

Geotourism: The Tourism of Geology and Landscape

13

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13 Geotourism potential in North Carolina: perspectives from interpretation at state parks

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Introduction

Established in 1789 as the 12th state, North Carolina lies in the eastern seaboard of the United States of America between the Appalachian mountain range and the Atlantic Ocean. It is ranked 28th with respect to its size (139,389 square kilometers) and is the 10th most populated state with 9.1 million residents as of 2007 (US Census Bureau, 2008). The state was known for its farming/tobacco, textile and furniture industries, but substantial transformation has taken place over the past few decades and now the service industry, led by tourism, is the major part of the state's economy (Gade, 2008).

North Carolina has a unique and rich natural heritage which includes geological, landscape and biological resources that span three physiographic regions: the Appalachian Mountains, the Piedmont Plateau and the Coastal Plain (Horton *et al.*, 1991; Stewart and Roberson, 2007). This natural heritage forms an integral part of the network of attractions enticing local, out-of-state and international tourists, who spent over \$17 billion in the state and generated almost 200,000 jobs in 2007 (TIA, 2008). Indeed, North Carolina's tourism promotional material (e.g., travel guides, brochures, websites) routinely highlight physical landscapes such as the Great Smoky Mountains, peaks like Pilot Mountain and geomorphic features such as waterfalls. Many of these geological features and attractions can be found in North Carolina's state park (NCSP) system, which received over 12.8 million visitors in 2007–2008 (Leung *et al.*, 2009), with an estimated annual economic impact of \$289 million to local economies (NCDPR, 2009). Landform-dependent recreation opportunities draw tourists to the state as well, with skiers enjoying the mountains and kitesurfers flocking to sandy beaches at the Outer Banks. In addition, mineral hunting has become a popular tourist activity with several independent contractors offering mine tours, cave tours and gemstone mining.

The geodiversity of North Carolina supports not only aesthetic and economic values, it also offers tremendous potential for research, education and recreation (Gray, 2004). The state capital city of Raleigh hosts the Museum of Natural Science, while the Museum of North Carolina Minerals is located along the Blue Ridge Parkway. Bulletins published by the North Carolina Geological Survey (NCGS) describe the geology at Eno River State Park, Gorges State Park, the Blue Ridge Parkway and the state park system as a whole (Carpenter, 1989; Carter *et al.*, 2001; Wooten *et al.*, 2003; Bradley, 2007).

Although the Roadside Geology Series has decidedly overlooked the southeast with the exception of Florida, other guides are being published to fill the need. Recently, the first geology guide book for North and South Carolina was published with the state-park visiting public as the target audience (Stewart and Roberson, 2007).

In pursuit of an eco-friendly path to development, North Carolina is embracing sustainable forms of tourism, in which geotourism, or tourism based on geoheritage and its conservation (Dowling and Newsome, 2006) seems to have a significant role to play. Similar to ecotourism, geotourism has the potential to support sustainable economic development while cultivating public support for geoheritage conservation (Burek and Prosser, 2008). However, these goals can be attainable only if geotourism opportunities are communicated to nature-seeking as well as causal tourists. Hence, interpretation is the key to connecting sustainable tourism with geoheritage conservation (Hose, 1996, 2006).

While there is a wealth of information about the resource base (geoheritage) and park facilities (infrastructure) that are important for geotourism development, we know far less about interpretation services that facilitate geotourism experiences. Two published studies seem to be particularly relevant to our discussion. Hose (1996) reports results from visitor studies on three geoheritage sites in the UK, which suggest a need for more interpretation and using appropriate vocabulary in interpretive materials. In China, Wei and Wang (2007) evaluated the effectiveness of interpretive materials and programs in Yuntaishan World Geopark using a visitor survey. The respondents were found to have a strong preference for interactive interpretation through interpreters or multimedia, and they were more interested in the scientific explanation on Yuntaishan's landform than in the fairy tales related to the site. These two studies point to the need for more evaluation of interpretive programs and materials in support of geotourism.

The purpose of this chapter was to take a first look at the current status and potential of geotourism in North Carolina from an interpretive perspective using state parks as an example. We were interested in the extent to which North Carolina's geoheritage is communicated to state park visitors and in what ways. We begin with a concise review of geoheritage in North Carolina. The rest of the chapter focuses on the results of a recent survey of state park managers on geoheritage resources and their interpretation. Implications to management and research are discussed in light of survey results.

Geoheritage in North Carolina

The varied landscapes in North Carolina are controlled for the most part by the underlying geology (Figure 13.1). The Blue Ridge Mountains make up the westernmost part of the state and include over 40 peaks that reach 1800 m in elevation. East of the Blue Ridge, the Piedmont is characterized by rolling hills and subdued topography, although there are several locations in the Piedmont with high elevations (over 900 m). The Coastal Plain makes up the eastern half of the state and has low elevation (about 120 m down to sea level) and low topographic relief. The Atlantic Ocean coast of North Carolina is marked by a chain of narrow barrier islands.

The rocks that make up the Blue Ridge mountains are metamorphic rocks that were created during a series of plate tectonic collisions beginning about 1 billion years ago with the assembly of the ancient supercontinent of Rodinia during an event known as the Grenville orogeny. Billion-year-old metamorphic rocks are ubiquitous in the western part of the Blue Ridge (Hatcher, 1989; Horton *et al.*, 1991).

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Rodinia began to rift apart beginning about 700 million years ago, and as the crust stretched, it broke along a series of faults. Crustal blocks slipped down along these faults creating basins that received thousands of meters of sediment. These rift-basin sedimentary rocks, now metamorphosed, are well-exposed in the Great Smoky Mountains and on Grandfather Mountain and the surrounding area. Igneous rocks, such as granite and basalt, were also created during this rifting and can be found scattered through the western Blue Ridge. The rifting eventually led to the complete breakup of Rodinia and the creation of an ancient ocean, known as Iapetus (Hatcher, 1989).

The eastern Blue Ridge also contains metamorphic rocks, but these are younger than those in the western Blue Ridge. Iapetus began to close beginning about 500 million years ago, and a continental fragment, now exposed in the western Piedmont, collided with North America about 460 million years ago (Hatcher, 1989). This event is known as the Taconic orogeny, and the eastern Blue Ridge is mostly made of metamorphosed sediments that were originally deposited on the Iapetus Ocean floor and were then scraped off as the continental fragment collided. The highest point in eastern North America, Mount Mitchell, is made of these metamorphosed ocean floor sediments. As the Taconic collision progressed, rocks of the North American continental margin were overridden and deeply buried. Some of the rocks melted and the rising bodies of magma intruded the metamorphosed sediments. These igneous rocks are now exposed in the eastern Blue Ridge at Whiteside Mountain (Miller *et al.*, 2006).

The Iapetus Ocean continued to close, and parts of the edge of the ancient continent of Gondwana, the continental land mass that consisted of South America and Africa, broke away and eventually collided with North America. These exotic fragments of crust are known as peri-Gondwana terranes and make up the bedrock geology that underlies the eastern half of the Piedmont. These rocks are mostly metamorphosed volcanic rocks and sediments that formed when these terranes were still attached to Gondwana, between about 550 and 650 million years ago. The collision between the peri-Gondwanan terranes and North America is possibly associated with the Acadian orogeny, which is a well-documented orogeny in the northern Appalachians, but its existence in the southern Appalachians is not well-established (Trupe *et al.*, 2003).

Final closure of Iapetus occurred about 330 million years ago when Gondwana collided with North America creating the supercontinent of Pangea. This major continent-continent collision is known as the Alleghanian orogeny and created a Himalayan-scale mountain range in the southern Appalachians. The effects of this collision are well-preserved in the Blue Ridge and in parts of the Piedmont. Major Alleghanian faults separate kilometer-scale sheets of metamorphic rock that were thrust over one another. A spectacular example of one of these thrust faults is exposed at Linville Falls along the Blue Ridge Parkway (Trupe *et al.*, 2004). As happened during the Taconic orogeny, thickening of the crust during the Alleghanian orogeny caused localized melting in deeply buried rocks. These rising bodies of magma crystallized and are now preserved throughout the Piedmont and Blue Ridge, including Stone Mountain State Park (Miller *et al.*, 2006).

North Carolina was tectonically quiet for about 100 million years following the Alleghanian orogeny. Pangea began to rift apart beginning about 220 million years ago during the Triassic period and a series of fault-bounded rift basins formed. Eventually, Africa separated from North America and the Atlantic Ocean was born. Since about 200 million years ago, there has been no active plate boundary in North Carolina. The high mountains have been eroding, and the sediments from this erosion have been deposited on the Coastal Plain and along the Atlantic continental shelf.

The Coastal Plain is underlain by sedimentary rocks that range in age from the Late Cretaceous period (~100 million years old) up to modern sediments that are being deposited along the Atlantic Ocean coast. The low topographic relief of the Coastal Plain is due to the presence of thick, easily erodible sediments that have been deposited on top of the metamorphic rocks of the Piedmont. The barrier islands that line the coast are Pleistocene features that have been actively moving at least since 18,000 years ago and continue to move today, primarily as a result of storms and sea-level rise.

Not only has this series of geological events created the landforms and landscapes which we see today, they have also shaped the ecosystems and play an important role in the development of urban and rural communities in the state. Some of the best examples of natural history and the interplay between nature and culture can be found in North Carolina's parks, natural areas and historic sites, of which the state park system is a major component.

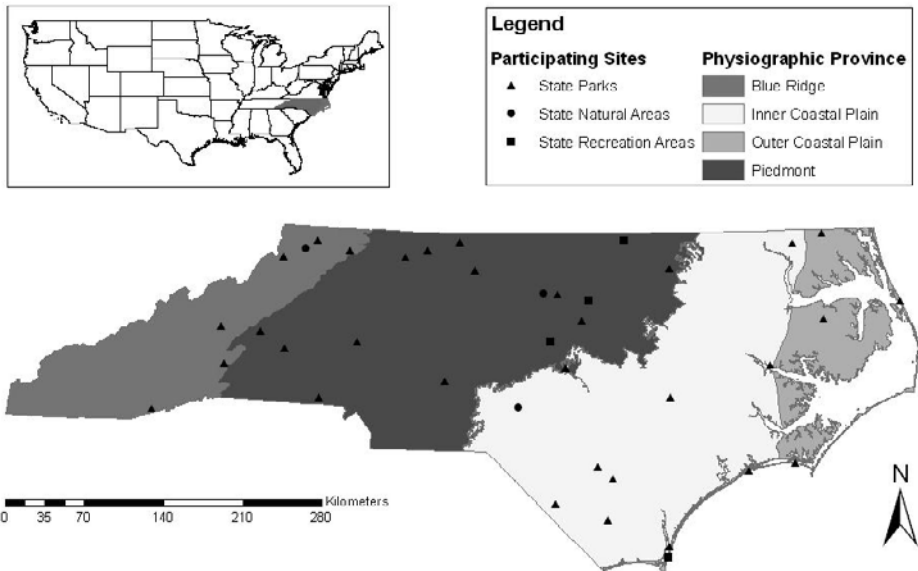


Figure 13.1: Physiographic regions and state parks in North Carolina.

Geotourism: a survey of state park managers

Purpose and methods

In order to gauge the extent to which geotourism in North Carolina is facilitated through interpretation of the state's geoheritage to park visitors, we conducted a survey to examine state park managers' perceptions of the occurrence of geological features and the interpretation of those features. The entire NCSP System consists of 66 different units, covering about 83,000 hectares of lands and waters (Leung *et al.*, 2009). This online survey included managers of 39 North Carolina state parks, state recreation areas and state natural areas (state park units hereafter) which are accessible to the public.

In February 2009, the NCSP system's Lead Interpretation and Education Specialist sent an e-mail request on our behalf to park superintendents urging them to take the 'Geotourism at North Carolina State Parks' online survey. The survey instrument consisted of 10 questions and addressed the following items:

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- ◆ The park's major interpretive themes.
- ◆ Identification of geologic features and existing interpretation related to a set of 22 basic geologic features listed in the survey. These included 10 landscape elements related to rock outcrops and large boulders and 12 general features such as hills and valleys, erosional features, sand dunes and estuaries. Survey participants also were given an opportunity to identify and comment on features not listed.
- ◆ Missed educational opportunity in the indoor or outdoor displays.
- ◆ Perceptions of the level of geotourism interest among the visiting public.

The survey was available online for three months and phone calls were conducted with non-respondents. At the end of the survey period, managers from all 39 target state park units had responded.

Survey results

Of the 39 North Carolina state park units participating in the survey, 15 superintendents responded themselves, while 24 passed the request along to a park ranger who completed the survey. The respondents were asked to rate their own geology knowledge and 21 percent reported moderate geology experience, 69 percent reported limited geology experience and 10 percent reported no geology experience. No respondent self-reported to have extensive geology experience or to be a geology expert.

Despite the low level of self-identified geologic knowledge, the respondents believed that the park system as a whole provides a variety of interpretation of geologic features across the state. Of the 289 total identified features at North Carolina state park units, 46 or 16 percent of the features were declared to have no interpretation. Interpretive talks were identified by the respondents as the most common form of interpretation, connecting to 181 or 63 percent of the identified features. Other forms of interpretation selected included exhibits (25 percent), outdoor signs (12 percent), indoor signs (2 percent) and websites (2 percent). Of the total identified features, 40 or 14 percent were identified as having other forms of interpretation and some respondents described additional publications, external websites or educational programs in which state park units are used for activity-based field trips. Morrow Mountain State Park, for example, conducts one such geology based program entitled 'Old as the Hills.' Pilot Mountain State Park in the Piedmont conducts a hands-on simulation of the process of creating sedimentary and metamorphic rocks and another discussing water quality and how the surrounding terrain affects water quality.

Of the 22 features presented to the survey respondents, creeks, streams or rivers had the highest occurrence, with 82 percent of the parks responding positively with interpretation such as talks, exhibits and outdoor signs offered to visitors. The least commonly reported feature in the state park system was earthquakes, with only two parks identifying and interpreting this occurrence. Only 62 percent of the total parks have exposed rock and park managers believe that 28 percent of the total parks have igneous rocks, 36 percent have metamorphic rock and 38 percent have sedimentary rock. Of the geologic features listed in the survey, respondents said they did not know if their park contained rocks that had been dated, unconformities or fossils more than the other features. The features that are most prevalent, with the least amount of interpretation, are hills and valleys. From this study we also have learned that creeks, rivers and streams along with water-related erosional features are the most interpreted features in the NCSP system.

Each park unit within the NCSP system has its own unique physical features, biota, biology, ecology and cultural history. When a state park is established, a set of interpre-

tive themes are developed as well. These themes provide the foundation from which programs, exhibits and educational publications are promoted. The major interpretive themes for NCSPs vary widely and encompass, geology, ecology, wildlife, water related issues, plant life and culture as reported by the respondents. Each respondent was asked to identify the major interpretive themes of their park and geology or geological features were reported as being a major interpretive theme at 46 percent of the parks.

When respondents were asked for their perceptions of missed educational opportunities in the indoor or outdoor displays, several responses were geologically based. These opportunities included increasing general knowledge of geologic history, coastline erosion processes, lake processes and employing basic learning aids for geology or offering fossil displays. Park specific suggestions included desires to add interpretation of the local mountain formations (Morrow Mountain State Park) and to have 'a knowledgeable geologist to periodically offer geology walks and talks in the park' (Gorges State Park). Missed educational opportunities in some cases were related to perceptions of the public's aptitude and the need to simplify the information presented, so that the 'majority of people can quickly read, understand and remember.' Another respondent claimed that 'visitors don't actually take the time to read the indoor or outdoor displays.'

Without directly surveying tourists at state parks, it is hard to gauge geotourism interest from the visitor's perspective. Park managers were asked for their perceptions of the level of geotourism interest among the visiting public. Only 5 percent believed the public to be very interested, 44 percent somewhat interested and 15 percent not interested. Almost one third of the respondents were uncertain about the geotourism interest of their visitors.

Some examples: the good, the bad and the possible

North Carolina state park units are dispersed across the state and although they are not a random sample of the statewide geology, many were chosen to showcase a portion of the state's natural beauty (Carpenter, 1989). Prior to this study, there was very little known about the geoheritage interpretation in the state park system. We have examined what a geotourist can expect in terms of geology and interpretation. A large disconnect that falls out of this survey is that geology or geological features were reported as being a major interpretive theme at 46 percent of park units, yet the level of geologic knowledge of park superintendents and rangers is self-reportedly low. In many cases the rangers have a strong educational background in natural resources management, with strong foundations in wildlife management and ecology. This disconnect in part is being bridged by the NCGS's willingness to assist state park staff with educational content and activities.

Although geoheritage interpretation is prevalent throughout the NCSP system, one place where geotourism can be better promoted is Stone Mountain State Park, which only offers one paragraph on the general park display interpreting the park's namesake. It reads:

One of the park's most spectacular features is Stone Mountain, a 600-foot granite dome. This magnificent feature is part of a 25-square-mile pluton, an igneous rock formed beneath the earth's surface by molten lava. Over time, wind, water and other forces gradually eroded the softer layers of rock atop the granite block and exposed the outcrop we see today. Wet weather springs continually carve troughs in the granite as water runs down the mountain's sloping face.

Interestingly, several state parks have taken a more active approach to offering geoheritage interpretive materials and programs which correspond to their respective geologic interpretive themes (Figures 13.2 and 13.3).

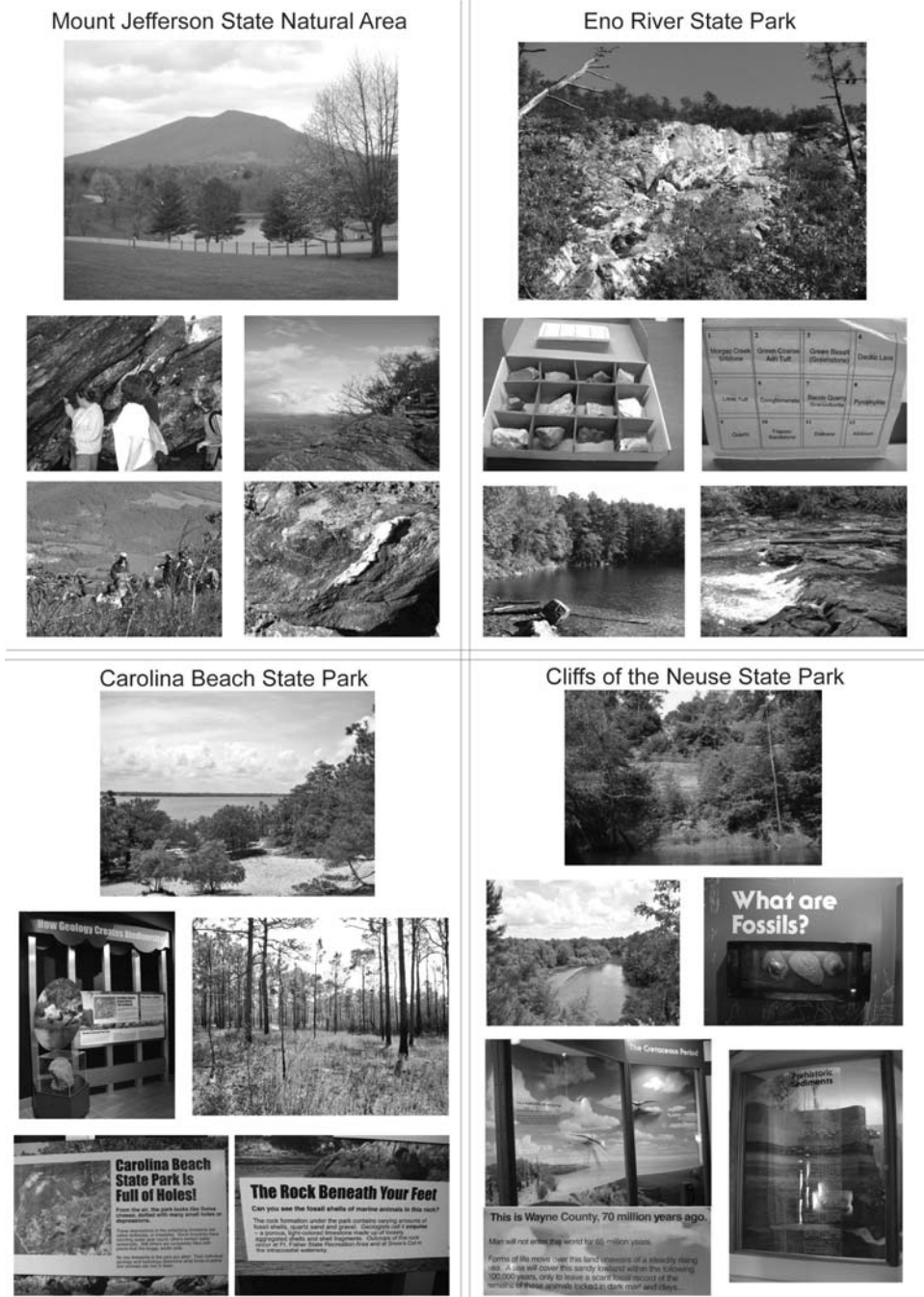


Figure 13.2: Geoheritage and its visual interpretation in four North Carolina state park units (also refer to Figure 13.3 for interpretive themes, identified features and interpretations).

Mount Jefferson State Natural Area

Geologic Interpretive Themes: “Mount Jefferson appears to be an inselberg, an isolated mountain surrounded by mountain ranges. The outcrops provide an excellent opportunity for interpretive study of the formation and subsequent erosion of the southern Appalachian Mountains.”

Survey results:

- Talks and/or outdoor signs cover topics such as the network of waterways, water and wind erosional features, weathered rocks, monadnocks, cliffs, signs of faulting, interesting minerals, metamorphic rocks and geologically dated rocks.
- There is additional interpretation for the rock cycle, the mountain vista, frost wedging, Lichens and air quality.

Eno River State Park

Geologic interpretive theme: “The metavolcanic rock lying under the water’s surface and scattered about the valley tells the story of the Eno River’s formation. Lying within the Carolina Terrane, the park contains many interesting geologic features that have enhanced the interpretive opportunities offered. Current programming focuses on the basics of geology, identification of rocks and minerals, and the park’s geologic history. Occoneechee Mountain State Natural Area includes the highest point in Orange County at 867 feet and numerous rock outcrops demonstrating evidence of ancient volcanic activity. The recent publication by the North Carolina Geologic Survey, *A Geologic Adventure Along the Eno River*, interprets the many geologic features found along the park’s trails and is an invaluable resource for park staff and the public.”

Survey results:

- Talks and/or outdoor signs cover topics such as the topography, the network of waterways, water and wind erosional features, monadnocks, cliffs, dykes/sills, interesting minerals, signs of faulting and igneous, sedimentary and metamorphic rocks.

Carolina Beach State Park

Although the interpretive themes for this park are plant related, several geological features were identified through this survey. Additionally, the park’s indoor displays highlight the important role of geology in creating distinct habitats within the park.

Survey results:

- Talks and/or exhibits cover topics such as the network of waterways, sand dunes, estuaries, weathered rocks, sedimentary rocks and sink holes.

Cliffs of Neuse State Park

Geologic interpretive themes: “The main feature of the park is the multi-layered cliffs along the banks of the Neuse River. The steep, colorful cliffs are not only an important scenic resource; they are also a valuable educational resource that provides visitors with a view back through time. Most of the exposed cliff layers belong to the Black Creek Formation, which was deposited during the late Cretaceous period more than 66 million years ago. The cliffs present a challenge to park interpreters because they are fragile and difficult to view from overlooks in the park. Therefore, exhibits and creative programming techniques must be used to make the cliffs and their geologic history come alive for park visitors. Activities help students learn how geologists and paleontologists use observations of landforms and fossils to create a picture of the

Cont...

local geography, climate and life forms of the Cretaceous period. The park museum provides models and dioramas that further illustrate this geologic age. Other park programs and museum exhibits demonstrate the geologic processes that formed the cliffs and continue to shape them today.”

Survey results:

- Talks and/or exhibits cover topics such as the topography, the network of waterways, water erosional features, weathered rocks, fossils, interesting minerals, sedimentary rocks, cliffs and unconformities.

Figure 13.3: Interpretive themes and survey results for four selected North Carolina state park units.

Implications: a call for geotourism as an educational tool

This survey is reflective of managers’ perceptions and may not be a comprehensive look at the geology statewide. Additionally, state parks may not be a complete sampling of statewide geology. Although some parks were established for distinctive geology, many were established for cultural significance, wildlife, ecological value or flora and fauna, as discovered in this survey. Despite these limitations, this exploratory study has identified where geotourism is well promoted and where it can better be promoted at state parks.

For instance, North Carolina should be known for its breadth of landscape from the slowly eroding Blue Ridge Mountains across the hilly river-filled piedmont to the estuaries and sand dunes of the coastal plain. With only a few books published as guides for geology tourism in NC, more must be done to recognize the value of geotourism. The geoheritage discussed in this chapter highlights geotourism assets such as evidence of the Taconic orogeny and associated metamorphic rock formations or the barrier islands that line the coast. These are the resources that can be promoted, which represent the unique types of geotourism opportunities in the state.

Given the discrepancy between the geologic points of interest at state parks and the self-identified lack of geologic knowledge of park managers, the burden of cultivating geotourism infrastructure and interest falls to those who have been geologically trained. The NCGS recognizes this discrepancy and beyond conducting research on state park land, they assist state park staff with educational activities. Furthermore, they have published additional geologic guides to various state parks and protected lands in North Carolina (Bradley, 2007; Carpenter, 1989; Carter *et al.*, 2001; Wooten *et al.*, 2003).

There is great potential for fostering environmental knowledge through tourism, but we must find ways to engage the public for geotourism to flourish. With the large tourism industry and a wide range of natural resources, North Carolina is an ideal backdrop for this agenda. Efforts to engage the public in the enjoyment of geotourism at state parks include a range of interpretive experiences, but new efforts to foster geotourism interest are always needed. Currently one such effort is being made by the NCGS, whose staff is developing a web-based interface for interactive geologic information (Bradley, personal communication). Eno River State Park was chosen as the pilot project for this effort because a significant amount of content already exists (Bradley, 2007). The links for Eno River Interactive can be found at http://www.ncgeology.com/pages/Index_eno.html. The long-term goal is to provide this service for each state park in which geology plays a major role in the significance of the park. The findings from this study will potentially be used in this endeavor.

Concluding remarks

This chapter is a small step toward better understanding of the link between geoheritage and geotourism opportunities in North Carolina. The findings may inform actions taken to better service the geotourism community by increasing availability of interpretation of geologic features and ensuring that the most prominent of geologic features are well represented to the public. This also could include more interactive ways to disseminate information about the geoheritage at state parks such as the Eno River example.

Improving visitor experiences through geotourism promotion will educate and inspire visitors about geoheritage and the value of its protection. When action is taken with the intent of conserving and enhancing geologic and geomorphological features, processes, sites and specimens for the future, it has been termed geoconservation (Burek and Prosser, 2008). Geotourism and geoconservation can be mutually beneficial. The initial activities leading up to geoconservation are in many ways synonymous with the steps leading to cultivating geotourism, such as initial awareness and appreciation of the existence of features, processes, sites and specimens, examination, description, scientific audit and valuing and communication of value with others. A difference occurs in the later steps of geoconservation with the awareness of a threat, conservation audit and protection through policy means (Burek and Prosser, 2008). The development of geotourism can lead to the awareness of threats and the geoconservation efforts at specific sites offering opportunities for geotourism. The use of geoheritage can contribute to the environmental, social and economic pillars of sustainable development through conserving and promoting educationally, scientifically, recreationally and culturally important features.

North Carolina, like the rest of the eastern seaboard of the United States, is on a tectonic passive margin with no 'flashy' geologic phenomena such as active volcanoes or large earthquakes. However, there are other very active geologic processes at work which can affect the lives of many who reside in the region such as river flooding, landslides and beach erosion. All of the geologic process, whether previous or ongoing, impact geoconservation and sustainable development objectives. Other issues happening in states such as New Jersey include the problem of urban sprawl obscuring the majority of interesting geological features (Gates, 2006). With increasing levels of population growth and urbanization in North Carolina, its geoheritage may also be threatened by similar pressure. Public support for geoconservation and for sustainable development of geoheritage-based tourism in NC is therefore critical for both to prosper, and, as Hose (2006) warns us, the absence of interpretation at geoconservation sites might lead to threatened geoheritage. Geotourism not only requires an appreciation or learning infrastructure, but it also requires tourists' interest and their cooperation with respect to appropriate behavior at geoheritage sites.

To understand tourist interest, further studies including visitor surveys may elucidate questions such as how interested is the visiting public in geoheritage and how could geotourism interest be cultivated. These questions would inform the development of tailored and effective interpretive programs to promote scientific understanding and a conservation ethic that would more likely result in positive learning and conservation outcomes. These studies would then help realize the potential to turn regular tourists into geotourists, thereby making mass tourism more sustainable.

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