Paleoblitz: Uncovering the fossil record of the national parks

By Vincent L. Santucci, Justin S. Tweet, and Jason P. Kenworthy

OVER THE PAST DECADE, A team of National Park Service (NPS) paleontologists and partners has been helping to uncover and record a 2-billion-year fossil record of life preserved throughout the National Park System. Fossilized remains or traces of ancient plants, invertebrates, vertebrates, and microbes have been documented in at least 234 national parks in this first system-wide paleontological resource inventory (fig. 1, next page). Through intensive research and data mining that could be regarded as "paleoblitzes," scientists have been collecting, compiling, and synthesizing baseline paleontological resource data, greatly expanding our knowledge and understanding of the scope, significance, and distribution of national park fossils. Additionally, this inventory work addresses provisions of the Paleontological Resources Preservation Act (2009) that enhance our abilities to manage, protect, interpret, and better undertake scientific research on park fossils.

The National Park Service initiated this system-wide paleontological resource inventory in 2001, based upon a plan to incrementally and systematically survey the 32 networks of parks in the Inventory and Monitoring (I&M) Program. As surveys progressed scientists wrote paleontological resource inventory reports for each I&M network, summarizing fossil resources for each park in the network. These summaries highlight park geology, known and potential paleontological resources, fossil specimens kept in NPS museum collections or at outside repositories, resource management issues, comprehensive bibliographies, and a list of recommendations for future work aimed at conserving these resources. In 2002, the first such report—for the Northern Colorado Plateau Network—was completed. Last December the Central Alaska Network was the final piece and all now all 32 networks have been inventoried. As a result of this work, the number of parks in the National Park System identified with paleontological resources essentially doubled.

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Inventory highlights

Collectively, fossils from the national parks span more than 1 billion years and represent major stages in the evolution of life on Earth. From primitive microbial mounds (stromatolites) high in the mountains of Glacier National Park (Montana) to the Ice Age remains of plants and animals preserved in caves deep within Grand Canyon National Park (Arizona) an extraordinary and diverse fossil record is preserved throughout the National Park System. A few milestones and notable examples of new information and discoveries resulting from the inventories follow:

- The first described and illustrated fossil specimen from the Western Hemisphere was collected in the late 1600s from an area that is now likely within Colonial National Historical Park (Virginia).

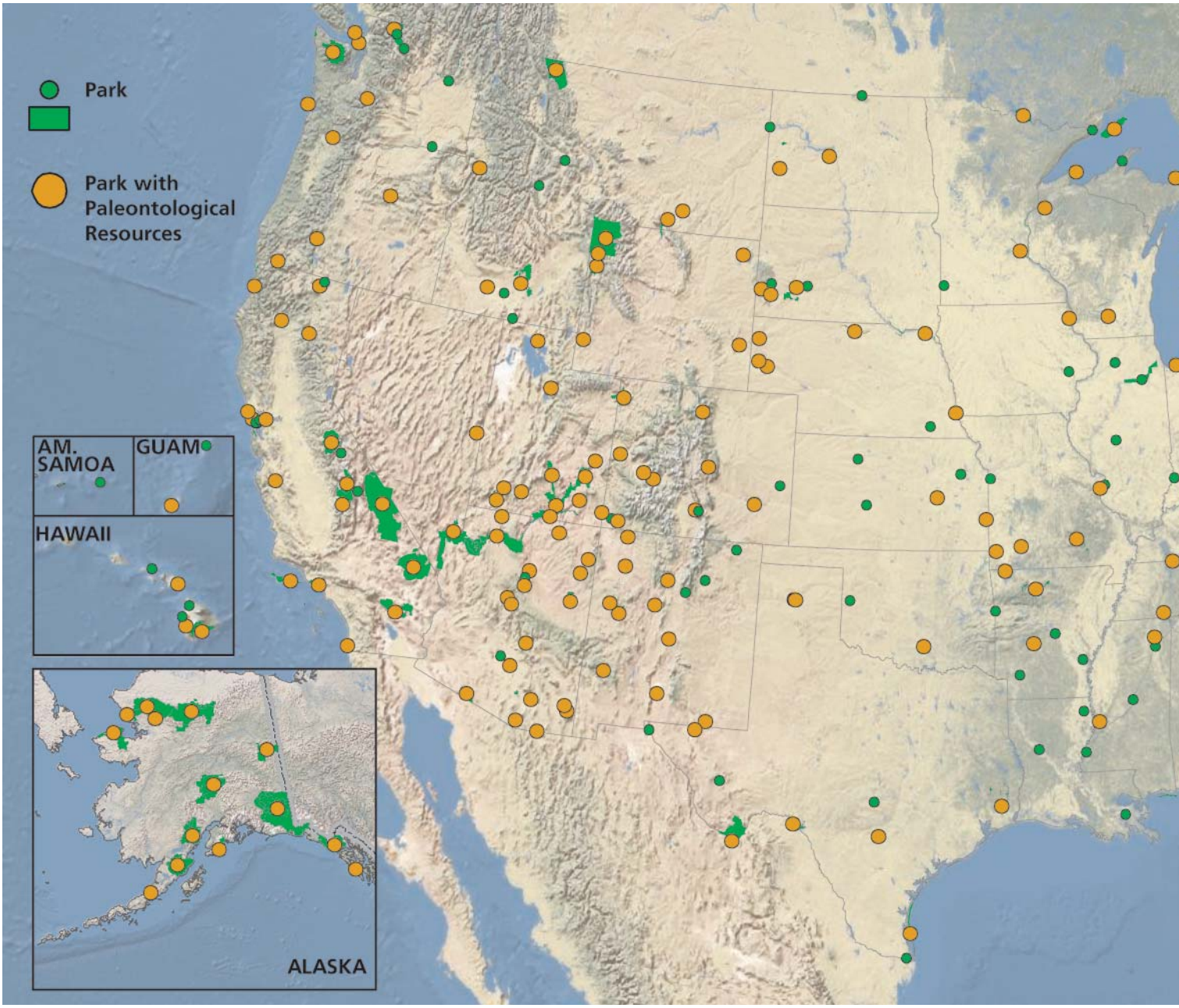
- Fossilized footprints of dinosaurs and other prehistoric vertebrates are documented in at least 35 units of the National Park System.

- The Smithsonian National Museum of Natural History assisted with preparation and identification of a rare and important fossil whale specimen discovered along the Suitland Parkway (Maryland), part of National Capital Parks East.

- The U.S. Geological Survey and the Smithsonian National Museum of Natural History possess important unpublished field notes and archives related to tens of thousands of fossil specimens that were collected from areas now administered by the National Park Service.

- Fossil marine invertebrates recently discovered in Silurian Period rocks (about 430 million years old) at Glacier Bay National Park and Preserve (Alaska) are helping to reinterpret the park's geologic history and revise the park's geologic map.

- The National Park Service maintains many examples of paleontological resources that occur in association with cultural resources, including fossils found at archeological sites, those contained in building stones of historical structures, and references to fossils in historical journals and other archives.



Alaskan national parks are recognized as frontiers for paleontological studies, and recent fieldwork there has yielded a wealth of important new fossil discoveries. Paleontologist Tony Fiorillo is helping to uncover new information on Alaskan dinosaurs based on his documentation of fossil dinosaur tracks at Aniakchak National Monument, Denali National Park and Preserve, and Wrangell–St. Elias National Park and Preserve. A team of paleontologists led by consulting geologist Robert Blodgett is helping to reinterpret the geology and paleontology of the Silurian and Devonian periods at Glacier Bay National Park and Preserve. Blodgett has discovered and is in the process of describing several new genera and species of marine invertebrate fossils from the park (fig. 2). Of particular importance to the geologic history of the area, the Glacier Bay fossils exhibit characteristics that are similar to those found in Siberia. This suggests that these Paleozoic rocks and fossils originated in Asia and were transported to the west coast of North America.

The paleontological inventories have helped to identify thousands of holotype fossil specimens derived from national parks. A holotype is a specimen upon which a new species is based and described in the literature. National parks from which holotype specimens have been discovered include Florissant Fossil Beds National Monument (Colorado) where

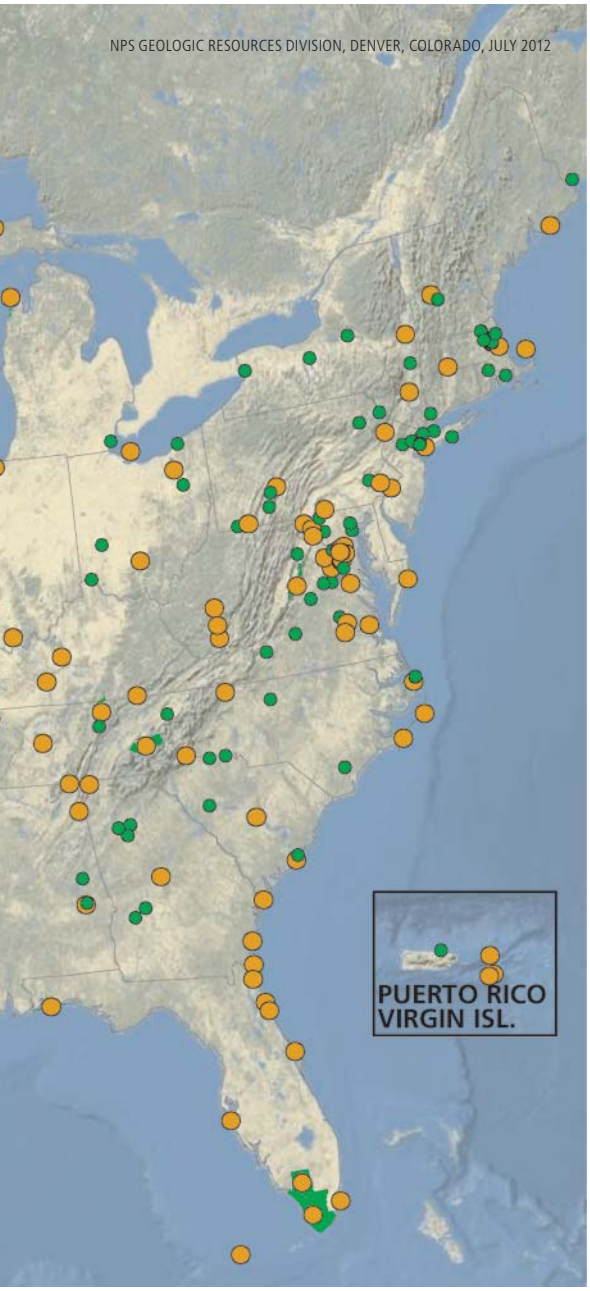


Figure 1. At least 234 areas of the National Park System (gold dots) preserve fossils in a variety of contexts. A systematic, system-wide inventory of paleontological resources over the past 10 years more than doubled the number of units with recognized fossil resources.

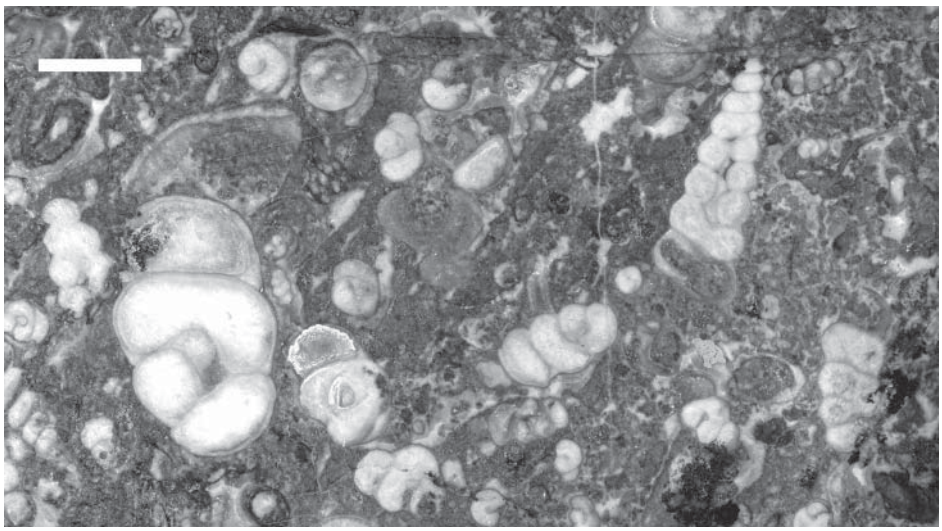
many specimens have been found, Guadalupe Mountains National Park (Texas), Grand Canyon National Park (Arizona), Yellowstone National Park (Wyoming, Montana, and Idaho), John Day Fossil Beds National Monument (Oregon), and Yukon–Charley Rivers National Preserve (Alaska). National Park Service fossil collections are maintained in museum institutions throughout the United States and are frequently featured in fossil exhibits and educational displays. The Smithsonian National Museum of Natural History maintains expansive collections of fossils from the national parks and serves as the principal repository for many of the national park holotype specimens.

The rich fossil heritage of the National Park System also contributes scientifically to our knowledge of past climate changes, ancient environmental conditions, evolution, shifts in paleobiodiversity, and biogeographic distribution of modern plants and animals. For example, Why did the bison survive the megafaunal extinctions in North America at the end of the last Ice Age while the mammoth, sloth, camel, horse, saber-toothed cat, and other animals did not? Careful analysis of fossils preserved in sequences of rocks from the fossil parks and other areas around the world often yields useful information to construct complex and fascinating stories of change over time. To the paleontologist, the dynamic history of Earth, along with changes in climate and sea level, are illustrated by patterns in the fossil record—sometimes revealing migration, sometimes adaptation, and sometimes extinction as outcomes.

National parks also provide excellent opportunities for public education related to fossils. For example, many parks enable visitors to encounter fossils in a natural state and in a geologic context—a markedly different experience from viewing fossils on display in a museum. In 2010, a seven-year-old girl on vacation from Georgia discovered an important saber-toothed cat skull while participating in a Junior Paleontologist program at Badlands National Park (South Dakota). This discovery made national headlines and the skull is now the centerpiece of a new fossil site and preparation laboratory, where visitors to Badlands can watch paleontological fieldwork in action. Also in 2010, the National Park Service was instrumental in the establishment of "National Fossil Day" as a nationwide partnership to promote the scientific and educational values of fossils.

As nonrenewable resources, fossils require specific management strategies to enhance their preservation. Frequently, fossils are documented and maintained in the rocks in which they are preserved, a condition referred to as "in situ." When fossils are maintained in situ at a park, periodic monitoring of these resources is recommended. Just as biological inventories preceded the establishment of resource monitoring programs in national parks over the last 15–20 years, the paleontological inventories of the last decade are giving rise to fossil monitoring in some national parks. In 2009, Glen Canyon National Recreation Area (Utah and Arizona) was selected as the prototype park for paleontological resource monitoring. Hundreds of dinosaur tracks documented along the shores of Lake Powell are intermittently submerged as the lake level fluctuates. A small team of paleontologists collaborated to develop a paleontological resource monitoring plan for the park. Through their effort, the park staff is able to assess the stability of in situ fossils, determine rates of change of fossil sites, and better evaluate both natural and human-related impacts on fossils. Monitoring activities since 2009 not only have documented loss of fossils along the shores of Lake Powell, but also have led to the discovery and documentation of recently exposed fossils (fig. 3).

Although the NPS "paleoblitz" has taken a decade to complete, this period is a mere moment from a geologic time perspective. The data gathered through the baseline paleontological resource inventories are



COURTESY OF ROBERT BLODGETT

Figure 2 (right). Marine invertebrate fossils from Glacier Bay National Park and Preserve provide clues to the geologic history of Alaska.

helping scientists make exciting new discoveries about the history of life, sometimes answering questions and in other cases generating new ones. The inventories have helped to increase the awareness of park managers and visitors alike as to how paleontological resources are linked to park environments today and have imparted a more holistic view of natural resource management in the national parks. The composition of park ecosystems has been shaped by, and is essentially the sum total of, the geologic, biologic, and climatic events of the past and present. Paleontology provides temporal perspectives on and other insights into biological resources, ecosystem management, and even climate change that may not be available from other fields of study.

The next step for fossil resource management in national parks is the completion of a comprehensive database of the inventory data. The NPS Geologic Resources Division is collaborating with the NPS Resource Information Services Division to develop the database of fossil resource information primarily for use by NPS parks, regions, and other offices. Over the next year the database will be finalized and populated. A variety of Web-based materials will also be developed and made available outside of the National Park Service. Access to this compilation of the vast information gleaned from the paleontological inventories will be a critical tool to better facilitate science-based management, protection, interpretation, and research of NPS paleontological resources. Ultimately the legacy of the paleontological inventory will be an enhanced ability to share the meaning and wonder of fossils preserved and discovered in our national parks.

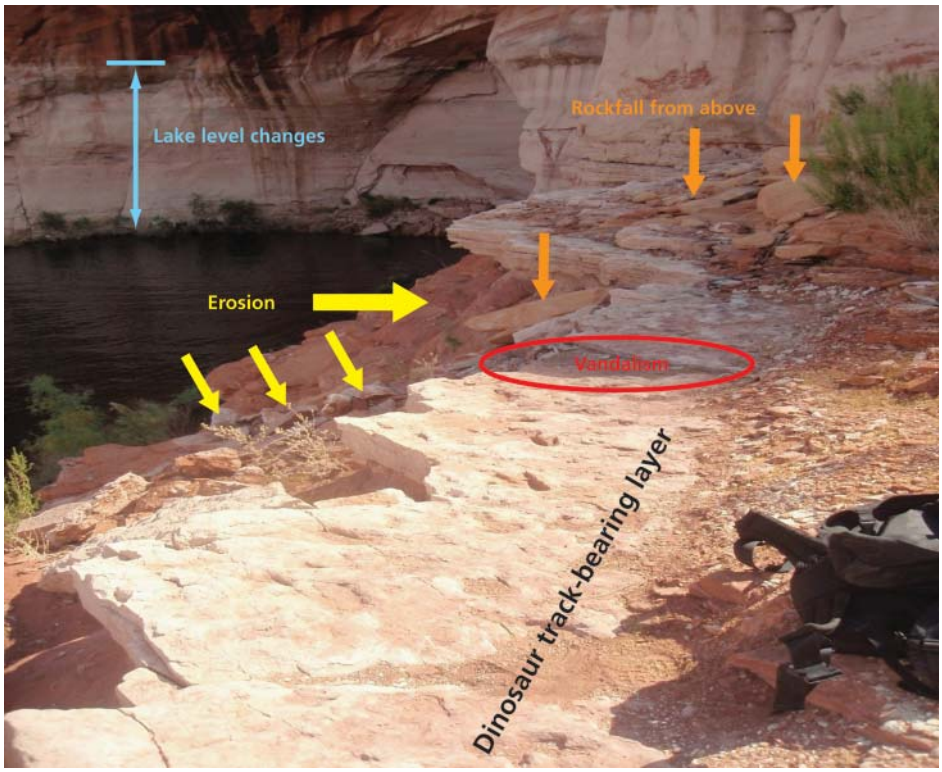


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Figure 3. With a diversity of fossil resources and resource management issues, Glen Canyon National Recreation Area (Utah and Arizona) was selected as a prototype park for paleontological resource monitoring. The dinosaur trackway shown here is affected by lake level changes, erosion, rockfall, and vandalism.

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