

Paleontological Excavations in Designated Wilderness: Theory and Practice

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Abstract—Wilderness is widely recognized as a valuable environment for scientific research, and it is generally assumed that this research will benefit the wilderness resource. But what if the research is of value only in understanding an ecosystem that has been extinct for 65 million years? What if thousands of pounds of material must be removed from the wilderness to conduct this research? In 1998, the New Mexico Museum of Natural History and Science excavated two sites within the Bisti/De-Na-Zin Wilderness—the first known paleontological excavations from a designated wilderness. This paper examines the Bureau of Land Management's analysis of the excavation proposal, including: discussions of appropriateness, determination of minimum tool, options for mitigating impacts to the wilderness resource, public outreach alternatives, and a post-excavation review of the Environmental Assessment prepared for this "ground-breaking" research.

The Bisti/De-Na-Zin Wilderness Area (B/DNZ), approximately 45,000 acres, is located in northwest New Mexico, approximately 30 air miles south of the city of Farmington and 20 air miles northwest of Chaco Culture National Historical Park.

Paleontological research has been conducted in the Bisti Badlands for almost a century. The strata exposed come from near the end of the Cretaceous Period (approximately 75 to 80 million years ago) through the beginning of the Tertiary Period (approximately 63 million years ago). Exposed on the surface of the B/DNZ, therefore, is a nearly continuous stratigraphic sequence between what is popularly known as the end of the Age of Dinosaurs and the beginning of the Age of Mammals. Almost 100 species of plants, and well over 100 species of animals (including invertebrates, fish, amphibians, reptiles, dinosaurs, and mammals) have been identified in the B/DNZ. Some of these represent either holotypes (specimens used for the original description of a species) or species found nowhere else to date.

The last comprehensive survey of this region was conducted in the mid-1970's (Kues and others 1977) and recorded over 200 paleontological sites within the Wilderness. Many additional localities have been identified through periodic monitoring. Current Bureau policy requires a permit signed by the BLM state director for the collection of any vertebrate fossils on public land. At the present, researchers from two museums hold permits for reconnaissance with limited collection (surface disturbance is limited to one

square meter) within the B/DNZ. Recent surface collections have produced some remarkable finds, such as the complete *Parasaurolophus* crest (Sullivan and Williamson 1999) that was recently used to speculate on the sound of possible dinosaur "calls" (Diegert and Williamson, 1998). By BLM policy, excavation permits are considered only on a case-by-case basis.

The Role of Wilderness in the Management of Paleontological Resources

Though few areas in the current National Wilderness Preservation System have significant paleontological resources, this is expected to change as additional areas under the jurisdiction of the Bureau of Land Management are designated by Congress. Prior to 1998, no paleontological excavations are known to have been conducted in any unit of the National Wilderness Preservation System after their designation—a condition that also may be expected to change. The management of the paleontological resources within the B/DNZ has been a source of some controversy in the past. If we are to avoid such contentiousness as future units are added, a well-reasoned approach to paleontological resources in designated wilderness should be universally adopted.

Section 4 (b) of the Wilderness Act states, "Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of...scientific...use." Traditionally, this has been interpreted as scientific use that is dependent on wilderness conditions—usually for the benefit of the natural values of wilderness. Neither is the case in paleontological research. It does not improve the management of the wilderness (the time frames of paleontology are many orders of magnitude too coarse for day-to-day—or even century-to-century—practical application), nor does it need the conditions of wilderness to be conducted (but, rather, simply the presence of fossils). When a wilderness contains the significant fossil resource present in the B/DNZ, however, paleontological research must take place within the Wilderness or not at all.

Note, however, that this section begins with the phrase, "Except as otherwise provided in this Act...." Is paleontological research a scientific use compatible with the other provisions of the Wilderness Act?

Arguments that paleontological research may not be compatible with wilderness center on three related points of contention (Berger and others 1990): 1) consumptive or extractive scientific use of a wilderness might seriously affect undisturbed natural systems; 2) removal of paleontological resources destroys their in situ value for professionals and recreationists alike; and 3) the removal of any

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nonrenewable resource from a wilderness negatively affects wilderness character.

It is undeniable that the human removal of a nonrenewable resource constitutes an "unnatural" disturbance of the wilderness ecosystem. However, as is always the case where the wilderness resource meets human technology or anthropocentric designs, unacceptability is a matter of degree. The material removed by collection in any year is a tiny fraction of that eroded away by one day's moderate rain. In the B/DNZ, despite an average annual precipitation of approximately nine inches, the steep slopes and lack of vegetation create high rates of erosion. The isolated (five or six per decade) heavy rains in the Hunter Wash drainage often carry as much as 1½ ton of sediment per second out of the Wilderness. True, one removal is a work of natural process, and the other is not. However, the difference is a matter of effect on the area's "wildness"; the effect on the biophysical resource is negligible.

The in situ value of a fossil is recorded at the time of its discovery. The site is noted and, if further study of the stratum is required at a later date, researchers can revisit the field. Far much more scientific information would be lost if the fossil were not removed for study. It can also be argued that far more educational information would be lost as well, as any fossil is apt to be seen by many more people in a museum setting than in a wilderness. And while the concept of removing part of a wilderness resource in order to preserve it may seem reminiscent of destroying a village in order to save it, permanently preserving fossils in the field is really the worst of both worlds: it is most certainly a constant reminder of human presence, and the addition of a foreign stabilizing chemical to halt erosion is more damaging to the natural system than simply hastening erosion by removal of the specimen.

This is far from recommending that all fossil material should be removed from wildernesses. Paleontologists at the New Mexico Museum of Natural History and Science expect that 95% of all fossil material will remain to delight and fascinate the wilderness recreationist.

Assuming research is conducted to minimize social impacts, the only lasting loss to the wilderness is something of its innately wild character—that mystical and primeval, quintessentially American, intangible quality that touches wilderness visitors and non-visitors alike. At its essence, wilderness is a place for the primitive. Justification of paleontological research in wilderness does not mean that wilderness stewardship responsibilities should be subservient to the science of paleontology. On the contrary, paleontological resources of areas such as the B/DNZ are a supplemental value of the Wilderness, and land managers must ensure that this particular community of life remains "untrammeled." As the science of paleontology serves only the human intellect, placing a wilderness resource at the mercy of this science would in fact be hobbling it to human use.

It is not the intent of this paper to downplay what could prove a very real loss, though it is perhaps important to remember that this loss of the primitive is every bit as anthropocentric as the gains in paleontology. Linda Merigliano, as reported by Parsons (1998), has framed the essential question: "How far should we deviate from 'wildness' to accommodate science?" It is an important question with no universal answer. Certainly, when the wilderness is

not necessary to the science, the answer is "not at all." But this is not always the case. In order to minimize impairment to the resource of "wildness" itself, the principle of the minimum tool must be rigorously applied to all research in wildernesses. While often synonymous with the "primitive tool" that would preserve wilderness resources, balance with the social and biophysical resources must also be considered when deciding upon the "minimum" tool to be used in a designated wilderness.

Therefore, paleontological research in designated Bureau of Land Management Wilderness should be subject to the following conditions:

- 1) Collection of any paleontological materials (not just vertebrate fossils, as is the case presently) will be permitted only with the approval of the BLM state director.
- 2) Approval will be granted only for scientific research or public education, and all collected material must be housed in an approved repository.
- 3) Necessary qualifications of the applicant will be determined by a BLM regional paleontologist in the permitting process.
- 4) Survey permits will be issued to monitor the paleontological resource of wilderness areas. These surveys will be used to identify new sites or sites that are at risk, and the potential for further research. It is expected that approximately 5% of the fossil material located on the surface will be collected during a survey; however, certain types of fossil material (such as teeth) will almost always be collected. Surface disturbance is limited to one square meter, with the disturbed depth no greater than 30 cm, within a 10-meter square area. Any greater disturbance would only be allowed under an excavation permit.
- 5) Excavation permits will be issued only on a case-by-case basis and after an Environmental Assessment determines that the proposed action will not degrade the overall wilderness character. Excavation decisions will be made following a logical and reasoned consultation between BLM wilderness specialists, BLM paleontologists, and outside experts in paleontology and wilderness management as needed to make an informed decision. Factors that will be considered in an Environmental Assessment are:
 - a) rarity or significance of the species;
 - b) rarity or significance of particular bone(s) found;
 - c) degree of completeness (whole skeleton or element);
 - d) state of preservation;
 - e) potential for providing new or additional information on the species, or paleoecology;
 - f) amount of disturbance to the other wilderness resources in relation to the benefit of recovery;
 - g) degree to which the fossil is at risk of loss due to erosion or vandalism; and
 - h) logistical difficulty in removal.
- 6) Any research will be conducted under the principle of using of the minimum tool. That is, "...except as necessary to meet the minimum requirements for the administration of the area for the purpose of [Wilderness],...there shall be no...use of motor vehicles, motorized equipment,...no landing of aircraft,

[and] no other form of mechanical transport...." (The Wilderness Act, Section 4 (c)). Analysis of what constitutes the "minimum tool" for any proposed action means balancing the impacts to three central, inter-related wilderness resources. First, what effect will the proposed action have on the biophysical resource, the wilderness lands designated "for preservation and protection in their natural condition" (The Act, Sec. 2 (a))? Second, what effect might it have on wilderness visitors, their experience of "solitude or a primitive and unconfined...recreation" (The Act, Sec. 2 (c))? And finally, what is its effect on the resource of wildness; i.e., what is the proposed action's effect on the tendency of "growing mechanization [to]...modify all areas" (The Act, Sec. 2 (a)), and does the area "retain its primeval character and influence" (The Act, Sec. 2 (c)) both during and after the proposed action?

In practical terms, some of the minimum tool restrictions on paleontological research should include:

- a) Any permit proposing research that could be conducted outside the Wilderness will be denied;
 - b) All survey permits will allow access only on foot or horseback;
 - c) Excavations will usually be conducted by hand tools only, by a team whose size may be limited and whose access to the site will be by foot or horseback only; and
 - d) A minimum tool analysis will be performed to determine the approved methods for removal of the specimen.
- 7) All collection must be conducted in a fashion that leaves the site in a substantially unnoticeable condition. This will be accomplished by a combination of backfilling, re-contouring, raking the surface, and—where necessary—revegetating the disturbed area to match the color, line, texture, and contrast of the surrounding, unexcavated land.

Practical Application of Wilderness Paleontological Excavation Theory _____

In early 1998, as a result of discoveries found during permitted surface reconnaissance in 1997, the first permit for a paleontological excavation in a designated wilderness was requested by the New Mexico Museum of Natural History and Science (NMMNH), under the direction of Curator of Paleontology Thomas E. Williamson. Dr. Williamson proposed to excavate three separate paleontological localities during the 1998 field season (late May through mid September):

- L-3503: skull of *Pentaceratops sternbergii*
- L-3506: partial skeleton of a large tyrannosaurid
- L-3522: partial skeleton of a hadrosaur

The find in locality L-3503 was deemed extremely rare. *Pentaceratops sternbergii* is known only from the San Juan Basin, and only six whole or partial skulls are known to have been collected. The specimen in this locality appeared to include a nearly intact and undistorted frill margin—a feature so preserved in only one other specimen. Additional specimens of *Pentaceratops* are necessary to document variability within the taxon and its relationship to other ceratopsian dinosaurs. New specimens collected with accurate geographic and stratigraphic data will help document the spatial and temporal distribution of these animals and

increase knowledge of Late Cretaceous paleoecology. In addition, NMMNH does not have a *Pentaceratops* skull on display or in its collection; therefore, the specimen in L-3503 was expected to have great public educational value.

Only two partial skeletons of tyrannosaurids, such as the one in L-3506, had been collected from the Kirtland Formation of New Mexico. It was unknown whether the L-3506 specimen was an *Albertosaurus*, "common" in the northern Rockies, or from one of two poorly known genera—*Aubysodon* or *Daspletosaurus*. The extreme rarity of this specimen made it of exceptionally high scientific value. If the specimen was found to be relatively complete, it was expected to go on display at the NMMNH, giving it great public educational value as well.

Only one relatively complete hadrosaur skeleton had been previously collected from the San Juan Basin, the holotype of *Parasaurolophus cyrtocristatus*; fewer than ten partial skeletons had been reported worldwide. L-3522 includes several disarticulated but apparently associated ribs and vertebrae. It was believed there may be other skeletal elements still buried at the site. Again it was argued that new specimens collected with accurate geographic and stratigraphic data will help document the distribution of these animals and increase knowledge of Late Cretaceous paleoecology.

Given the rarity and significance of these finds, an Environmental Assessment was prepared on the NMMNH permit. Following the reasoning outlined above, the permit was approved. Both to lessen impacts to the Wilderness and for ease of their operations, NMMNH researchers planned to camp outside the Wilderness on land managed by the State of New Mexico. In addition, BLM applied a variety of stipulations to protect wilderness resources:

The project areas and access routes were largely unvegetated. However, to reduce the loss of plant species of special concern in the camping area, NMMNH was required to show BLM that they had obtained authorization from, and met the requirements concerning protection of vegetation of, the State of New Mexico for the camping areas.

Likewise, no cultural sites were found on the surface in any of the project areas. However, without careful campsite selection, cultural sites found in the camp areas could be disturbed. To reduce the disturbance of cultural sites, NMMNH was required to show BLM that they have obtained authorization from, and met the requirements concerning protection of cultural resources of, the State of New Mexico for the camping areas. In addition, if any cultural resources were discovered during excavation, BLM required that all work at that site would stop and a Farmington District Office archaeologist be contacted for further direction.

To reduce the impacts on the ferruginous hawk (*Buteo regalis*), a species easily disturbed by humans and known to nest in the B/DNZ, NMMNH was required to:

- a) travel at least $\frac{1}{3}$ mile from any nest identified in the April 1998 BLM survey of project areas and access routes;
- b) camp at least $\frac{1}{2}$ mile from any nest; and
- c) if a nest was found within $\frac{1}{2}$ mile of any of the three fossil localities, postpone excavation at the affected localities until after the end of the ferruginous nesting season (July 15). (Note: no nest was found within this buffer zone.)

Post-Excavation Analysis _____

NMMNH was required to conduct their research under the principle of using the minimum tool:

- a) daily access was allowed only on foot;
- b) all materials had to be carried in without the use of carts or other wheeled conveyances;
- c) excavations were conducted by hand tools only; and
- d) the use of a helicopter was considered the minimum tool for removal of these fossils.

[While a helicopter certainly is not primitive, and its use degrades the resource of wildness, other means (packing out by hand, by horse, or by wagon) were impractical due to the weight of the specimens, impractical due to the topography and geology of the localities, and would have created greater negative impacts to the biophysical resources. To minimize the social and biophysical impacts of helicopter flights, use was limited to one day for all three localities combined, and after ferruginous hawk nesting season ended. NMMNH arranged for the National Guard to fly out the field-prepared fossils.]

To reduce the effects of soil compaction or other disturbances of the natural soil regime, NMMNH was required to:

- a) travel on existing cow trails or wash bottoms, where possible;
- b) stockpile separately any different soil horizons encountered during excavation, and preserve the integrity of these strata during rehabilitation of each locality;
- c) rehabilitate the sites to a substantially unnoticeable condition, using a combination of backfilling, re-contouring, and raking the surface to match the color, line, texture, and contrast of the surrounding, unexcavated land; and
- d) remove from the wilderness (rather than bury) all fragments of plaster or other jacketing material.

Finally, NMMNH was required to provide photodocumentation of the process, from pre-excavation through post-reclamation.

The lack of adequate numbers of wilderness rangers or law enforcement personnel make the BLM ill-equipped to protect the paleontological resources of the B/DNZ given a sudden influx of fossil-hounds. Therefore, although we discussed the public relations coup of posting excavation progress reports on The Web, it was determined that neither NMMNH nor BLM would publicize the excavations in progress. Only those employees or volunteers of either organization that needed to know were informed of the exact localities or the dates of excavation. The Environmental Assessment contained no map. In any post-excavation scientific publicity, the localities were to be described in no more detail than "within the Bisti/De-Na-Zin Wilderness," and the rarity of these particular finds were to be stressed, rather than the ubiquitousness of fossils in the area. The Environmental Assessment stressed that there would be no publicity or public outreach effort made by the NMMNH or the BLM during the time of excavation. Any public affairs or environmental education initiative would be conducted after the fossils were removed from the field and the localities rehabilitated.

Summertime excavations in the high desert proved particularly arduous when conducted entirely with hand tools. As a consequence, the field work took longer than planned, and only two of the localities were collected. Though analysis is far from complete, the results from a paleontological point of view are, so far, as impressive as was hoped (Williamson and Carr 1999). The remaining fossil, L-3522, was collected in the autumn of 1999; NMMNH determined that it was in small enough pieces to be carried out by hand after field-preparation.

Photodocumentation and onsite visits six months after rehabilitation have demonstrated the remarkable capacity of this barren land to heal its visual scars given a heavy precipitation event (which arrived in October 1998). The sites are extremely difficult to find, even for one who had been there during the working period. While the dig was in progress, no ferruginous hawks were disturbed from their nests, and not one visitor happened upon the excavation team.

There was, however, a problem during the helicopter removal of the jacketed specimens. The New Mexico BLM State Office's Public Affairs department had heard about the dig and, without contacting any field personnel or their own state office wilderness coordinator, or even reading the Environmental Assessment, orchestrated a media extravaganza. The day of the removal, rather than only one National Guard helicopter showing up, a second one filled with video cameras and members of the press flew in to take spectacular footage. In addition, a third helicopter arrived, owned by a television station that wanted its own visual angle on the proceedings. Once at the staging area outside the B/DNZ, where the fossils were to be loaded on trucks for the haul to Albuquerque, the press helicopters were informed they could not land within the Wilderness. Consequently, they created no short-term biophysical resource impacts. (It is not known what long-term impacts, in the form of increased vandalism of paleontological specimens due to the additional popular exposure, might accrue, but these are probably slight.) On the day of the removal, six parties of visitors signed in at the voluntary registration box approximately four miles from the nearest locality. None mentioned the helicopters in their comments, and none complained, so perhaps the social resource impacts were entirely tolerable. But as Merigliano asks, "If visitors don't complain, is it OK?" (Parsons 1998). Certainly, the added helicopters further degraded the resource of wildness. And it was a degradation that was both entirely avoidable and seemingly incomprehensible to most of those involved.

Conclusions _____

The Wilderness Act states, "Except as otherwise provided in this Act, wilderness areas shall be devoted to the public purposes of...scientific...use." This traditionally has been interpreted as a support for scientific use that is dependent on wilderness conditions, and usually for the benefit of the natural values of wilderness. Paleontological research does not improve management of the wilderness (unless one considers the not-insignificant indirect benefit of this science's

popularity increasing support for wilderness protection). Nor does paleontological research require wilderness conditions. Quite the contrary, wilderness conditions make paleontological research all the more difficult. But when a wilderness happens to contain significant fossil resources, paleontological research must take place within that wilderness or not at all. Indeed, the supplemental value of its paleontological resources may be one of the reasons that particular wilderness was added to the National Wilderness Preservation System.

By applying stringent mitigating measures, very real social and biophysical impacts to wilderness by paleontological research can be minimized. Can the wilderness accept some degradation of wilderness? Again, with mitigation, these impacts, though real, may be acceptable. Managers must remember that one of the greatest threats to wilderness is their tendency to rationalize tiny actions that chip away at these unique areas. Given that, paleontological research can be conducted in such a way that the gains in knowledge and support outweigh the losses.

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