

Creation of both the text and graphics-based indexes is being accomplished in the NDGS' Geographic Information Systems Center, using ARC/INFO software. Separate files are being created for each scale and category of DSD. Text files will consist of alphabetical listings of USGS quadrangle maps (various scales) for which a given category of DSD is available. Graphics-based files will present the same information, but will consist of ARC/INFO graphics files (converted to a GIF format) illustrating USGS quadrangle map areas for which DSD is available (Figure 1). If space permits, we will also provide ARC/INFO graphics files (you will need ARC/INFO to view these) which provide greater detail for the indexes than the GIF files.

The NDClear Online files will be available to anyone worldwide who has access to the Internet and a gopher client program. The files will reside on a gopher server operated by the State of North Dakota through the Information Services Division of the Office of Management and Budget. Although the state gopher server is not fully operational as this goes to press, it is expected that NDClear Online will be ready for use early in 1995. To access this server via gopher, one can enter the following: **gopher gopher.state.nd.us**

Upon reaching the state gopher server, a series of menus will be displayed. To reach NDClear Online, one must choose "North Dakota Government" from the first

menu, "State Agencies" from the second, "Geological Survey" from the third, and "NDClear" from the fourth menu. A README file will be present once access to NDClear has been gained. The README file will explain the types of files available, and the steps required to search for the category of clearinghouse information desired.

To submit information about the availability of DSD to the clearinghouse coordinator, for inclusion in NDClear Online, send your information (via E-mail on the Internet) to: **mark@eagle.ndgs.state.nd.us** Your information should include the following: unit of coverage (statewide, county, 7.5' quad, 30'X60' quad, etc.) and the name of that unit; category (roads, soils, etc.); data source, including scale (1:24,000 scale, 1:250,000 scale, etc.); and the name, address, and phone number of the person from whom this data may be obtained. For those lacking access to the Internet, the same information may be mailed to the clearinghouse coordinator for inclusion in NDClear Online.

We hope that this "second generation" clearinghouse will provide a more efficient and accurate means for those requiring DSD, to enable them to locate and inexpensively acquire this most expensive part of any computer-based mapping or modeling system.

*The NDGS' Clearinghouse Coordinator is Mark R. Luther*

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## Stumpf Site Registered as a North Dakota Natural Area by John W. Hoganson

A private ceremony was held at John Stumpf's ranch on September 2nd to commemorate the addition of the Stumpf Site to North Dakota's Registry of Natural Areas. Jesse Hanson, coordinator of the Planning and Natural Resource Division of the North Dakota Parks and Recreation Department, and I presented John Stumpf with a plaque and certificate endorsed by Governor Schafer in recognition of Mr. Stumpf's commitment to preserving this important paleontological site (Fig. 1). Kathy Armstrong-Olson, coordinator of the North Dakota Parks and Recreation Department's Nature Preserve/Natural Heritage Program, and John Campbell, Earle Campbell, and Mike Marquart representing the North Dakota Paleontological Society (a partner in study and preservation of the site), and John Stumpf's brother and sister-in-law also attended.



**Figure 1.** *Stumpf Natural Area Registry ceremony. l. to r: Jesse Hanson, John Stumpf, and John Hoganson.*

The North Dakota Natural Areas Registry is an important part of North Dakota's Nature Preserves Program and relies on citizen-based conservation to help preserve important natural areas in private ownership. The Registry Program was developed by the North Dakota Parks and Recreation Department and North Dakota Chapter of the Nature Conservancy; when fossil sites are involved the North Dakota Geological Survey takes an active role. Currently there are about 55 Natural Areas in North Dakota. Most of these are biological sites — sites of rare or endangered species or unique habitats. The Stumpf Site is the fourth site in North Dakota on the Registry because of its paleontological significance. The other registered paleontological sites are the Little Badlands Natural Area, Fitterer Ranch Natural Area, and Obritsch Ranch Natural Area.

Through the Registry Program, landowners are notified of natural features on their land having state significance and are asked to voluntarily protect those areas. The Registry is a volunteer, non-binding, non-regulatory program. State officials advise the landowner of the significance of their site and suggest management strategies. They also provide official signs stating that the site is a North Dakota Natural Area. Landowners are asked to notify Registry Program managers of any proposed changes in use or ownership

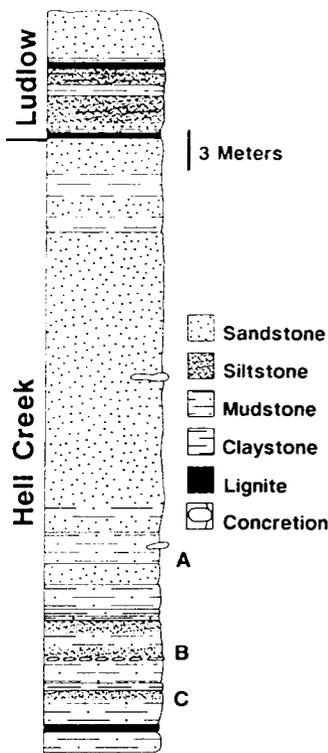
of the site. Registry site owners may terminate participation in the program at any time.

The Stumpf Natural Area is a site of dissected terrain south of Mandan where erosion has exposed approximately 54 meters of fossil-bearing rocks (Fig. 2). At this site 45 meters of the Late Cretaceous age (65 million years old) Hell Creek Formation is overlain by 9 meters of Paleocene age Ludlow Formation (Fig. 3). The basal 15 meters of the Hell Creek Formation, consisting of sandstones and siltstones deposited in a deltaic and marine shoreline setting, have yielded a diverse assemblage of fossils (Fig. 4).

At least 34 vertebrate taxa and 9 invertebrate taxa have been identified from the several hundred fossils recovered from the Hell Creek Formation at the Stumpf Natural Area (Hoganson, et al., 1994). The non-marine fossil assemblages (Fig. 3, levels A and B) are dominated by disarticulated skeletal remains of dinosaurs, mostly hadrosaurs (duckbilled dinosaurs, Fig. 5a). Fossils of at least 8 species of dinosaurs have been found at the site, including in addition to hadrosaurs, ceratopsians (horned dinosaurs, Fig. 5b), ankylosaurs (armored dinosaurs), tyrannosaurs (large carnivorous dinosaurs, Fig. 5c), and dromaeosaurs (small carnivorous dinosaurs, Fig. 5d). The remains of freshwater fish, amphibians, turtles, crocodiles,



**Figure 2.** *Hell Creek Formation exposed at the Stumpf site. It was at the end of the Cretaceous, as the Hell Creek Formation was being deposited, that the last dinosaurs died.*



**Figure 3.** Geologic section at the Stumpf site and stratigraphic position of fossil assemblages (A, B, C).

**Figure 4.** Excavation of a dinosaur rib at the Stumpf site. From l. to r: Dallas Schneider, Michele Gutenkunst, John Campbell, Austin Schneider, and Ian Mitchell.

crocodile-like champsosaurs (Fig. 5e), alligators, mammals (Fig. 5f), snails (Fig. 5g), clams, and plants (Fig. 5h) are found associated with the dinosaur fossils. Three meters above the base of the site (Fig. 3, level C) is a marine sandstone, called the Breien Member of the Hell Creek Formation, that contains shark (Fig. 5i) and ratfish (Fig. 5j) fossils.

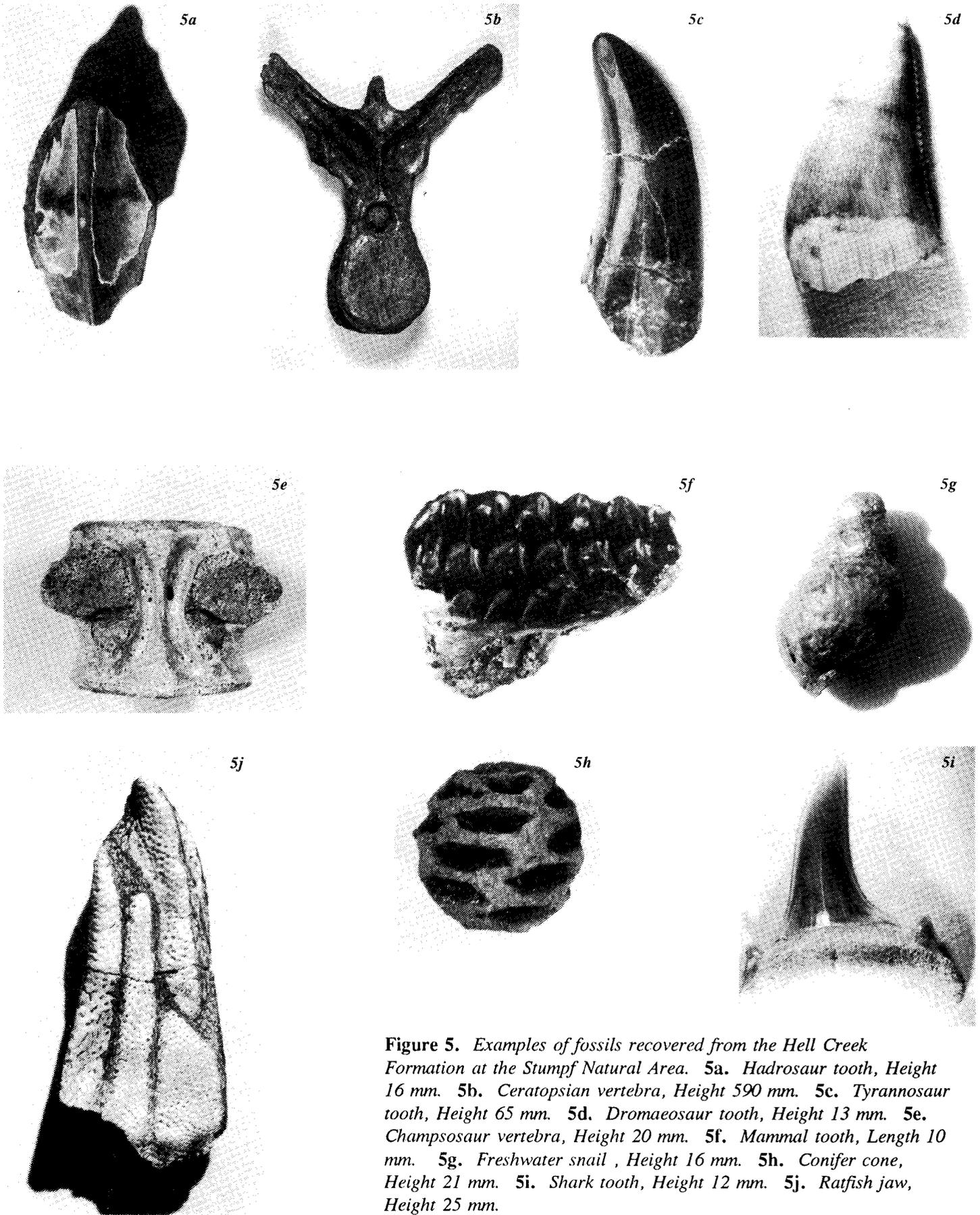
The Stumpf Natural Area is significant for several reasons. It contains the most diverse assemblage of fossils from the Hell Creek Formation in central North Dakota, including dinosaurs and early mammals. It is the farthest east Hell Creek fossil assemblage so far discovered in the United States. Fossils from this site provide intriguing insights about the ecosystem that existed in central North Dakota 65 million years ago. The marine fossils found in shoreline sandstones near the base of the site provide information about the kinds of organisms that inhabited the last Cretaceous sea to cover North Dakota. The site is also currently part of a research project to investigate the cause of the extinction of dinosaurs and other organisms at the end of the Cretaceous (Murphy, et al., 1993). Archaic (probably about 4,000 years old), Late Woodland (about 1,000 years old), and Plains Village (about 300 years old) artifacts found at the site suggest that it is also of archeological significance. The rugged

badland terrain is also a refuge for abundant wildlife.

Federal and state governments cannot and should not be held solely responsible for survival of our significant fossil sites and specimens. Individual landowners must play an integral role in conserving our fossil resources. Without their active participation and commitment we will lose, year by year, more of these sites and objects of our natural heritage. I would like to take this opportunity to thank Mr. John Stumpf for his willingness to participate in the Natural Areas Registry Program and preserve this important fossil site.

## REFERENCES

- Hoganson, J. W., Campbell, J. M., and Murphy, E. C., 1994, Stratigraphy and paleontology of the Cretaceous Hell Creek Formation, Stumpf Site, Morton County, North Dakota: North Dakota Academy of Sciences, v. 48, p. 95.
- Murphy, E. C., Hoganson, J. W., Nichols, D. J., and Forsman, N. F., 1993, The Cretaceous/Tertiary boundary in south-central North Dakota: Geological Society of America Abstracts with Programs, v. 25, no. 6, p. A-113.



**Figure 5.** Examples of fossils recovered from the Hell Creek Formation at the Stumpf Natural Area. **5a.** Hadrosaur tooth, Height 16 mm. **5b.** Ceratopsian vertebra, Height 590 mm. **5c.** Tyrannosaur tooth, Height 65 mm. **5d.** Dromaeosaur tooth, Height 13 mm. **5e.** Champsosaur vertebra, Height 20 mm. **5f.** Mammal tooth, Length 10 mm. **5g.** Freshwater snail, Height 16 mm. **5h.** Conifer cone, Height 21 mm. **5i.** Shark tooth, Height 12 mm. **5j.** Ratfish jaw, Height 25 mm.