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NAME-BEARING FOSSIL TYPE SPECIMENS AND TAXA NAMED FROM NATIONAL PARK SERVICE AREAS

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Abstract—More than 4850 species, subspecies, and varieties of fossil organisms have been named from specimens found within or potentially within National Park System area boundaries as of the date of this publication. These plants, invertebrates, vertebrates, ichnotaxa, and microfossils represent a diverse collection of organisms in terms of taxonomy, geologic time, and geographic distribution. In terms of the history of American paleontology, the type specimens found within NPS-managed lands, both historically and contemporary, reflect the birth and growth of the science of paleontology in the United States, with many eminent paleontologists among the contributors. Name-bearing type specimens, whether recovered before or after the establishment of a given park, are a notable component of paleontological resources and their documentation is a critical part of the NPS strategy for their management. In this article, name-bearing type specimens of fossil taxa are documented in association with at least 71 NPS administered areas and one former monument, now abolished.

INTRODUCTION

As part of a synthesis of National Park Service paleontological resource data, we have compiled information on fossil taxa named from specimens found within or potentially within current (2016) park boundaries, including specimens collected prior to the establishment of a given park. This information includes citations, and, if available, type specimen catalog numbers, detailed type localities, and geologic formations. Name-bearing type specimens are the material on which a species, subspecies, or variety is based (note that the use of varieties outside of botany was ended in 1960, so "varieties," i.e., *Genus species* var. *variety*, are now regarded as subspecies). The holotype or syntype series of a given taxon is the original point of reference for the description and subsequent evaluations and discussions of that taxon and its taxonomic and phylogenetic relationships, and provides the basis for comparisons with other taxa. As the standard of a given species or more inclusive rank, a type specimen ideally preserves morphological characteristics that allow that species to be distinguished from all other taxa, but this is not always the case in practice. An inadequate type specimen, for example due to poor preservation or incompleteness, can lead to a species being regarded as dubious (nomen dubium) or invalid (nomen vanum) (Mones, 1989). Because of the subjectivity inherent to alpha taxonomy, and the fact that new information is constantly being added, a given type specimen may be evaluated as diagnostic or not diagnostic multiple times over the course of years. This is most common for the oldest type specimens, which were described when little was known about fossil organisms and there were fewer specimens available for comparison. Subsequent studies may validate the original description, modify the diagnosis based on more complete material or a better understanding of the original material, or determine that a given taxon is a synonym of another taxon. A notable example of how evaluation changes over time is *Brontosaurus*, which was published as a unique genus in Marsh (1879), considered a synonym of *Apatosaurus* by Riggs (1903), and most recently considered a distinct genus again by Tschopp (et al. 2015).

Together with their importance in academic paleontology, type specimens also play an important role in paleontological resource management on NPS and other public lands. Even if a type specimen was collected prior to the establishment of a park, the field locality still exists and is within the boundaries of that park. Park managers rely on accurate resource information in order to consider that resource during management planning and decision making. Type localities have scientific, natural resource, and sometimes historical significance. The scientific value of type localities includes the potential of finding additional fossil material of a taxon (topotypes), and the likely presence of additional paleoecological, sedimentological, stratigraphic, and/or taphonomic data. For natural resource management, type localities have potential to yield additional paleontological resources and may be threatened by natural processes or human activities. There are also type localities that are of historical significance.

Some NPS areas were specifically created in recognition of the fossils collected and described from such localities, or are symbolized by a particular fossil organism described from a site within the park. These include the hoofed mammals of Agate Fossil Beds National Monument, Nebraska, the sauropod *Apatosaurus louisae* from Dinosaur National Monument, Utah, the Hagerman Horse (*Plesippus shoshonensis*, now *Equus simplicidens*) from Hagerman Fossil Beds National Monument, Idaho, and the petrified wood *Araucarioxylon arizonicum* from Petrified Forest National Park, Arizona, with the latter two being the state fossils of their respective states. Other sites record the presence of notable expeditions, like those of John Wesley Powell in the late 19th century, or discoveries that have made important contributions to the field, like the incredible diversity of plants and insects at Florissant. These factors illustrate the need to document type localities carefully, which requires research so they can be properly managed and preserved.

There are other benefits to this research as well. The process of researching types often reveals additional information of interest for paleontological resource management. Fossil species described and named from park areas serve as proxies for periods of historical research and collecting in those parks. For example, if a museum has holotypes from a locality, it probably has other specimens from that locality as well, perhaps including specimens that have not been published. Literature that describes or references types may mention other specimens from a park, and often can be used to find additional publications on a park's paleontology. All of this information is useful and aids park resource managers to identify possible areas that may require higher levels of monitoring and protection. It is important for park museum personnel to keep track of type specimens, as discussed in the next section. Finally, species named from within a park are useful for interpretive and educational purposes, providing points of interest for discussion of a park's paleontological resources.

FOSSIL HOLOTYPES AND NPS MUSEUM POLICY

Museum collections at parks were established from the inception of the National Park System in 1916. As of 2016, the NPS collections included 592,253 cataloged paleontological specimens with an identified backlog of 36,863 specimens requiring cataloging. All NPS museum specimens are cataloged into the Interior Collection Management System (ICMS), which is the museum collection database used by all agencies of the Department of the Interior. One of the fields in ICMS is whether or not the cataloged item is considered to be Controlled Property. NPS Controlled Property includes all:

- objects valued at $1000 or more;
- firearms;
- incoming loans from outside the NPS;
- objects that are especially vulnerable to theft, loss or damage (the park must assess the risk);
- and natural history specimens with high scientific value, such as type or voucher specimens.

Each year parks must conduct a 100% inventory of controlled property (Byrne, 2000), including a physical examination of the specimens to confirm they are in good condition and establish their physical location in the collection. That the NPS designates all holotypes as Controlled Property, whether for modern or fossil specimens, demonstrates its recognition of the scientific importance of these specimens and the need for their long-term preservation. The required inclusion of these specimens in a park's annual inventory of its museum collections applies not only to those specimens physically in the park collections but to any holotypes that are part of the park collections housed in partner repositories.

There are many fossils holotypes that were collected prior to the formal establishment of a park. While park staff may be interested in these specimens as documentation of the fossils in the park and may be interested in the locality information for making informed management decisions on how these localities will be managed, it is important to note that the NPS typically does not have any legal claim to these type specimens collected prior to NPS administration of the locality, and they are not included in the annual inventory.

BACKGROUND

Systematic research on the paleontology of the National Park Service received a significant boost when paleontological resources were included as one of the types of resources to be studied through the Inventory and Monitoring program (I&M). As its name suggests, the program was established to inventory and monitor various types of natural resources. 270 NPS units with significant natural resources were identified and organized into a system of 32 I&M networks, based on ecoregions of the United States (e.g., the Southern Colorado Plateau Network, or the North Coast and Cascades Network). Between 2002 and 2012, paleontological resource inventories were completed for all 32 I&M networks and their constituent parks. For many parks, these inventories were the first baseline assessments of their paleontological resources. By 2012, a large amount of information had been amassed on the paleontology of the NPS, but it had never been collated or studied in a systematic fashion. In addition, almost a decade had passed since the earliest I&M-based paleontological resource inventories.

Not only had new information come to light on the paleontology of some of the parks described in the earlier inventories, but the oldest inventories were not as comprehensive as the later inventories. The early reports did not include some of the types of information that were later requested by park and network staff as they became more knowledgeable about these resources and their importance. In light of these considerations, it was decided in 2012 to initiate the Paleontological Synthesis Project, which would systematically organize, evaluate, and update paleontological resource information for the NPS. One outgrowth of the project was the preparation of publications focused on specific thematic subsets. These include the compilation of NPS paleontological resource data concerning distribution in geologic time, taxonomic diversity, institutions that maintain collections of fossils from NPS lands, and the data used for the present study, focused on name-bearing types and fossil taxa described from NPS areas.

METHODOLOGY

Researching fossil taxa and name-bearing type specimens in the Internet age is much easier than at any other time since the beginning of paleontological research, but this work still depends on finding the pertinent species in the first place. The most basic search is simply to use the name (or names) of a park and permutations of "type" and "new species" in a search engine. For taxa named before the establishment of a given park, the names of geographic features and geologic formations can be employed instead. Taxa are also located during more general study of the paleontological resources of a given park, and in turn a full paleontological inventory of a park is the best way to make sure that all taxa are found. As a researcher becomes more familiar with the geology and geography of a given park, better and more detailed searches can be performed, although there is an element of serendipity even when a park has been studied exhaustively. Many paleontologically significant areas in the NPS have at least some widely available collation of fossil species. In other cases, relevant species were found in museum publications listing type specimens, bibliographies of various taxonomic groups, or by combing the works of authors known to have been active in various park areas.

Recent updated inventories for the Northern Colorado Plateau, Mediterranean Coast (coastal southern California, designated in reference to climate), Greater Yellowstone, Northeast Coastal & Barrier, Southern Plains, and Mojave Desert inventory inventory and monitoring networks have provided opportunities for thorough taxonomic searches, as well as park-level inventories for Big Bend National Park, Golden Gate National Recreation Area, and Mississippi National River and Recreation Area. Finally, the online database of fossils from Florissant (http://planning.nps.gov/flfo/),which was compiled by park staff, was an invaluable resource for collating the numerous type specimens of Florissant Fossil Beds National Monument. After finding a promising lead, we would then locate the original publication in order to confirm that the specimen did originate within what is now a unit of the National Park System, or, in cases where locality information was vague, within an area that includes an NPS unit. No taxa were accepted without reviewing the original publication in which the taxon and name-bearing type were described.

Our list of NPS fossil type specimens is probably most complete for taxa published before 1923 and since the mid-1990s. Pre-1923 documents are in the public domain in the United States and are widely available electronically, and can often be easily searched. The Biodiversity Heritage Library, Google Books, Internet Archive, and JSTOR provide various formats of the major early journals and many other early publications. Nevertheless, the sheer taxonomic productivity of many workers from this era, and the use of place names and formation names that have long since been superseded, make it inevitable that some taxa have been missed. Publications from the past two decades are well-sampled because they are also well-represented electronically and postdate the establishment of all but a few NPS units, permitting fruitful searches using a park's modern name. Taxonomically, vertebrates are probably most completely represented, because of Oliver Perry Hay's bibliographies (e.g., Hay, 1902), which cover the period of time when taxonomic splitting and inadequate locality information were most prevalent, and the Bibliography of Fossil Vertebrates (http://www.bfvol.org/).

A variety of different methods and sources were utilized in the search. The two most basic mechanisms for finding taxa were dedicated geological databases such as GeoRef and search engines. The primary weakness of search engines is a worse signal-to-noise ratio than a database inquiry. The major advantage over a database was a much greater capability to search the text of documents, making it simpler to search more directly. Taxa found through databases were usually uncovered as a result of looking for any kind of paleontological information concerning a given park: we would find a number of publications that might be relevant, and a certain percentage would turn out to include new taxa once we read them. The primary weakness of GeoRef and other databases is that entries often become less comprehensive for older literature, making older documents more difficult to find. In addition, depending on the standards of entry and the scope of a database, certain publications can be difficult to find or omitted altogether. Early- and mid-20th-century volumes of series published by the Carnegie Institute of Washington, Geological Society of America, and U.S. Geological Survey proved most elusive. The major advantage of a database search was a much better signal-to-noise ratio. The differences between the two methods can be characterized by "broad" searches using databases versus "narrow" searches using search engines. More recently, the advent of well-maintained "[Year] in paleontology" articles on the English Wikipedia has allowed us to locate references of interest published in the past few years, which may not be in databases yet and often have a smaller online presence than references that have a few years of circulation.

Whatever the search method, we would only sometimes find the intended information directly. Instead, many successful inquiries began from an intermediate source, such as a review article or a museum's catalog of type specimens. Intermediate sources sometimes also provided the names of significant authorities or localities that could be used as search terms. Localities were particularly useful; a productive locality usually has a paper trail, and it is not uncommon for fossil taxa to be named after a locality, particularly if multiple species were described from a site. Searching on "[site name]ensis" in a collections database led to finding multiple references and additional taxa more than once. Occasionally, an older name will include a ligature like æ or œ, a diaeresis like ö, or a hyphen; these usages are no longer considered valid, and later authors split the ligatures and remove the extra marks, unless discussing a taxon in historical context. In practical terms, these characters can make it difficult to trace the publication history of a taxon, depending on the search method. Geographically, Alaska presented a particular challenge for all search methods, and information was almost always found through intermediate sources. A major contributing factor to this is that many fossils described from Alaska were reported in long monographs with generic titles, easily overlooked when using databases and search engines. To compensate, it was found necessary to search by authors who were active in Alaskan paleontology, and then review their work on a publication-by-publication basis.

Specimen numbers and detailed type locality information are included in most 20th and 21st century publications, but are often missing in 19th century publications. We were able to determine most missing type specimen numbers from a combination of museum type catalogs, online museum databases, and later revisions. Unfortunately, some type specimens are now missing or have been destroyed because of disasters such as fire. In some cases, especially for taxa described in the 19th century, the missing material pertains to taxa that never had a type specimen designated with a catalog number, or did not have a specific type designated. It is important to remember that the current system of formally designating types and establishing repository information took time to develop. In the most problematic cases, taxa were named for specimens that were never illustrated and were part of collections known to be largely destroyed. Benjamin Franklin Shumard (1820–1869) is a particular victim, having been associated with three institutions that suffered losses: the Texas Geological Survey (facilities converted into a munitions factory during the Civil War: Hill, 1887), the museum of the Academy of Science of St. Louis (a May 1869 fire: Starr, 1898); and the University of Missouri (Columbia) (a January 1892 fire: Lane and Webster, 1971). Microfossil type numbers have proved difficult to determine in some cases, and some are still outstanding.

Determining the actual geographic location of type localities can sometimes be challenging. Taxa were only accepted as "confirmed" if locality information was sufficient to show placement within the boundaries of a park. This left a number of taxa with locality information that was not adequate to establish position within or outside of NPS boundaries. During the 19th and early 20th centuries, publication standards were not as stringent with regard to locality information. It was often enough to provide a general area of discovery, such as "the White River Badlands" or "Petersburg." This deficiency can be attributed to a variety of reasons: simple adherence to the standards of the time; a lack of quality maps or named landmarks; description of material acquired by collectors other than the author, who may not have kept good records; and, in the case of certain researchers, a vested interest in maintaining secrecy about productive localities.

The result is that many taxa either published before about 1920 or based on fossils collected before 1920 can only be attributed to a general area that now includes a modern NPS unit, due to the absence of detailed locality information. It would be inappropriate to ignore these species, but also inappropriate to consider them in the same light as species with more firmly established type localities; therefore, they are listed separately, as "potential." More recent descriptions usually include a type locality with at least a reference to a useful landmark, and often township-range-section coordinates, latitude and longitude, or UTMs. Modern GPS technology makes defining the position of a locality much simpler than in the past. However, occasionally even coordinates are insufficient because they are too close to a boundary, though this is rare.

Inadequate historical locality information is a particular issue for fossil name-bearing type specimens associated with 11 park units: Badlands National Park (BADL), Colonial National Historical Park (COLO), Florissant Fossil Beds National Monument (FLFO), Fossil Butte National Park (FOBU), Guadalupe Mountains National Park (GUMO), John Day Fossil Beds National Monument (JODA), Mississippi National River and Recreation Area (MISS), Niobrara National Scenic River (NIOB), Petersburg National Battlefield (PETE), Saint Croix National Scenic Riverway (SACN), and Vicksburg National Military Park (VICK). These units share several characteristics: there was significant collection in the general areas of these parks during the 19th century; there are more taxa from these parks with unknown or missing holotypes than noted with parks in general; and most of the type irregularities, such as uncertain types and syntype series based on material collected across widely distributed localities, are associated with these parks. Also, not coincidentally, these park units are of particular interest for the history of paleontology in North America and NPS lands.

RESULTS

At this time, we have found descriptions of 4855 taxa based at least in part upon fossils found or potentially found within 71 NPS units, one affiliated unit, and the abolished Fossil Cycad National Monument (Table 1; Fig. 1 for geographic distribution, Figs. 2 and 3 for representative examples). They include:

- 2222 species, subspecies, and varieties named from specimens collected from sites within modern park boundaries (four with syntypes from two parks, leaving a revised total of 2218 unique taxa);
- 2561 taxa named from specimens that potentially were collected within modern park boundaries (one with syntypes potentially from two parks, leaving a revised total of 2560 unique taxa);
- 13 taxa named from specimens collected on or immediately adjacent to Santa Fe National Historic Trail (SAFE), and 43 taxa named from specimens collected at sites potentially on or along the trail;
- 1 taxon named from a specimen collected by the Lewis and Clark expedition on or near Lewis and Clark National Historic Trail (LECL);
- 1 taxon named from a specimen historically associated with Springfield Armory National Historic Site (SPAR), but not found within modern boundaries;
- And 19 taxa associated with the former Fossil Cycad National Monument.

These totals include taxa currently accepted as valid, dubious taxa, and taxa that are now considered synonyms of previously named taxa. They do not include informally named taxa, such as taxa described in theses and dissertations but not described formally, or other taxa not meeting the requirements of the International Code of Zoological Nomenclature or International Code of Botanical Nomenclature. This stipulation primarily affects Big Bend National Park (BIBE), where a number of taxa have been named in unpublished work. Taxa now regarded as pseudofossils are omitted, such as *Brooksella canyonensis* (Bassler, 1941) from GRCA, and *Lingula calumet* and *Paradoxides barberi* (Winchell, 1885) from Pipestone National Monument (PIPE). The species of *Rutgersella* from DEWA were tentatively retained. Two taxa in the Florissant Database were not included because they have no citations and are not mentioned in any other sources, which suggests that they are "artifact" names from museum collection records, perhaps uncorrected pre-publication names or applied accidentally. These two taxa are "*Hybius rohweri*" and "*Otiorhynchites contusa.*" Because of the inherent subjectivity of declaring species dubious or synonyms, and because many species have not been evaluated since they were described, no attempt was made to adjust numbers to remove species that have been declared dubious or synonymous at one time or another.

In some cases, particularly MISS, taxa were based on a number of syntypes (or cotypes in older parlance) from multiple locations, not all of which are within or potentially within a park area. This issue could be addressed by designating lectotypes. There are also a handful of syntype series that include specimens from multiple NPS units. These include the invertebrates *Astarte meeki* Stanton (1899) (Grand Teton National Park [GRTE] or John D. Rockefeller National Parkway [JODR] and Yellowstone National Park [YELL]), *Inoceramus acuteplicatus* Stanton (1899) (JODR and YELL), and *Productus parviformis* Girty (1899) (GRTE and YELL), the bird *Phasianus mioceanus* Shufeldt (1915) (Chimney Rock National Historic Site [CHRO] and Scotts Bluff National Monument [SCBL]), and the angiosperm *Celtis mccoshi* Lesquereux (1883) (potentially FLFO and FOBU). *Astarte meeki* is also unusual in that some of its syntype material comes from a location that is in either GRTE or JODR. The echinoid *Holectypus pealei* Clark (in Clark and Twitchell, 1915) is also based on a specimen collected from a location that is in either GRTE or JODR.

GEOGRAPHIC DISTRIBUTION

All seven regions (Table 2) and 26 of 32 inventory and monitoring networks (Table 3) have been the source of type material. The six networks that have not been the source of type materials are the Klamath (KLMN), North Coast & Cascade (NCCN), Northeast Temperate (NETN), Pacific Islands (PACN), Sierra Nevada (SIEN), and Sonoran Desert (SODN) networks. Much of the bedrock geology of the parks in these networks consists of igneous and/or medium- to high-grade metamorphic rocks, and these networks also share limited fossil records overall, so this result is not necessarily surprising. In general, most types come from lands west of the Mississippi River. Those from east of the river mostly represent invertebrates, but there are two important Pleistocene cave sites that were the sources of numerous vertebrate types: Cumberland Cave in POHE (Potomac Heritage National

TABLE 1. Fossil taxa named from specimens recovered from localities either known to be within or potentially within NPS park boundaries (as of 2015). The totals are adjusted as follows: four species were named from syntypes found in two NPS units, and one species was named from syntypes potentially from two NPS units. Fossil Cycad National Monument (abolished), LECL, SAFE, and SPAR are included in this table for completeness. See Tables 2 and 3 for explanations of the region and network acronyms.

PARK	REGION	NETWORK	CONFIRMED	POSSIBLE	TOTAL
Agate Fossil Beds National Monument (AGFO)	MWR	NGPN	25	0	25
Aniakchak National Monument and Preserve (ANIA)	AKR	SWAN	2	0	2
Antietam National Battlefield (ANTI)	NCR	NCRN	2	0	2
Badlands National Park (BADL)	MWR	NGPN	33	211	244
Big Bend National Park (BIBE)	IMR	CHDN	33	0	33
Big Cypress National Preserve (BICY)	SER	SFCN	17	0	17
Bryce Canyon National Park (BRCA)	IMR	NCPN	4	0	4
Canyon de Chelly National Monument (CACH)	IMR	SCPN	3	0	3
Canyonlands National Park (CANY)	IMR	NCPN	4	0	4
Cape Hatteras National Seashore (CAHA)	SER	SECN	23	0	23
Capitol Reef National Park (CARE)	IMR	NCPN	2	0	2
Carlsbad Caverns National Park (CAVE)	IMR	CHDN	4	0	4
Chaco Culture National Historical Park (CHCU)	IMR	SCPN	1	1	2
Channel Islands National Park (CHIS)	PWR	MEDN	19	0	19
Chesapeake and Ohio Canal National Historical Park (CHOH)	NCR	NCRN	12	0	12
Chickasaw National Recreation Area (CHIC)	IMR	SOPN	2	0	2
Chimney Rock National Historic Site (CHRO) (affiliated)	MWR	N/A	2	0	2
Colonial National Historical Park (COLO)	NER	NCBN	25	96	121
Cumberland Gap National Historical Park (CUGA)	SER	CUPN	0	1	1
Cuyahoga Valley National Park (CUVA)	MWR	HTLN	3	1	4
Death Valley National Park (DEVA)	PWR	MOJN	71	0	71
Delaware Water Gap National Recreation Area (DEWA)	NER	ERMN	4	0	4
Denali National Park and Preserve (DENA)	AKR	CAKN	3	0	3
Dinosaur National Monument (DINO)	IMR	NCPN	16	2	18
Florissant Fossil Beds National Monument (FLFO)	IMR	ROMN	429	1314	1743
Fort Foote Park (FOFO) (National Capital Parks-East)	NCR	NCRN–NACE	2	0	2
Fort Laramie National Historic Site (FOLA)	IMR	NGPN	0	2	2
Fort Union Trading Post National Historic Site (FOUS)	MWR	NGPN	0	1	1
Fossil Butte National Monument (FOBU)	IMR	NCPN	4	53	57
Gates of the Arctic National Park and Preserve (GAAR)	AKR	ARCN	13	0	13
Glacier Bay National Park (GLBA)	AKR	SEAN	9	0	9
Glacier National Park (GLAC)	IMR	ROMN	30	0	30
Glen Canyon National Recreation Area (GLCA)	IMR	SCPN	2	0	2
Golden Gate National Recreation Area (GOGA)	PWR	SFAN	5	1	6
Grand Canyon National Park (GRCA)	IMR	SCPN	159	13	172
Grand Teton National Park (GRTE)	IMR	GRYN	13	0	13
Grand Teton National Park (GRTE) or John D. Rockefeller, Jr. Memorial Parkway (JODR)	IMR	GRYN	2	0	2
Great Basin National Park (GRBA)	PWR	MOJN	3	0	3
Great Smoky Mountains National Park (GRSM)	SER	APHN	1	1	2
Guadalupe Mountains National Park (GUMO)	IMR	CHDN	219	28	247
Hagerman Fossil Beds National Monument (HAFO)	PWR	UCBN	45	0	45
John D. Rockefeller, Jr. Memorial Parkway (JODR)	IMR	GRYN	1	0	1
John Day Fossil Beds National Monument (JODA)	PWR	UCBN	197	130	327

Katmai National Park and Preserve (KATM)	AKR	SWAN	20	2	22
Lake Clark National Park and Preserve (LACL)	AKR	SWAN	19	0	19
Lake Mead National Recreation Area (LAKE)	PWR	MOJN	2	0	2
Mammoth Cave National Park (MACA)	SER	CUPN	0	1	1
Mississippi National River and Recreation Area (MISS)	MWR	GLKN	113	250	363
Missouri Scenic and Recreational River (MNRR)	MWR	NGPN	0	8	8
Mojave National Preserve (MOJA)	PWR	MOJN	4	0	4
Natchez Trace Parkway (NATR)	SER	GULN	0	1	1
Niobrara National Scenic River (NIOB)	MWR	NGPN	18	37	55
Noatak National Preserve (NOAT)	AKR	ARCN	1	0	1
Ozark National Scenic Riverways (OZAR)	MWR	HTLN	5	7	12
Pea Ridge National Military Park (PERI)	MWR	HTLN	1	0	1
Petersburg National Battlefield (PETE)	NER	MIDN	0	140	140
Petrified Forest National Park (PEFO)	IMR	SCPN	94	2	96
Point Reyes National Seashore (PORE)	PWR	SFAN	2	0	2
Potomac Heritage National Scenic Trail (POHE)	multiple	N/A	20	0	20
Richmond National Battlefield Park (RICH)	NER	MIDN	0	6	6
Saint Croix National Scenic Riverway (SACN)	MWR	GLKN	5	49	54
Santa Monica Mountains National Recreation Area (SAMO)	PWR	MEDN	50	0	50
Scotts Bluff National Monument (SCBL)	MWR	NGPN	5	1	6
Theodore Roosevelt National Park (THRO)	MWR	NGPN	1	0	1
Upper Delaware Scenic and Recreational River (UPDE)	NER	ERMN	4	0	4
Valley Forge National Historical Park (VAFO)	NER	MIDN	49	0	49
Vicksburg National Military Park (VICK)	SER	GULN	26	202	228
Wrangell-St. Elias National Park and Preserve (WRST)	AKR	CAKN	33	0	33
Yellowstone National Park (YELL)	IMR	GRYN	175	0	175
Yukon-Charley Rivers National Preserve (YUCH)	AKR	CAKN	131	0	131
Total unique taxa:			2218	2560	4778
Special cases:					
Fossil Cycad National Monument (abolished 1957)	[MWR]	[N/A]	"19"	0	"19"
Lewis and Clark National Historic Trail (LECL)	multiple	N/A	"1"	0	"1"
Santa Fe National Historic Trail (SAFE)	multiple	N/A	"13"	"43"	"56"
Springfield Armory National Historic Site (SPAR)	NER	N/A	"1"	0	"1"
Total unique taxa including special cases:			2252	2603	4855

TABLE 2. Fossil taxa named from specimens recovered from localities either known to be or potentially within NPS boundaries (as of 2015), sorted by NPS regions. The IMR numbers have been adjusted to account for three species with syntypes in two NPS units and one species with syntypes possibly from two NPS units, and the MWR confirmed and total counts have been adjusted to account for one species with syntypes in two NPS units. Potomac Heritage National Scenic Trail (POHE) is counted under "N/A." Fossil Cycad National Monument (abolished), LECL, SAFE, and SPAR are omitted.

REGION	CONFIRMED	POSSIBLE	TOTAL
Alaska (AKR)	231	2	233
Intermountain (IMR)	1194	1414	2608
Midwest (MWR)	210	565	775
National Capital (NCR)	16	0	16
Northeast (NER)	82	242	324
Pacific-West (PWR)	398	131	529
Southeast (SER)	67	206	273
N/A	20	0	20

Scenic Trail) and Port Kennedy Cave in VAFO (Valley Forge National Historical Park).

TEMPORAL DISTRIBUTION

Although NPS fossil taxa have been described from the Mesoproterozoic to a few thousand years ago, they are concentrated in a few geologic periods (Table 4), which usually can be associated with specific fossil-rich occurrences in certain parks. Cambrian type specimens come primarily from GRCA (Grand Canyon National Park), SACN, YELL, and YUCH (Yukon–Charley Rivers National Preserve). The Ordovician is represented mostly by taxa from MISS. GUMO and GRCA provide most of the Permian type specimens. PEFO (Petrified Forest National Park) provides most of the Triassic type specimens. The Cretaceous type specimens come from a mix of several parks. The Eocene is represented mostly by FLFO, followed distantly by JODA and YELL. BADL, JODA, and VICK provide most of the Oligocene type specimens. The Miocene type specimens come from several parks, led by AFGO (Agate Fossil Beds National Monument) and SAMO (Santa Monica Mountains National Recreations Area). COLO, HAFO (Hagerman Fossil Beds National Monument), and potentially PETE provide most of the Pliocene type specimens. Almost all of the

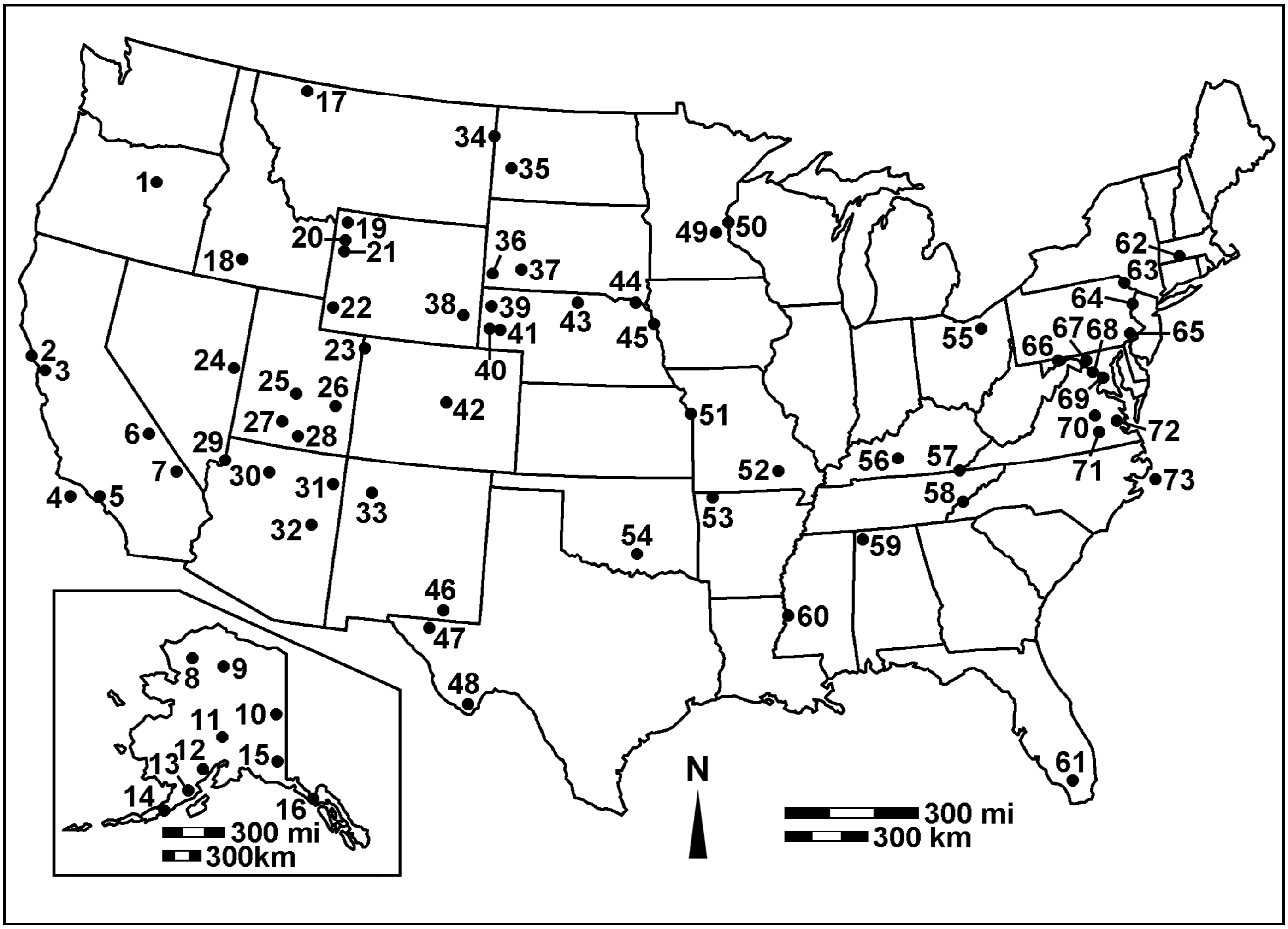

FIGURE 1. National Park Service units associated with name-bearing type fossil specimens. **1**, John Day Fossil Beds National Monument (JODA), Oregon; **2**, Point Reyes National Seashore (PORE), California; **3**, Golden Gate National Recreation Area (GOGA), California; **4**, Channel Islands National Park (CHIS), California; **5**, Santa Monica Mountains National Recreation Area (SAMO), California; **6**, Death Valley National Park (DEVA), California–Nevada; **7**, Mojave National Preserve (MOJA), California; **8**, Noatak National Preserve (NOAT), Alaska; **9**, Gates of the Arctic National Park and Preserve (GAAR), Alaska; **10**, Yukon-Charley Rivers National Preserve (YUCH), Alaska; **11**, Denali National Park and Preserve (DENA), Alaska; **12**, Lake Clark National Park and Preserve (LACL), Alaska; **13**, Katmai National Park and Preserve (KATM), Alaska; **14**, Aniakchak National Monument and Preserve (ANIA), Alaska; **15**, Wrangell-St. Elias National Park and Preserve (WRST), Alaska; **16**, Glacier Bay National Park (GLBA), Alaska; **17**, Glacier National Park (GLAC), Montana; **18**, Hagerman Fossil Beds National Monument (HAFO), Idaho; **19**, Yellowstone National Park (YELL), Wyoming–Montana–Idaho; **20**, John D. Rockefeller, Jr. Memorial Parkway (JODR), Wyoming; **21**, Grand Teton National Park (GRTE), Wyoming; **22**, Fossil Butte National Monument (FOBU), Wyoming; **23**, Dinosaur National Monument (DINO), Utah–Colorado; **24,** Great Basin National Park (GRBA), Nevada; **25**, Capitol Reef National Park (CARE), Utah; **26**, Canyonlands National Park (CANY), Utah; **27**, Bryce Canyon National Park (BRCA), Utah; **28**, Glen Canyon National Recreation Area (GLCA), Utah–Arizona; **29**, Lake Mead National Recreation Area (LAKE), Arizona–Nevada; **30**, Grand Canyon National Park (GRCA), Arizona; **31**, Canyon de Chelly National Monument (CACH), Arizona; **32**, Petrified Forest National Park (PEFO), Arizona; **33**, Chaco Culture National Historical Park (CHCU), New Mexico; **34**, Fort Union Trading Post National Historic Site (FOUS), North Dakota–Montana; **35**, Theodore Roosevelt National Park (THRO), North Dakota; **36**, Fossil Cycad National Monument (abolished 1957), South Dakota; **37**, Badlands National Park (BADL), South Dakota; **38**, Fort Laramie National Historic Site (FOLA), Wyoming; **39**, Agate Fossil Beds National Monument (AGFO), Nebraska; **40**, Scotts Bluff National Monument (SCBL), Nebraska; **41**, Chimney Rock National Historic Site (CHRO) (NPS-affiliated site), Nebraska; **42**, Florissant Fossil Beds National Monument (FLFO), Colorado; **43**, Niobrara National Scenic River (NIOB), Nebraska; **44**, Missouri Scenic and Recreational River (MNRR), Nebraska; **45**, Lewis and Clark National Historic Trail (LECL), multiple states; **46**, Carlsbad Caverns National Park (CAVE), New Mexico; **47**, Guadalupe Mountains National Park (GUMO), Texas; **48**, Big Bend National Park (BIBE), Texas; **49**, Mississippi National River and Recreation Area (MISS), Minnesota; : **50**, Saint Croix National Scenic Riverway (SACN), Minnesota–Wisconsin; **51**, Santa Fe National Historic Trail (SAFE), multiple states; **52**, Ozark National Scenic Riverways (OZAR), Missouri; **53**, Pea Ridge National Military Park (PERI), Arkansas; **54**, Chickasaw National Recreation Area (CHIC), Oklahoma; **55**, Cuyahoga Valley National Park (CUVA), Ohio; **56**, Mammoth Cave National Park (MACA), Kentucky; **57**, Cumberland Gap National Historical Park (CUGA), Kentucky–Tennessee–Virginia; **58**, Great Smoky Mountains National Park (GRSM), Tennessee–Virginia; **59**, Natchez Trace Parkway (NATR), multiple states; **60**, Vicksburg National Military Park (VICK), Mississippi–Louisiana; **61**, Big Cypress National Preserve (BICY), Florida; **62**, Springfield Armory National Historic Site (SPAR), Massachusetts; **63**, Upper Delaware Scenic and Recreational River (UPDE), New York–Pennsylvania; **64**, Delaware Water Gap National Recreation Area (DEWA), New Jersey–Pennsylvania; **65**, Valley Forge National Historical Park (VAFO), Pennsylvania; **66**, Potomac Heritage National Scenic Trail (POHE), multiple states; **67**, Antietam National Battlefield (ANTI), Maryland; **68**, Chesapeake and Ohio Canal National Historical Park (CHOH), multiple states; **69**, Fort Foote Park (FOFO), Maryland; **70**, Richmond National Battlefield Park (RICH), Virginia; **71**, Petersburg National Battlefield (PETE), Virginia; **72**, Colonial National Historical Park (COLO), Virginia; **73**, Cape Hatteras National Seashore (CAHA), North Carolina.

TABLE 3. Fossil taxa named from specimens recovered from localities either known to be within or potentially within NPS boundaries (as of 2015), sorted by Inventory & Monitoring networks. The GRYN confirmed and total counts have been adjusted to account for three species with syntypes in two NPS units, and the NGPN confirmed and total counts have been adjusted to account for one species with syntypes in two NPS units. A fifth species may have syntypes in both NCPN and ROMN units, but because these are different networks, the NCPN and ROMN totals have not been adjusted. Chimney Rock National Monument (CHRO) is included with the NGPN. POHE is counted under "N/A." Fossil Cycad National Monument (abolished), LECL, SAFE, and SPAR are omitted.

I&M NETWORK	CONFIRMED	POSSIBLE	TOTAL
Appalachian Highlands (APHN)	1	1	2
Arctic (ARCN)	14	0	14
Central Alaska (CAKN)	167	0	167
Chihuahuan Desert (CHDN)	256	28	284
Cumberland Piedmont (CUPN)	0	2	2
Eastern Rivers and Mountains (ERMN)	8	0	8
Great Lakes (GLKN)	118	299	417
Greater Yellowstone (GRYN)	188	0	188
Gulf Coast (GULN)	26	203	229
Heartland (HTLN)	9	8	17
Mediterranean Coast (MEDN)	69	0	69
Mid Atlantic (MIDN)	49	146	195
Mojave Desert (MOJN)	80	0	80
National Capital Region (NCRN)	16	0	16
Northeast Coastal and Barrier (NCBN)	25	96	121
Northern Colorado Plateau (NCPN)	30	55	85
Northern Great Plains (NGPN)	83	260	343
Rocky Mountain (ROMN)	459	1314	1773
Southeast Coast (SECN)	23	0	23
Southern Colorado Plateau (SCPN)	259	16	275
Southeast Alaska (SEAN)	9	0	9
San Francisco Bay Area (SFAN)	7	1	8
South Florida/Caribbean (SFCN)	17	0	17
Southern Plains (SOPN)	2	0	2
Southwest Alaska (SWAN)	41	2	43
Upper Columbia Basin (UCBN)	242	130	372
N/A	20	0	20

TABLE 4. Fossil taxa named from specimens recovered from localities either known to be or potentially within NPS boundaries (as of 2015), sorted by geologic time. The Oligocene, Cretaceous, Jurassic, and Mississippian confirmed totals have been adjusted to account for one species with syntypes in two NPS units, and the Eocene possible total has been adjusted to account for one species with syntypes possibly from two NPS units. Fossil Cycad National Monument (abolished), LECL, SAFE, and SPAR are omitted.

AGE	CONFIRMED	POSSIBLE	TOTAL
Unknown	0	1	1
Cenozoic unspecified	2	2	4
Neogene	1	0	1
Holocene	1	0	1
Pleistocene	76	2	78
Pleistocene?	1	0	1
Pliocene	95	235	330
Pliocene?	1	0	1
Miocene/Pliocene	1	0	1
Miocene	108	9	117
Miocene?	0	33	33
Oligocene/Miocene	11	0	11
Oligocene	86	429	515
Eocene/Oligocene	15	36	51
Eocene	747	1412	2159
Paleocene?/Eocene	3	0	3
Paleocene/Eocene	5	1	6
Paleocene	7	1	8
Cretaceous	103	40	143
Cretaceous?	0	1	1
Jurassic	43	2	45
Triassic	116	2	118
Permian	298	37	335
Pennsylvanian	13	2	15
Mississippian	45	3	48
Devonian	37	1	38
Silurian	32	0	32
Ordovician	140	257	397
Ordovician?	1	0	1
Cambrian	203	54	257
Proterozoic?	1	0	1
Neoproterozoic	15	0	15
Mesoproterozoic	11	0	11

Pleistocene type specimens come from POHE and VAFO.

TAXONOMIC DISTRIBUTION

The most frequently described fossil taxa from NPS units, represented by the most name-bearing types, are invertebrates (Table 5). They encompass wide geographic, stratigraphic, and taxonomic diversity, from Paleozoic brachiopods, bryozoans, and trilobites from GRCA and GUMO, to Cenozoic mollusks from COLO and VICK, to the abundant arthropods of FLFO. Plant types and taxa are next, followed by vertebrates (mostly mammals), and then "Other" (mostly microfossils) and ichnofossils. There is an interesting separation between invertebrates and vertebrates, which have more "potential" than "confirmed" taxa, and plants, ichnofossils, and other taxa, which have the opposite pattern.

Broadly speaking, invertebrates and vertebrates are the most likely types of fossils to have been described before the inclusion of detailed locality information was de rigueur. FLFO, GRCA, and PEFO are the only three units with a confirmed taxon from all five categories of fossils. GRCA's diversity stems from its numerous formations, representing both marine and terrestrial settings over most of the Paleozoic.

TABLE 5. Division of fossil taxa by broad taxonomic categories. The color coding is maintained through the rest of the document for ease of visual assessment. “Other”, in practical terms, includes various protists, algae outside of true plants, fungi, acritarchs, and enigmatic forms. The numbers have been adjusted to account for three invertebrates with syntypes from multiple NPS units, one vertebrate with syntypes from two NPS units, and one plant with syntypes possibly from two NPS units. Fossil Cycad National Monument (abolished), LECL, SAFE, and SPAR are omitted.

TAXONOMIC CATEGORY	CONFIRMED	POSSIBLE	TOTAL
Plant	522	226	748
Invertebrate	1213	1936	3149
Vertebrate	291	373	664
Ichnofossil	80	7	87
Other	112	18	130

FLFO’s and PEFO’s diversity come from single extremely productive formations with a mix of terrestrial and subaqueous organisms (the Florissant and Chinle formations, respectively). If taxa potentially from a park are included, JODA joins these three; plants, vertebrates, trace fossils, and other fossils (fungi) have been named from fossils definitely found in the monument, but invertebrates have only been named from specimens that may or may not have been collected from areas in the monument. Like GRCA, JODA includes several formations that yield a great taxonomic diversity of fossils.

CHRONOLOGICAL DISTRIBUTION

An examination of descriptions of fossils over time illustrates some broad trends (Table 6). The inception and growth of American paleontology through the 19th century can be seen in a chronological breakdown of the taxa associated with NPS areas, including the interruption of the Civil War. The oldest names come from areas associated with three NPS units in the East and South: COLO, PETE, and VICK. The first western types are from the BADL area (*Poebrotherium*

FIGURE 2. Diversity of type specimens collected from NPS lands: plants, ichnofossils, and invertebrates. Original taxonomic combinations used. All photos by the authors except where noted. Top row, left to right: USNM 4358, *Fraxinus wrightii* (YELL), angiosperm leaf (courtesy of Smithsonian Institution. Photo by authors); USNM 222760, *Pinus premurryana* (YELL), conifer cone (courtesy of Smithsonian Institution. Photo by authors); USNM 424805, *Quintacava velosida* (JODA), fruit (courtesy of Smithsonian Institution. Photo by authors). Middle row, left to right: USNM P 8807, *Cycadeoidea colossalis* (FOCY), cycadeoid (courtesy of Smithsonian Institution. Photo by Michael Brett-Surman/ USNM); USNM 11155, *Mesichnium benjamini* (GRCA), arthropod tracks (courtesy of Smithsonian Institution. Photo by authors); USNM 11536, *Dromillopus parvus* (GRCA), tetrapod tracks (courtesy of Smithsonian Institution. Photo by Patrick Getty/USNM). Bottom row, left to right: USNM 95872, *Paleoscotylus divergus* (PEFO), invertebrate borings in wood (courtesy of Smithsonian Institution. Photo by authors); AMNH FI 289, *Graptolithus hallianus* (SACN), graptolite (courtesy of American Museum of Natural History. Photo by authors); USNM 89879, *Cremacrinus punctatus* (MISS), crinoid (courtesy of Smithsonian Institution. Photo by USNM).

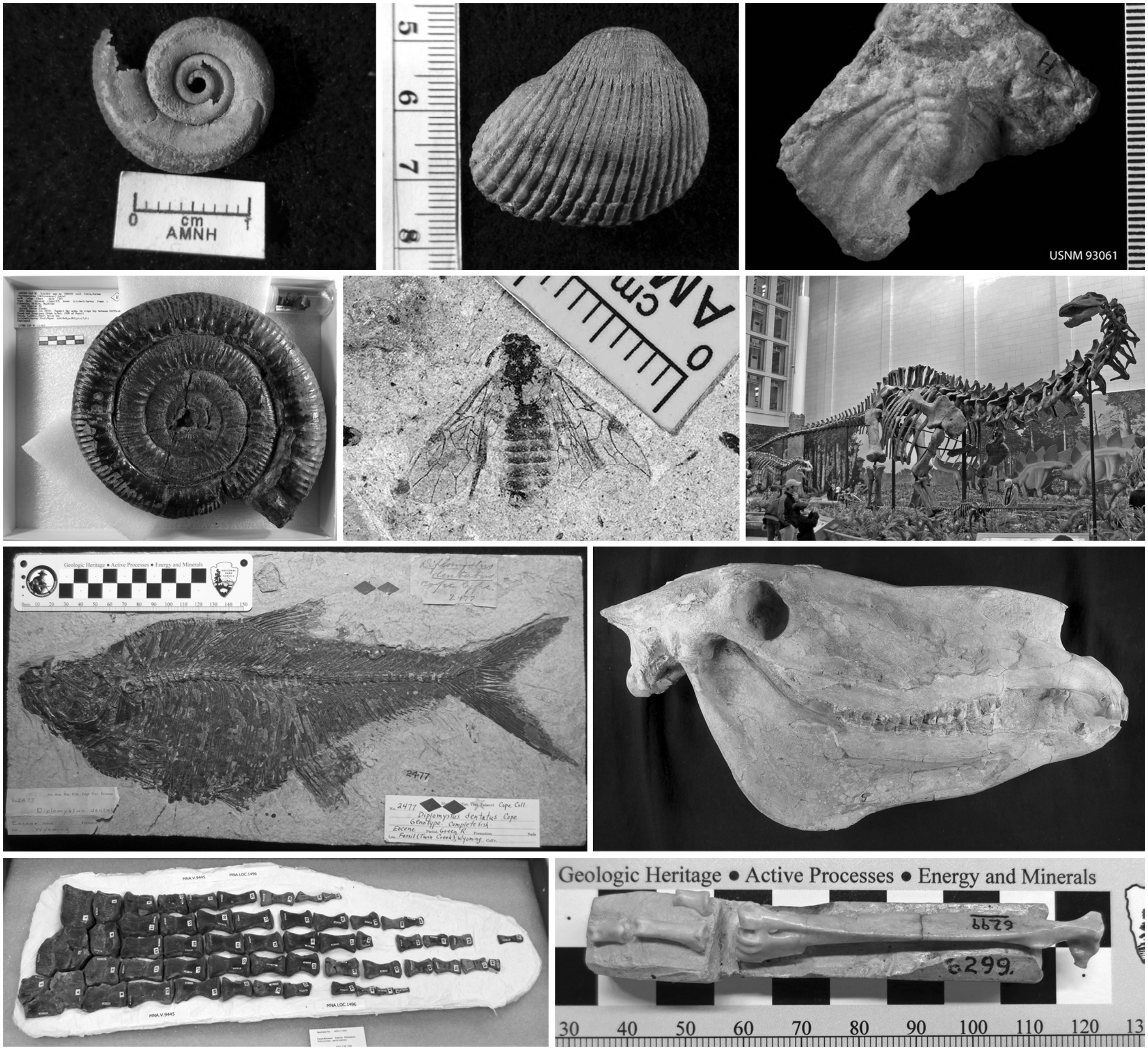

FIGURE 3. Diversity of type specimens collected from NPS lands: invertebrates and vertebrates. Original taxonomic combinations used. All photos by the authors except where noted. Top row, left to right: AMNH FI 27938, *Straparollus* (*Leptomphalus*) *micidus* (GUMO), gastropod (courtesy of American Museum of Natural History. Photo by authors); LACMIP 10095 (originally UCLA 3258), *Anadara* (*Anadara*) *topangaensis*, bivalve (courtesy of Natural History Museum of Los Angeles County. Photo by Caitlin De La Cruz/LACM); USNM 93061, *Briscoia robusta* (YUCH), trilobite (courtesy of Smithsonian Institution. Photo by Suzanne McIntyre/USNM). Second row, left to right: USNM 131425, *Stephanoceras* (*Skirroceras*) *juhlei* (LACL), ammonite (courtesy of Smithsonian Institution. Photo by authors); AMNH FI 18919, *Hemichroa eophila* (FLFO), sawfly (courtesy of American Museum of Natural History. Photo by AMNH); CMNH 3018, *Apatosaurus louisae* (DINO), dinosaur (photo by Tadek Kurpaski , CC BY 2.0). Third row, left to right: AMNH FF 2477, *Diplomystus dentatus* (potentially FOBU), fish (courtesy of American Museum of Natural History. Photo by authors); USNM 11986, *Plesippus shoshonensis* (HAFO), horse (courtesy of Smithsonian Institution. Photo by Michael Brett-Surman/USNM). Bottom row, left to right: MNA V9445, *Eopolycotylus rankini* (GLCA), plesiosaur (courtesy of Museum of Northern Arizona. Photo by authors); AMNH FARB 6299, *Proictinia effera* (AGFO), bird (courtesy of American Museum of Natural History. Photo by authors).

wilsoni Leidy [1847]). The peak in described taxa from the 1890s to the 1910s represents both great activity and a scientific atmosphere conducive to taxonomic splitting. Description of new taxa decreased over the next few decades, in part because many taxa had already been described, in part because of changing perceptions of variation and taxonomy that shifted interest away from naming new taxa, and in part because of external events (wars and economic disruption) that took attention and funding from activities such as paleontology. Taxa described since the peak include both forms based on new material and forms described from material collected during the preceding decades. The advent of improved locality information in the early 20th century can be seen by the "confirmed" totals becoming greater than "possible." Over the past few decades, "possible" taxa are usually based on material collected prior to modern standards for locality reporting.

Historical Considerations

The history of North American paleontology is intertwined with these NPS fossil name-bearing types (Fig. 4). The first illustrated fossil from North America, a bivalve shell illustrated in a 1687 edition of Martin Lister's "Historiae Conchyliorum", is a specimen of

TABLE 6. Fossil taxa sorted by the dates of publication for the taxonomic descriptions. For the purposes of this table, decades are XXX0-9, not XXX1-0. The possible and total tallies for the 1880s are reduced by one because one species named in that decade has syntypes possibly from two NPS units, the confirmed and total tallies for the 1890s are reduced by three, and the confirmed and total tallies for the 1910s are reduced by one. Fossil Cycad National Monument (abolished), LECL, SAFE, and SPAR are omitted.

DECADE	CONFIRMED	POSSIBLE	TOTAL
1820s	0	32	32
1830s	0	26	26
1840s	0	243	243
1850s	6	114	120
1860s	3	47	50
1870s	40	130	170
1880s	3	241	244
1890s	177	758	935
1900s	348	268	616
1910s	190	356	546
1920s	130	84	214
1930s	281	93	374
1940s	132	64	196
1950s	132	24	156
1960s	183	23	206
1970s	143	5	148
1980s	97	32	129
1990s	158	6	164
2000s	138	10	148
2010s	57	4	61

a species later described by Say (1824) as *Pecten jeffersonius* (now *Chesapecten jeffersonius*) (Ward and Blackwelder, 1975; Ray, 1987). Both this specimen and the material described by Say were probably originally collected from an area in or near what is now COLO (Ward and Blackwelder, 1975; Ray, 1987; Kenworthy and Santucci, 2003). A fossil collected on the Lewis and Clark expedition described as *Saurocephalus lanciformis* (Harlan, 1824) is still extant and can be seen in the collections of the Academy of Natural Sciences in Philadelphia. Whether on the national historic trail or not, it is certainly part of the history that LECL commemorates. Similarly, one of the first good dinosaur body fossils from North America is the partial skeleton described by Edward Hitchcock, Jr. (1865) as *Megadactylus polyzelus* (now *Anchisaurus polyzelus*); this specimen was discovered during construction at Springfield Armory, and although the site is just outside the current boundaries of SPAR, the skeleton is an interesting part of the historical complex that the site was established to commemorate. Other notable "firsts" included in the tallies are the first fossil taxon named from the Badlands (*Poebrotherium wilsoni* Leidy [1847]) and the first fossils described from what is now DINO (*Amplexus zaphrentiformis* White [1876] [now *Barytichisma zaphrentiforme*]). The first fossil reported from the Badlands, a brontothere jaw (USNM 21820) reported by Prout (1846) as a "*Palaeotherium*," was named a short time later as *Menodus giganteus* by Pomel (1849); the specimen described as *Palaeotherium proutii* (USNM 113) by Owen et al. (1850) is not Prout's specimen (Mihlbachler et al. 2004).

MISCELLANEOUS FINDINGS

FLFO has contributed the most taxa by far, primarily arthropods, but plants are also well represented. With 1743 of the total 4855 unique taxa, approximately 36% of the fossil species named or potentially from NPS lands are from FLFO. This total will no doubt continue to grow as new material is found and old material is reevaluated.

The documentation of these types is in more than 1000 publications by more than 350 lead authors. Twelve of these authors are responsible for more than 100 taxa each, contributing 2515 of the 4855 taxa (52%). These authors were primarily active during the late 19th and early 20th centuries, many of their taxa can only be assigned to a general area including an NPS unit, and several were major authorities on Florissant fossils or were authorities on a broad taxonomic group who lent their expertise to fossils from diverse areas (Table 7).

A systematic tally of NPS fossil name-bearing types sorted by repositories was not done for several reasons. For many 19th century types a repository was not indicated, and in some cases the specimen was in a private collection, not a public repository. In other cases, multiple institutions have type material from a single taxon. Sometimes this is because different specimens of a syntype series are at different institutions, as is sometimes the case for MISS taxa. Another way this can happen is if a type consists of a part and counterpart, and the two pieces become separated, as frequently happened with FLFO taxa.

TABLE 7. Authors who contributed more than 100 taxa (lead authorship only).

AUTHOR	LIFE	CONFIRMED TAXA	POTENTIAL TAXA	TOTAL TAXA	NPS AREAS
Charles Thomas Brues	1879–1955	36	101	137	FLFO
Theodore Dru Alison Cockerell	1866–1948	178	157	335	FLFO
Timothy Abbott Conrad	1803–1877	0	171	171	COLO, PETE, VICK
Edward Drinker Cope	1840–1897	41	89	130	FLFO, FOBU, JODA, VAFO
George Herbert Girty	1869–1939	141	7	148	GUMO, YELL
Frank H. Knowlton	1860–1926	89	29	118	FLFO, JODA, KATM, YELL
Henry Charles Lea	1825–1909	0	106	106	PETE
Leo Lesquereux	1806–1889	4	132	136	FLFO, FOBU, JODA, YELL
Steven R. Manchester	Active	128	1	129	JODA
Samuel Hubbard Scudder	1837–1911	1	600	601	FLFO, FOBU
Edward Oscar Ulrich	1857–1944	27	194	221	GRCA, MISS, OZAR, SACN
Henry Frederick Wickham	1866–1933	107	176	283	FLFO
Totals:		752	1763	2515	

FIGURE 4. Examples of historically significant type specimens associated with NPS units. Clockwise from top left: ANSP 5516, holotype of *Saurocephalus lanciformis*, found on the Lewis and Clark expedition (courtesy of Academy of Natural Sciences of Drexel University. Photo by authors); ANSP 11012, holotype of *Poebrotherium wilsoni*, the first new species named from the White River Badlands (courtesy of Academy of Natural Sciences of Drexel University. Photo by authors); USNM 144776, lectotype of *Amplexus zaphrentiformis* (syntype lot 8064; now *Barytchisma zaphrentiforme*), from the first collection of fossils described from what is now Dinosaur National Monument (courtesy of Smithsonian Institution. Photo by authors); and the femur of ACM 41109, holotype of *Megadactylus polyzelus* (now *Anchisaurus*), collected during construction at Springfield Armory (courtesy of Beneski Museum of Natural History, Amherst College. Photo by Kate Wellspring/ACM).

The National Museum of Natural History (USNM) in Washington, D.C. is the repository with the largest number of fossil holotypes and syntypes from or possibly from NPS units. This reflects the use of the USNM as a repository for the U.S. Geological Survey. The Organic Act of 1879, which established the USGS, specified that fossils of the United States Government, including those of the USGS, "when longer needed for investigations in progress, shall be deposited in the national museum."

The reduction in force of the USGS in 1995 and the dissolving of the Paleontology and Stratigraphy Branch greatly reduced the level of activity of the USGS in the description of new fossil taxa. In 1996, the USGS and USNM signed a memorandum in which the USNM would selectively accept portions of the USGS paleontology collections, which included holotypes (many from parks), and the other specimens would be distributed to other institutions. Under this memorandum the USGS paleontology collections at Menlo Park were transferred to the University of California Museum of Paleontology (UCMP) in Berkeley, California, and the collections at Reston were transferred to the Virginia Museum of Natural History (VMNH) in Charlottesville, Virginia. The USGS still maintains collections at its facility in Lakewood, Colorado, among which are fossils including types collected from NPS units. As an agency of the Department of the Interior it is required to follow all DOI policy on museum collections under its jurisdiction, both historical and contemporary, with the exception of collections being used in active research, termed "working collections."

Other institutions with large collections include the American Museum of Natural History (AMNH) in New York City, New York; the Academy of Natural Science of Drexel University (ANSP), Philadelphia, Pennsylvania; the Museum of Comparative Zoology (MCZ), Harvard University, Cambridge, Massachusetts; the University of California Museum of Paleontology (UCMP), Berkeley, California; the University of Colorado Museum of Natural History (UCM), Boulder, Colorado; the University of Florida collections (UF), Florida Museum of Natural History, Gainesville, Florida; the University of Minnesota Paleontology Collection (UMPC), Minneapolis, Minnesota; and the Yale Peabody Museum of Natural History (YPM), New Haven, Connecticut. Most of these are fairly predictable from the history of paleontology. Of the outliers, the UCM is a major repository for FLFO types, the UF is a major repository for JODA types, and the UMPC is a major repository for MISS types. In addition to outside institutions, several NPS units now retain types from their own lands in their park collections, and occasionally hold types from adjacent lands if they fall within the park Scope of Collection (the latter were not counted). Park collections with types include AGFO, DEVA, DINO, FLFO, FOBU, GUMO, JODA, and PEFO. A small number of types, all petrified wood, have been left in situ.

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