Fossil Casts and Scans

1. What are casts and scans?

Casts and scans are high fidelity replicas of specimens. They are an exact copy of an original object or specimen in its proportion and size. Casts are produced by making a mold from the original. A 3-D scan is produced using surface or volumetric scanning or imaging techniques and results in digital copies of fossils that can be used with a 3-D printer to produce the replica.

2. What are some reasons for making casts and scanning specimens?

Casts and scans are made:

- when fossils can't be collected from the field and remain *in situ*
- to produce replicas of holotypes to preserve the original through reduced handling
- before destructive analysis to record the exact form of the original and so that missing portions can be replaced if needed
- for research, interpretive programs, exhibits, or loans
- to share with other institutions
- to sell through the park gift store or cooperating association

Note: Scanning is a good alternative to molding if the specimen is too delicate to survive the molding process.

3. Why are fossils left in situ?

During a paleontology survey or research project, a researcher may encounter trace fossils, complete fossilized logs, vertebrate specimens, or other fossil evidence that precludes collection due to its landscape-scale size. Similarly important fossils found in an archeological context sometimes can't be collected due to the impact on the cultural resource. When photographs, measurements, and drawings are not sufficient to properly document the specimen, a cast or scan may be made of the specimen.

Fossils left in the field are subject to weathering and over time will be lost. At a minimum, weathering will continue to diminish the quality of details on the specimen rendering it unsuitable for scientific study.

4. How are casts or scans made?

Casts are made from a casting medium (e.g., polyurethane resin or plaster) that is poured into a mold. Molds are made using a durable molding material, such as high quality polymers, including latex, silicones, or polyurethanes. It's important to know and test the working properties of the mold material on a small portion of the fossil or uninformative material because it comes into direct contact with the object. Record all materials used in making a mold.

Scans can be made with a variety of methods that capture surface data (e.g., photogrammetry and infrared laser scans) and volumetric data (e.g., computed tomography [CT] and magnetic resonance imaging [MRA]). The digital files (generally DICOM, TIFF, STL, or OBJ file types) produced from scanning require a large amount of storage space and must be migrated to maintain access.

5. Should I catalog casts and replicas made from 3-D printers?

Accession and catalog a high fidelity, museum quality replica made from a mold or 3-D printer to serve as a voucher for the specimen. The reference cast is then available for future research and to serve as a plastotype if the holotype specimen is catastrophically destroyed, lost, or stolen. In rare cases a digitype may be designated, such as if the original object is destroyed during an imaging method (e.g., serial grinding and imaging).

If a cast is to be used as the type specimen for a new ichnotaxa, identify and catalog the first clean cast with minimal defects made from the mold as the holotype. Cite the NPS catalog number for this cast in any publication.

Catalog digital files of scans as archives. These files become part of the park's resource management records.

Owing to the fragmentary or distorted nature of many fossils, scans of fossil material are often mirrored or manipulated by paleontologists to create "complete" skeletal reconstructions for interpretive and research purposes, such as biomechanical analysis. These augmented scans are not reproductions but reconstructions based on scientific evidence. The digital files can be cataloged as archives in the park's natural resource files, while 3D prints made for interpretive purposes should be treated as other interpretive media.

6. How should I document additional casts of the same object?

After the first high fidelity cast or scan is made for the park collection, additional copies (casts) can be produced from the mold. Researchers may catalog subsequent casts made from the mold or scan and place them in the collections of their home institutions. However, all citations of the specimens should:

- credit the NPS
- identify the park from which the original was collected

- include the NPS catalog number for the cast or scan of the specimen that is housed at the park

7. How should I mark casts and scans?

Casts and scans are reproductions. Mark them as reproductions to ensure that they won't be confused with the original. You can mark "Reproduction" or "R" on large objects, or cast them in a different color. Some casts are too small to mark, or made from a material, such as clear resin that should not be marked. You can document these with a tag. Photograph the object with the tag as additional documentation.

8. Can casts be made for non-NPS purposes?

Yes. Casts and scans can be reproduced for non-NPS purposes by using an agreement. The agreement grants permission to a contractor or organization (for profit or nonprofit) to reproduce a museum object for sale or distribution. The NPS does not have the authority to license products or receive royalties or a fee for making a reproduction of a museum object or specimen. However, a third party, such as the park cooperating association, can license a product on behalf of the park.

Note: When you grant permission to one non-NPS individual or organization to reproduce a museum object, you must also allow the same access to other non-NPS individuals or organizations.