; thus, the visual modality of learning is being used, and by providing information to reveal attributes of the past climates of JODA, behavioral beliefs are being targeted. A third interpretive tool, relating the unfamiliar to the familiar, is found in the second paragraph of the wayside’s text (paragraph three, Appendix C) in the following statement: “The ecosystem that flourished in each layer is shown in the round artist rendition pictures. Notice how much life changes when the climate slowly changes.” In this instance, the unfamiliar concept of how much climate change impacts life is made familiar through visually showing how small changes in temperature and precipitation can greatly change life; in addition, since this comparison is achieved through the presentation of information, behavioral beliefs are being targeted with this tool. Finally, an example of the fourth tool of learning domain is found in the wayside’s second paragraph in the sentences: “Unfortunately, the current climate change is occurring far more rapidly than these previous events. Our greenhouse gas emissions have greatly increased its rate. Imagine how great the consequences on life will be.” Since this statement uses information to create an intellectual connection to the potentially severe consequences of climate change as well as an emotional connection by implying life will be severely harmed, it is using both the cognitive and affective learning domains and is targeting both behavioral and normative beliefs.

**Video (Appendix D)**

In accordance with the field framework, the video contains all four interpretive tools (normative beliefs were an acceptable substitute for the fifth tool of cultural cognition) in table
three, as well as targets all three beliefs. The introduction (paragraph one, Appendix D) contains the interpretive tool of a theme statement; the theme of the video is “It’s the consequences of past climate changes on plants, animals, and entire ecosystems, which gives valuable insight as to what awaits future generations of the world.” By mentioning climate change will harm the referent group of “future generations”, the theme targets normative beliefs; in addition, by using information to reveal an attribute of climate change, it has consequences for plants, animals, and entire ecosystems, the theme also targets behavioral beliefs. In the second scene of the video (paragraph two, Appendix D) the interpretive tool of relating the unfamiliar to the familiar is used in the sentences: “Certain features in paleosols act as climate recorders. Like a barometer telling you about the weather, they reveal how wet or dry, warm or cold an area once was.” This tool is seen in the comparison of paleosols, something few people are familiar with, to a barometer, which many more people are familiar with, in order to convey how they are evidence of past climate changes; in addition by using information to relate an attribute of paleosols, they record the climate, behavioral beliefs are being targeted. In the fifth scene in the movie (paragraph five, Appendix D), the interpretive tool of learning domain was used in the conveyance of climate change consequences; “In fact, the climate cooled to an average temperature only five degrees warmer than today. The ranchers and farmers that live here now, they depend on these conditions, this ecosystem and climate, for their livelihood. Imagine what would happen if the climate shifted back.” Since this statement creates both intellectual connections, the climate was only five degrees warmer than today, and emotional connections, the livelihood of ranchers and farmers could be in jeopardy, this statement uses both the cognitive and affective domains, as well as targets both behavioral and normative beliefs by revealing attributes of climate change and how it will affect the referent groups of “ranchers” and “farmers.” Lastly, the interpretive tool of modalities of learning was used in the seventh scene (paragraph seven, Appendix D) in the following sentences: “In that spirit, John day Fossil Beds has built this zero energy ranger
residence behind me. It makes more energy than it uses, while still having all the modern conveniences.” By visually showing a zero energy building and some of its features, this part of the video is using the visual modality of learning; also, by sharing how a person can positively impact climate change, it is targeting control beliefs.

Podcast (Appendix E)

The podcast, despite being limited to only auditory communication, incorporates all four interpretive tools (the fifth tool of cultural cognition was acceptably substituted by normative beliefs) in table three and targets all three beliefs. The interpretive tool of a theme statement is found in the first paragraph in its script (paragraph one, Appendix E): “These colored rocks reveal the great impacts that natural, slow-moving climate change has on life, which means the present, unnaturally rapid climate change will have immense consequences for future generations.” This sentence uses the concept of a referent group, future generations, being harmed by climate change, and uses information to reveal an attribute of climate change, it has great impacts on life; therefore, the theme is targeting both normative and behavioral beliefs. A second interpretive tool is found in the second paragraph of the podcast script (paragraph two, Appendix E), the use of learning domain as shown in the following sentences: “These basalt floods were not responsible for changing the area’s ecosystems. It was something else far more devastating. What could this possibly be? It was climate change.” By utilizing an attribute of climate change, it can change ecosystems, in order to create intellectual connections, climate change impacts life more than immense lava floods, the cognitive learning domain is being used to target behavioral beliefs in these sentences. An example of a third interpretive tool used in the podcast, relating the unfamiliar to the familiar, is found in the second paragraph of its script (paragraph two, Appendix E); “Think about what this means for future generations. What was responsible for most extinctions was not a catastrophic natural disaster on a scale unseen by us, but rather the process
of climate change.” In this example the unfamiliar concept of the severity of climate change consequences is compared to the much more familiar severity of outcomes generated by large natural disasters. Through relating the referent group “future generations” could be significantly harmed by climate change and by relating an attribute of climate change, it has caused extinctions, this interpretive tool is targeting normative and behavioral beliefs. The last interpretive tool of modalities of learning is found in the third paragraph of the podcast script (paragraph three, Appendix E); it is seen in the statement: “But there is hope. If you reduce the amount of energy you use, this rate will be reduced, giving a brighter future to the next generations.” In this statement, a way for people to positively impact climate change, reduce energy use, is aurally presented to visitors, thus the auditory modality of learning is being used; furthermore, by revealing how a person can positively affect climate change, this statement is targeting control beliefs.

**PowerPoint Program (Appendix F)**

The field framework was also successfully implemented at WRST in a PowerPoint program; it was easily altered to include the four interpretive tools (normative beliefs were used instead of cultural cognition) in table three and the three TPB beliefs. It was determined the best way to successfully integrate the field framework was to use it in its entirety in the conclusion, with parts of it incorporated into other sections in the program. The first interpretive tool used to adapt the program was the creation of a stronger theme statement; each section of the program refers back to the theme; thus, its main tenets are repeated in order to increase the probability of remembrance. The exact wording of the theme statement in the conclusion section (slide 59, Appendix F) is: “Tonight we have explored how much glaciers change life and how their absence can have consequences for plants and animals;” by using information to reveal attributes of
The International Climate Change Partnership is a collection of private corporations including General Motors, Boeing, and DuPont. What do you think they say about climate change? They agree we need to slow the rate of greenhouse gas emissions, and we need to mitigate the risks from climate change.

These items are shown visually on slides fifty-seven and fifty-eight with the purpose of providing visitors with examples of referent groups that one would not think would support climate change but actually do; as such, these slides are using the visual modality of learning to target normative beliefs. Slide sixty-one (slide 61, Appendix F) contains the third interpretive tool of learning domain; it includes the sentences: “Here is what a one meter or three and one third foot rise in sea levels will do. It will cost us approximately one trillion US dollars and flood the homes of 145 million people.” These sentences, and the corresponding chart on the slide, reveal one consequence of climate change is flooding; by using both emotion, such as people’s homes will be flooded, and information, such as one attribute of climate change is it will cause one trillion U.S. dollars in damages, to make connections, this slide is using both the cognitive and affective learning domains to target behavioral beliefs, and possibly normative beliefs if the visitor identifies with someone or something they consider to have value that is found near the coast.

This slide, sixty-one is also a part of the fourth, and last, interpretive tool of relating the unfamiliar to the familiar; slides fifty-nine to sixty-one (slides 59-61, Appendix F) utilize charts and graphs to relate the unfamiliar, the consequences of climate change, to something familiar, flooding and natural disaster damage. This relationship is primarily performed using information, glaciers are currently melting because of climate change and as a result ocean levels are currently rising, to relate this attribute of climate change; thus behavioral beliefs are being targeted by this tool, with the same possibility of normative beliefs also being targeted, depending on if there is something or someone near the coast a visitor values.
Evaluation

In order to obtain an understanding of the frequency of use of the developed interpretive products and the effectiveness of the field I-TPB framework, an evaluation measure was implemented. Since there are numerous regulations that make survey work difficult in the NPS and since this type of experiment design was beyond the scope of the project, a more unique, less rigorous, evaluation tool was designed, the use of social media. JODA’s YouTube and Twitter pages were used as the location of the video and to advertise the interpretive products respectively; also, Twitter and Facebook pages were created and managed by the author for the entity “The Greatest Threat” and a logo that incorporates a visitor prompt was developed (figure four). This prompt is intended to encourage visitors to respond with messages not only about the overall quality of the interpretive product, but, most importantly, also about the climate change message contained within the product; therefore, the prompt consists of the following statement: “Help us to get the message right! Leave comments, questions, and concerns about this (insert type of interpretive product) at:” with the address for the Facebook and Twitter websites following the prompt. The logo incorporates these two items, the prompt and website addresses, and adds the official logos of Twitter and Facebook, which act as a quick visual stimulus for visitors who are already engaged in social media. This logo was placed on all of the interpretation products with the exception of the wayside due to its potential permanence;

Figure 4: Social Media Logo

Help us to get this message right!
Leave comments, questions, and concerns about this ___ at:

www.facebook.com/GreatestThreat www.twitter.com/GreatestThreat
there is a legitimate possibility visitors will be viewing the wayside decades from now. Since there are no guarantees the webpages will last anywhere near that long, and since a wayside’s information is not easily changed, it was decided not to place the logo on the sign.

Overall, this evaluative measurement was only partially successful; it did provide knowledge of the frequency of use of some of the interpretive products; however, comments were minimal, which means the effectiveness of the field I-TPB framework is unknown. The results obtained are as follows. First, the YouTube page that contained the video also allowed comments; as such, it is known that 135 people have viewed the video, three “liked” the video, and one “disliked” the video; unfortunately, no comments were made. Related to this page is JODA’s Twitter page, which advertised the video by sending out a tweet about it; approximately one thousand followers received the tweet, six “liked” it, and two posted comments after viewing the film; these comments included: “After viewing this fine work, I am looking forward even more to visiting the Park!” Finally, “The Greatest Threat” Twitter account received four followers, while “The Greatest Change” Facebook page received four likes. No relevant comments were posted on either site. The incompleteness of this evaluation method can be partially attributed to difficulties in advertising the products; one of the products, despite its finalized design, has still not been produced. In addition, despite several requests, none of the products have been posted on JODA’s website, which also creates doubt as to how often the site bulletin is given to visitors in terms of both are there copies readily available and, if so, is park staff handing them out. Despite these issues, there is at least one incredibly positive attribute of this evaluation tool; the Twitter and Facebook pages can be, and will be, continued into the future. Therefore, there is an opportunity for views of these pages to increase, as well as the comments posted on them, allowing for additional evaluation of the project to be obtained.

The nature of the products themselves also allows for a more formal (scientific) evaluation to take place at a later date when resources are available, either by obtaining funding
from a source outside of the NPS or by obtaining NPS approval. Specifically, a multi-step 
evaluation process could be implemented that would determine if these climate change products 
developed using the I-TPB framework are successful in changing climate change beliefs and 
behavior. For both logistical and statistical simplification, as well as the ability to obtain better 
results due to the diversity of the interpretation products developed, this evaluation process would 
only occur at JODA. The first step would be to measure the potential impact of the interpretation 
products by calculating the percentage of visitors who viewed them; this would be accomplished 
by compiling the following data. First, available NPS website statistics would be used to 
determine the amount of people who clicked on the link to the video, and to the podcast link if it 
is implemented, on JODA’s website and then compared to the total amount of website visitation. 
Next, site bulletin usage would be obtained by recording the amount of times the site bulletin is 
given to visitors in the main visitor center and comparing it to total visitation of that visitor 
center. Finally, a simple survey of park visitors would be implemented to determine the 
percentage of visitors that experienced at least one of the interpretation products and, if so, which 
one(s) they experienced.

The second step consists of determining changes in park visitor’s climate change beliefs 
and potential behavior; since visitors’ climate change beliefs before viewing the products would 
be difficult to determine using surveys (as a result of the products already being implemented and 
available on the internet), focus group interviews will be used to flush out these changes, if any, 
and the reasons for them. In addition, participants would be asked to take part in a follow up 
survey and contact information obtained; the purpose of this survey would be to provide insight 
into the effectiveness of the interpretation products in changing climate change behavior by 
surveying climate change related actions months after the focus groups ended. Contact 
information would also be used to obtain a more accurate view of climate change behavior, both 
before experiencing the interpretation products and after experiencing them, through obtaining
data on energy use before the products were created (such as from energy bills) and comparing it to data on energy use after the products were experienced.

The third, and final step, of the evaluation process would be the implementation of the results; each interpretation product, with the exclusion of the wayside, can be easily changed based on the findings of the first two steps of this process. The site bulletin can be edited using Adobe InDesign and new copies distributed, the new podcasts in the series can incorporate the changes suggested by the results, and the video can be edited by using voice-overs that incorporate a significant amount of additional film not yet used. In all, this multi-step evaluation process would not only provide a mechanism to understand the impacts of the interpretation products, and thus the successfulness of the field I-TPB framework, but also the means to refine both the products and the framework in order to increase their effectiveness.
CONCLUSION

The main goal of the internship was to develop climate change interpretation products for John Day Fossil Beds National Monument; therefore, the development of four interpretation products and implementation of two thus far at JODA means this internship was a success. However, because the internship was part of a Master’s project, there was a higher goal involved: to develop a strongly supported by theory framework that field interpreters with limited resources and knowledge of experiment design can use to increase the probability of interpretation impacting visitor behavior. This framework is intended to be used as evidence for the need to increase the role of interpretation in the NPS’s Climate Change Response Strategy. Currently, the completion of this Master’s project goal is uncertain; the framework developed has strong scientific support and was relatively easy to implement as seen in its incorporation into a preexisting interpretive PowerPoint program at Wrangell-St. Elias National Park. Thus, this part of the goal was mostly successful, although research is needed in order to determine how easily the framework can be implemented by other interpreters. The uncertain part of this goal is the impact, if any, the interpretation products had on climate change behavior; however, it was known at the start of the project this would be the eventual outcome, since the obtainment of this information was outside the scope of the project. Why then develop this I-TPB framework, and its corresponding simplified field version, knowing it would not be subjected to rigorous scientific testing?

The answer is twofold; first, the exclusion of experiments designed to test the framework in this project does not mean it cannot be tested in the future. Perhaps one person who reads this paper will find value in the field I-TPB framework and have the means and resources to test its effectiveness. Or perhaps an opportunity, coupled with the necessary funding, will be made available to the author to test the framework at a later date. Regardless of who performs the
research, it is the field I-TPB framework that needs scientific evaluation, specifically its ease of implementation. Several other frameworks exist that join interpretation with the TPB; however, these frameworks have remained in the domain of the researcher. Consequently, their overall effectiveness is very limited. A way must be found to join interpretation and the TPB in a manner such that the interpreter who is giving multiple programs every week and hundreds over a course of a year can, and is willing to, use it; the field I-TPB framework was created with this need in mind. Hopefully, future research will provide its scientific justification, that it can adequately satisfy the role of allowing the average interpreter to change beliefs and behavior. Fortunately, this scientific evaluation of the field I-TPB framework will not require researchers to start from scratch; its testing can utilize existing strong experiment design by incorporating similarities in the experiment designs of previous studies that combine interpretation with the TPB, similarities that include a salient belief elicitation phase and a multiple stage approach. These studies include: Ballantyne and Hughes (2004); Lee and Moscardo (2005); Powell and Ham (2008); Hughes, Ham, and Brown (2009); and Brown, Ham and Hughes (2010).

The second answer to the question of why a framework was developed for the project knowing it would not be tested is, simply put, a result of climate change being a threat to the protection of NPS resources, and consequently its mandate and mission, that is unlike anything it has experienced before. As a person who willing admits they bleed green and grey, I have an obligation to do my part in reducing the harmful impacts of climate change. Furthermore, the consequences of climate change on NPS resources is a part of the much greater category of the consequences of climate change on society; consequences that are not well known, understood, or accepted by the majority of the population. This is of great concern; numerous types of scientific evidence obtained from places such as JODA strongly suggest climate change has been responsible, either indirectly or directly, for almost all previous extinction events. This is not to imply humans will go extinct, no researcher is arguing that; however, it is to imply that some of
the plant and animal species society depends on every day, such as food crops, could go extinct or be greatly altered. Furthermore, as temperatures continue to increase, more glaciers and ice sheets will melt creating sea level rise that will flood coastal areas, which is where a significant portion of earth’s population lives. In addition, scientific evidence obtained from numerous sources strongly suggests human actions, primarily in the form of greenhouse gas emissions, has increased the rate of climate change. As such, climate change has very real, very serious consequences that can be reduced if we take action soon; however, before this behavior change can occur, people’s attitudes and beliefs must first be changed, as argued by the rigorously researched TPB. This is why the TPB was chosen to be the basis of the framework used in creating the interpretation products; it greatly increases the likelihood of impacting climate change behavior, which can lead to reduced climate change consequences. Even if the interpretation products only change one additional person’s attitude and behavior towards climate change, then this part of the project goal will be considered successful; after all, one additional person is one additional person whose influence can spread far beyond a single individual. Also, this acts as a potential addition to the resolution of a problem that has no solution; the wicked nature of the problem of climate change makes it such that it cannot be resolved overnight or even over years. It is something that will take time, money, and research as well as a fundamental shift in the ideas and behavior of society. While numerous attempts are already being made for its resolution; in the end, if it is even possible, climate change resolution will require constant additions and modifications by new thoughts, theories, and actions. Hopefully, the Interpretation-Theory of Planned Behavior framework developed during this project will be one link in a chain of items that create a significant reduction in the negative consequences of climate change; thus, leading to a currently unimaginable outcome, anthropogenic climate change will be resolved.
REFERENCES


APPENDIX A: BIBLIOGRAPHY


APPENDIX B: JOHN DAY FOSSIL BEDS SITE BULLETIN

Front:

The Greatest Change: Staying Still

Earth as it appeared 50 million years ago (top) and today (present). The dashed line is the equator. Notice how Oregon has experienced little north and south movement during this time span.

Have you ever thought about how different things were in your life a few years ago? Scientists at John Day Fossil Beds National Monument ponder this question every day, but at an almost unimaginable scale. The fossils they study reveal fifty million years of changes in Oregon’s life and climate. This story contains a valuable lesson about what awaits future generations: not all species of life survive climate change.

Watch Out for the Plates!

Throughout geologic time, dramatic changes in eastern Oregon’s climate have occurred. In the last 50 million years it has changed from semi-tropical to today’s semi-arid conditions. What could cause this? The answer is plate tectonics.

Earth’s surface is composed of many different moving pieces called plates, which fit together like pieces of a jigsaw puzzle. Surprisingly, the dramatic cooling that occurred in Oregon wasn’t due to it moving further from the equator. It was caused by the movement of earth’s other plates.

Take a look at the above pictures. The top picture shows earth early in the Cenozoic Era, approximately 50 million years ago. The bottom picture is earth as it appears today. Do you see that Antarctica was much closer to Australia and South America in the top picture? Land bridges connected these two places to Antarctica, blocking the path of ocean currents. The currents turned north, flowed around the equator, and then back to Antarctica, keeping it much warmer than it is today. As the Antarctic plate moved south, the land bridges disappeared, allowing ocean currents to circle the continent. Without warm water from the equator, Antarctica cooled and became ice covered. This cooled the entire planet, changing earth’s global climate.

Compare the pictures again, but this time look at India. In the early Cenozoic Era it was an island. Over time, its plate has slowly moved north, colliding with Asia. This caused the Tibetan Plateau and Himalayan Mountains to rise. The Tibetan Plateau alone has an average elevation of 15,000 ft (4572 m) and is 1/3 the size of the United States! These high elevation areas shifted the flow of air through the atmosphere, which changed the location of high and low pressure areas. As you might have discovered from weather reports, highs and lows affect the weather. As a result, earth’s climate changed and Oregon cooled.
And Carbon Too!

Earth’s climate changed for another reason: carbon. Ancient rocks and fossils reveal that climate changes in response to the amount of carbon in the atmosphere. During the early Cenozoic, a reversed greenhouse effect happened. Large amounts of carbon from the atmosphere, in the form of carbon dioxide and methane, became trapped in the oceans. Without this extra blanket of carbon, the atmosphere couldn’t hold as much heat. This “sequestration” of carbon had the same impact as the plate tectonic events occurring at this time; it cooled Earth’s climate. These events also had another common impact: they changed life.

Jungles, Forests, & Grasslands—Oh My!

Plants and animals are adapted to the climate where they live. If the climate changes, they must adapt to the new conditions, move to a new area, or become extinct. Fossils unearthed in John Day Fossil Beds confirm this story of life and climate change. Fifty million years ago, this area resembled the present day subtropical jungles of Panama. Compare that with the sagebrush and grasses now dominating this semi-arid place! There are other startling results. Even the most common species face extinction when the climate changes. For example, oredonts were numerous and diverse sheep-like mammals that roamed the forests of North America long ago. However, a cooling, drying climate led to trees being replaced by sagebrush and grasses. Despite surviving for more than fifteen million years, oredonts were unable to adapt to the new, open environment and became extinct. Currently, humans are numerous and successful, but our species has only survived for 200,000 years. How much do you think the current climate change will impact us?

It’s the End of the World as We Know It!

You might ask, how can humans, with our technology, be greatly impacted by climate change? One example is found in eastern Oregon. Its climate is changing; it is getting warmer. This means its plants and animals will change as well. Do you think hikers and hunters will be affected if elk and deer are no longer able to live in the area? How will local ranchers be impacted if grasses, the main food of their cattle and sheep, become scarce? Climate change affects the species we depend on everyday for survival. This is why we should be concerned that it’s changing.

Also causing concern is that today’s event is different than previous natural climate changes. Recall the reasons for the previous events. Are there currently land bridges to Antarctica? Have the Himalayas and Tibetan Plateau dropped thousands of feet? The answer to these questions is, of course, no. This means the amount of carbon in the atmosphere is the cause of the current climate change. Humans are contributing dramatically to it by releasing carbon filled greenhouse gases. Groups as different as automotive corporations and environmental groups recognize the need to reduce these emissions. John Day Fossil Beds National Monument has already taken great steps to achieve this. A highly energy efficient ranger residence that creates more energy than it uses, has been constructed in the Painted Hills district. You can make a difference too. Simple choices can have profound impacts. If all drivers in the U.S. changed their driving habits by carpooling and combining trips, U.S. carbon emissions would be reduced by 25%. Ultimately, we must act together to reduce our greenhouse gas emissions. If not, our children’s planet may be as different to them as the environment preserved in the John Day Fossil Beds is to us.
Have you ever thought about how different things were in your life a few years ago? Scientists at John Day Fossil Beds National Monument ponder this question every day, but at an almost unimaginable scale. The fossils they study reveal fifty million years of changes in Oregon's life and climate. This story contains a valuable lesson about what awaits future generations: not all species of life survive climate change.

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Help us to get the message right! Leave comments, questions, & concerns about this handout at: www.facebook.com/GreatestThreat                            www.twitter.com/GreatestThreat
“How strangely out of place a score of palm-trees, a hundred yew trees or even a bank of ferns, would seem here now! And yet here these once lived, and died, and were buried...”

Thomas Condon 1871

Gaze across the valley to the colored rock layers on the other side. Within these beautiful layers are a diversity of fossils and paleosols, ancient fossilized soils. These fossils reveal the past climates of John Day Fossil Beds. Move your eyes from layer to layer. You have now seen climate change and its immense consequences on life.

The geologic column to the right reveals the average temperature and precipitation of the area when each layer was made. How has the area’s climate changed? The ecosystem that flourished in each layer is shown in the round artist rendition pictures. Notice how much life changes when the climate slowly changes. Unfortunately, the current climate change is occurring far more rapidly than these previous events. Our greenhouse gas emissions have greatly increased its rate. Imagine how great the consequences on life will be. What will you do to help?
Video Link: http://www.youtube.com/watch?v=jr0czQhvkJ4E

Video Script

Red, Orange, Green, Brown. At John Day Fossil Beds National Monument, color is the language of the land. It tells an amazing story about the fates of past worlds, with a cast of characters that are both familiar yet strange to us. It’s a story of survival and change, life and death. And during the current unprecedented rate of climate change, its message is of great importance. It’s the consequences of past climate changes on plants, animals, and entire ecosystems, which gives valuable insight as to what awaits future generations of the world.

In National Park Service lands throughout the country, numerous landscape features provide evidence for climate change being a reoccurring phenomenon. Each one is but a single chapter in an unending story. At John Day Fossil Beds, numerous layers of colored rock reveal many of these chapters. While they can be identified, at least in part, by their color, their voice comes from two other features, paleosols and fossils. Paleosols are ancient fossilized soils that reveal the climate that existed a long time ago. But, how can this be? How can soil provide climate information? Certain features in paleosols act as climate recorders. Like a barometer telling you about the weather, they reveal how wet or dry, warm or cold an area once was. Fossils are the remains of organisms; they reveal the life that existed in an area a long time ago. Together, paleosols and fossils bring to light the relationship between climate and life; they are bound together. If the climates changes, life must adapt or move in order to avoid extinction. When you look at the colored rock layers in this landscape, you are seeing this consequence of climate change. Each one has experienced a changing climate. By using the voice of their main characters to translate the language of color, this story can be told.
The first chapter is located near the bottom in the stack of the monuments rock layers. It is the orange and apricot Clarno Formation and it tells a story where truth is stranger than fiction. Fifty million years ago, eastern Oregon had a hot, wet, semi-tropical climate. Bananas, palm trees, ferns, and crocodiles lived in a jungle like ecosystem, similar to what we find in Panama today. One consequence of climate on life is that it determines the species that can live in an area. When similar climates occur, even ones separated by time and distance, they often contain similar species. If the climate changes, then the species must adapt or move in order to avoid extinction, as is revealed in the middle chapter of our story.

On top of the Clarno formation lies the brilliant red, purple, and yellow colored Big Basin Member. This middle chapter in our story shows what happens when the climate changed from sub-tropical to a warm, humid climate similar to what is experienced in South Carolina and Georgia today. The consequence of this climate change was the ecosystem changing from a jungle to a mixture of wetlands and hardwood deciduous forests. In this setting, frogs and salamanders moved about on the floor of an ancestral dawn redwood, maple, and oak forest, and fish were swimming in lakes. As you can see, things have since changed. What happened is told in the final chapter of our story.

The final chapter in our story is the dark red-brown Picture Gorge Basalts. They stripe the upper part of the mountains like layers on a cake. These colorful basalts were a series of lava floods that cooled, hardened, and became rock. They are also a good visual indicator for an immense change that took place. Shortly before the basalt floods, a great battle began between trees and grasses and shrubs over control of the valleys. This battle raged during the time of the basalt floods and after with the valleys shifting from open to wooded and back many times. Eventually, trees retreated into their current mountains homes, giving control of the valleys to grasses and shrubs. What could cause such an immense change in ecosystems? The answer was climate change. It was a result of global cooling and drying that took place. In fact, the climate cooled to an average temperature only five degrees warmer than today. The ranchers and farmers that live here now, they depend on these conditions, this ecosystem and climate, for their livelihood. Imagine what would happen if the climate shifted back.
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Video Script Continued

How might a dramatic, rapid global warming impact the ranchers that depend on the plants surrounding the monument to graze their cattle? Unfortunately, this is one question that might soon be answered by becoming reality.

Currently, an unprecedented rate of rapid global climate change is being observed. The Intergovernmental Panel on Climate Change, a collection of thousands of scientists, reports there is at least a 90% chance our greenhouse gas emissions are causing this rate. These emissions speed up the process of natural climate change, causing widespread concern. And the National Park Service considers climate change as the greatest threat the parks have ever faced. As such, its adopted the goal of being carbon neutral by the year 2016. In that spirit, John Day Fossil Beds has built this zero energy ranger residence behind me. It makes more energy than it uses, while still having all the modern conveniences. It is possible to live energy free without great changes to your lifestyle. Remember this, because it is only with your help the rate of climate change can be reduced. This is necessary because the bond between climate and life includes us. As our story has showed, natural climate change has great consequences on life. Imagine what will happen during one that occurs much faster. Think about all the types of life you depend on every day for air, medicine, and food. What would you do if they go extinct? If we reduce our greenhouse gas emissions, we can stop them from becoming just another part of the landscape’s colors.
APPENDIX E: JOHN DAY FOSSIL BEDS PODCAST

Podcast Script

Imagine a world of uncertainty, where death and renewal alternate like the seasons. This was the world of the Columbia Basalt Floods. For ten million years, eastern Oregon experienced a series of lava floods that alternated with calmer times. At John Day Fossil Beds National Monument, one part of the Columbia Basalt Floods left behind a story written in color. This is the dark red-brown rock layers of the Picture Gorge Basalts that stripe the monument’s mountains. Their story reveals not only a cycle of lava floods but also an event with far greater consequences. These colored rocks reveal the great impacts that natural, slow-moving climate change has on life, which means the present, unnaturally rapid climate change will have immense consequences for future generations.

Long before the Picture Gorge basalts, in the orange, red, and yellow colored rocks, the land was heavily forested. Hidden in these colors is the beginning of a slow transition in the area’s ecosystems. It was slowly changing from forests to lands of shrubs and grasses. During the Miocene era, the Picture Gorge basalt floods interrupted this transition. Great vents in the northwestern United States intermittently spewed out fast moving lava numerous times. All told, more than 300 individual flows released enough material to bury all of the continental United States under forty feet of lava! The stripes that make up the Picture Gorge Basalts are individual flows separated by thousands of years. These dark red brown layers also contain an invaluable message. Despite each lava flow causing untold destruction, there was enough time between them for life to return to the area. In fact, both forest and shrub and grassland ecosystems existed in the valleys after this natural disaster. These basalt floods were not responsible for changing the area’s ecosystems. It was something else far more devastating. What could this possibly be? It was climate change. Throughout the transition in ecosystems, the climate was slowly cooling and drying. After the basalt floods, the climate changed enough that forests could only survive in the mountains. This opened the valleys to the dominant ecosystem you see here today, the shrub and grasslands. Unable to adapt to this new environment, several forest dependent species, such as oreodonts, became extinct. Think about what this means for future generations. What was responsible for most extinctions was not a catastrophic natural disaster on a scale unseen by us, but rather the process of climate change.
This makes it important that we act now. Currently, the climate is changing at a rate greater than any of earth's previous climate changes. What is causing this increased rate of change? It is a result of humans emitting greenhouse gases, such as carbon dioxide. We are increasing the magnitude of a process that already has greater impact than most natural disasters. But there is hope. If you reduce the amount of energy you use, this rate will be reduced, giving a brighter future to the next generations.

Help us to get the message right! Leave comments, questions, & concerns about this podcast at: www.facebook.com/GreatestThreat  www.twitter.com/GreatestThreat
APPENDIX F: WRANGELL-ST. ELIAS POWERPOINT- CONCLUSION

Slide 45
There is one other species of life that glaciers change- us

Slide 46
Anybody come to Alaska to hike on a glacier?

Slide 47
How about just to see them?
Or perhaps you came for the wildlife that glaciers help to survive, like this nice juicy salmon.

Unfortunately we can’t enjoy glaciers the same way visitors did just thirty-five years ago. USGS topography maps made in the 1970s show a glacier here. You can see that it is now gone.

It turns out that in a thirty year timespan from 1971-2000 average temperatures increased by three degrees Fahrenheit in Alaska. You don’t have to take my word for it or anyone else’s. This is automated weather station data- no human involvement here.
And this has had a startling effect on glaciers. Recall how I said glaciers in Alaska form right at the freezing point. It doesn’t take much of a temperature increase, then, for them to melt. So why has Alaska warmed so much?

In 2007, the Intergovernmental Panel on Climate Change published a report that examined this very issue. What is the Intergovernmental Panel on Climate Change and why should you believe what they discovered?

They are an organization made up of thousands of scientists from around the world. The InterAcademy Council, an independent multinational organization of science academies, reviewed their work and concluded their “assessment process has been successful overall and has served society well.”
Their 2007 report has two amazing facts: 90% confident the net effect of human activities since 1750 has been a warming of the planet, and 90% chance the increase in global temperatures since the mid-20th century is due to an increase in human created greenhouse gas concentrations.

And they are not alone; the National Park Service (NPS) also examined this issue. In response, they created a new management plan to address climate change. Inside is a startling quote by Jonathan Jarvis, the current director of the NPS.

“I believe climate change is fundamentally the greatest threat to the integrity of our national parks that we have ever experienced”
And there is one other organization that has something to say about climate change. The International Climate Change Partnership is a collection of private corporations including General Motors, Boeing, and DuPont. What do you think they say about climate change?

They agree we need to slow the rate of greenhouse gas emissions, and we need to mitigate the risks from climate change. Now, I know you have probably heard too much about climate change and are now looking for the exits, so I’m just going to share with you one last thing; the reason I’m mentioning climate change at all.

Tonight we have explored how much glaciers change life and how their absence can have consequences for plants and animals. This holds true for a species with the common name of humans. One other way glaciers change us is by giving us land to live on. Glaciers and their companion, icefields, hold an enormous amount of water. This lowers ocean levels and gives us a wonderful coastline where so many people live.
Consequently, because glaciers and icefields are currently melting, global sea level is currently rising. To give you an idea of how much it can rise, if either the glaciers and ice on Greenland or the West Antarctic Ice Sheet were to completely melt, and nothing else, sea levels would rise by sixteen and a half feet or six meters.

Here is what a one meter or three and one third foot rise in sea levels will do. It will cost us approximately one trillion US dollars and flood the homes of 145 million people. Imagine what a six-fold increase in sea levels will do.

This is just something to think about when you’ve heard for the millionth time how you can reduce climate change by reducing your greenhouse gas emissions, which is primarily done by saving energy. Climate change isn’t just a contentious issue. There are very real, very severe consequences that come from it.
If you remember anything at all during your time here, I hope you remember this. When you are out viewing and experiencing the incredible scenery of Wrangell-St. Elias National Park, a land created and constantly changed by glaciers, in order for your children, your grandchildren, and future generations to experience the same wonderful things you have, you have a decision to make.

Do I take action to help lower the rate of climate change and ensure this place remains as special as it is now, or do I not take action and hope that reality is different than what was shared with you tonight? This choice is yours to make.
APPENDIX F: WRANGELL-ST. ELIAS POWERPOINT-
OUTLINE BEFORE CONCLUSION

I. Introduction to Wrangell-St. Elias National Park
   a. I’m Bryan and on behalf of Wrangell-St. Elias Nat. Park and Preserve, I would like to welcome you here to my program. Before we begin, I have a quick question. Where are we?
   b. Let me orientate you to where you are in Alaska and where the park is.
   c. This is where you are. Wrangell-St. Elias is one of nearly 400 NPS sites, 17 of which are in Alaska.
   d. Every one of these sites has a something that makes it unique. A story, messages, woven into the fabric of its existence.
   e. As the NPS’s largest site, the story of Wrangell-St. Elias is quite large. It contains multiple chapters, multiple features that make it unique. If I was to share with you its entire story, well you’ll have to extend your vacation by a few weeks.

II. Introduction to the Program
   a. Tonight, we are going to explore my favorite chapter in the story of Wrangell-St. Elias National Park. But you are going to have to guess what it is.
   b. I’m going to show you four pictures now and I want you to tell me what they have in common.
      a. This is a picture of Barlett Cove, this is a picture of caribou, this is a picture of the Copper River and this is a picture of the wildflower lupine.
      b. What they have in common is they have all been impacted by glaciers.
      c. The great changes created by glaciers is my favorite chapter in the story of WRST
   c. I know it is difficult to imagine how much glaciers can change anything, but especially life, from where you are sitting, but if you go up to 20,000 feet and look down on the park what you’ll discover is:
      i. Forest (trees), which is so prevalent in our current view, is not so prevalent in the park.
ii. However, 25% (3.3 million acres - 1.5 Yellowstones) of this park is covered by glaciers! Hundreds of glaciers are in Wrangell-St. Elias, some of which are unnamed.

b. Theme Statement

The greatest force changing life in Wrangell-St. Elias National Park is glaciers; their absence has serious consequences for many species of life.

III. What is a Glacier?

a. Before I share with you how glaciers change everything from pikas at 10,000 feet elevation to salmon in the rivers, I wish to provide some understanding of what glaciers are.

b. Recipe for a glacier is snow, time, and movement

i. Glacier Formation

1. It begins with an accumulation of snow over time
2. Snow builds up in a given location to the point that the bottom layers are literally compacted by the weight of the top layers
3. Air is forced out and the snowflakes change into blue glacial ice
   a. Which means glacial ice is under pressure; as it melts you get the rice crispy sounds of snap, crackle, and pop.
   b. Beware the scientists in McMurdo station in Antarctica - have been known to slip ice cubes made from glacial ice into unsuspecting people’s drinks. The problem is the glacier ice there is under so much pressure, when it melts, the pressure release causes the glass to break!
4. If the process stopped there we wouldn’t have a glacier, we would have an icefield.

ii. Glacier Movement

1. Different than an icefield because of movement
2. How do glaciers move? It is more than just gravity.
   a. Also move because of pressure from the top layer of accumulated snow,
      i. You take carbon and put it under pressure, you get a diamond
ii. You take ice and put it under pressure, you get silly putty- the ice becomes plasticky, and oozes

b. Also, when you increase pressure, you lower the temperature at which water freezes. In Alaska, glaciers form right around the freezing point or 32 F. As snow builds up on the ice, it insulates the ice. This is how sled dogs survive in the bitter cold of Alaska- they build nests in the snow. This means the ice under the snow is still at 32 F, but, because of the pressure, the freezing point is now about 29-30 F. This means the ice melts.

c. This more flexible structure and nice lube of water allow gravity (glaciers are typically formed on mountain sides, not flat land), to move the glacier; to push it downhill

3. Surging

a. For an idea of how well this system works, just look at surging glaciers

b. Surging glaciers are glaciers that advance quite rapidly; scientists are uncertain what causes this great movement

c. When I say great movement: surging glaciers can move up to 330 feet in a single day

d. Wrangell has several dozen surging glaciers including the 70 mile long Hubbard Glacier

e. Black Rapids Glacial Advance- during the winter of 1936-37 it moved 4 miles with an average advance of more than 100 feet per day!

IV. Animals and Glaciers

a. Does that seem like a great place to live to anyone? Or to build a home?

b. What about here, in these crevasses, great cracks, in the glacier?

c. Believe it or not, many species of life use glaciers as their homes. Sometimes permanently, like ice worms.

d. Other animals use glacier as their summer home, like caribou
i. There are two types of caribou in Wrangell-St. Elias, barren ground and woodland. They both hate one thing in particular. A certain blood sucking insect that some Alaskans call winged rats.

ii. This insect is, of course, the mosquito. And belief it or not, caribou hate them more than people. In some instances it literally drives them crazy.

iii. It turns out mosquitoes do not like cold, windy places. So during the summer, caribou move onto glaciers.

iv. You are probably wondering, how do caribou survive on glaciers? Well, they do sometimes move off of the glacier to feed and they feed along the edges of glaciers, but believe it or not, there is food for caribou on glaciers. Quite often, isolated rock outcroppings sticking out of the glacier contain a caribou’s favorite food, a certain type of lichen. Anybody want to guess what it is? It is Reindeer lichen; reindeer are just domesticated caribou.

v. So, caribou very much use glaciers as their summer homes. Without them for refuge, disease outbreaks from insects would increase causing a noticeable reduction in population. It’s amazing how much glaciers change life.

e. Sometimes those rocky outcroppings that contain reindeer lichen are something different.

i. In quite a few places in Alaska, so many glaciers have formed on a single mountain that its peak becomes isolated. It sticks up out of the ice like a tower of a castle. When this occurs they are called by their native Alaskan name- Nunataks.

ii. While they look barren, they are often teeming with life. Some of it is blown there, some of it travels there, and some of it is trapped there.

iii. Pikas are an animal often found on nunataks. They are small mouse like creatures that make a very loud, very shrill shriek. They normally feed on insects and plants, but for some odd reason the pikas on nunataks have a craving for protein. Since they are not predators they have to rely on what nature provides and that is dead birds.
1. Unfortunately, during strong storms, birds get blown into the rocks of nunataks and die, much like this cedar waxwing that was blown into a window outside of the visitor center.

2. What pikas do is eat the brains of the birds to fulfill their protein cravings. So, the next time you see one of these cute little guys, just remember they are after your brains!

3. It’s amazing how much glaciers change life.

   iv. At first glance it appears glaciers would be harmful to pikas, but they do something pikas are very, very thankful for. Glaciers are the moat surrounding the castle nunatak, which prevents predators from reaching them. Pika numbers are already in significant decline, without glaciers, they could very well be on the verge of extinction.

f. While life like iceworms, caribou, and pika benefit from glaciers by using them as homes, other species benefit from glaciers in a different way.

V. Flour and Loess

a. Every glacier has at least one conveyor belt attached to its very bottom- a stream of meltwater.

b. These streams flow from the glacier towards the ocean and carry with them the pieces of the land the glacier has eroded away.

c. The smallest pieces of these rocks and minerals carried by the stream is known as glacial flour or loess.

d. Anybody here take calcium, iron, sodium, and/or potassium? These are minerals.

e. Since they contain minerals, glacial flour enriches the WRST’s waterways and the life that uses them.

f. There are more than 1000 miles of free flowing glacial streams in the park, each one enriched by glacial flour.

g. What this does to life is best shown by the famous Copper River Red salmon.

   i. Near the mouth of the Copper River- about 120 miles south and slightly east from hear there is a place called Miles Lake which has a sonar counter that records the amount of salmon that pass by it.

   1. Can be more than 70,000 in one day!

   ii. Anybody had a chance to eat them? Very tasty- the first ones to market can go for as much as $70 a pound in the lower 48. Why do they taste so
good? High fat content because of the minerals from glacial flour (don’t worry it’s the good fat- anybody heard of Omega 3’s?)

iii. It’s amazing how much glaciers change life.

h. Also, at the place where most of the park’s glacial streams end, the mouth of the Copper River, lies something else that is a direct result of the enriching nature of glacial flour- the largest wetland in North America.

i. Without glaciers to provide them with nutrients, Copper River Red salmon would at least not be as healthy as they are now, which could lead to a decline in their numbers. Regardless, this would not only impact salmon, but also numerous people who depend on them for their livelihood.

j. But glaciers do disappear sometimes; they retreat and shrink and wait until the climate is right for their return. What is quite remarkable is that even in their absence, glaciers are changing life.

VI. Sublimation and Succession

a. Glaciers are so massive their weight compresses the land they sit on top of. This isn’t your normal compression that you get from a bulldozer or steam roller either. This is literally the earth’s crust being pushed down. Let me say that again- think about the tallest skyscrapers, the largest office buildings and factories or even entire cities. None of them come close to what glaciers do to the land, literally press it down into the earth.

b. When the earth rises again (after the Glacier is gone) it’s called: Glacier Rebound

c. One of the best examples of this is in a place connected to Wrangell-St. Elias. This park is part of a much larger U.N. World Heritage Site which includes Glacier Bay National Park.

d. In Glacier Bay, there is Bartlett Cove, which is the location of a 240 year (+-20 years) retreat by glaciers.

   i. Without their weight, the cove’s coastline has risen 18.7 feet in that time
   
   ii. Highest peak rates are 1.26 inches per year (a foot in a decade!).

   iii. If you were to get on a boat, go there, and get out, most of us would be standing on land that was under the ocean when we were born.

e. This isn’t just happening at Glacier Bay Nat. Park, happens everywhere large glaciers that once flowed into the ocean are now receding, including Wrangell-St. Elias National Park. Everywhere glaciers retreat, new land is revealed. And not
just through glacial rebound. When they cover the land, glaciers literally strip it not only of all its vegetation, but even soil, so when they retreat, uncolonized land is revealed.

f. What will soon start in these areas of bare rock is one of nature’s most impressive acts: the succession of life.

g. Who has heard of this? It’s the march of life from small plants to mature forests.

h. Starts out with colonizing plants like mountain avens (dryas) and fireweed
   i. Have fireweed and dryas people stand up
   ii. These plants fix nitrogen (nitrogen is needed for plants to grow but has to be changed to a form that can be utilized by plants)
   iii. Stabilizes the thin and fragile soil

i. Next stage is shrub-lands of willows and alders.
   iv. Have alder person stand up and in front of fireweed and dryas people.
   v. Forms thickets and prevents soil from blowing or washing away

j. Finally, the forest reappears. First comes the tree quaking aspen.
   vi. Have quaking aspen person stand up and in front of alder person
   vii. Aspens get their name from long stems on the leaves, which causes the leaves to quake in the wind
   viii. Provide shade needed for the ecosystem to circle into its final step

k. The final step is also known as the climax stage.
   ix. Have spruce person stand up and in front of alder person
   x. This is an old growth forest with black and white spruce as the dominant plant species.
   xi. In order for the cycle to continue a disturbance needs to happen again

l. If glaciers don’t regrow, if the cycle of glacial advance and retreat ends at retreat, then dryas and fireweed meadows naturally turn into alder habitat (have dryas and fireweed people sit down), the alder habitat naturally turns into aspen habitat (have alder person sit down), and the aspen habitat naturally turns into spruce habitat (have aspen person sit down). And now our wonderful diversity of ecosystems has turned into just one. I don’t know about you, but the hikes I enjoy the most go through more than one ecosystem. It is amazing just how much glaciers change life.

m. And yet, there is still another species of life that glaciers change.
APPENDIX F: WRANGELL-ST. ELIAS POWERPOINT-SLIDES BEFORE CONCLUSION

Slide 1

Slide 2

Slide 3

Slide 4

Slide 5

Slide 6
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