



Change assessment of the Gallatin Petrified Forest, Montana
by James Roy Wilbur

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in
Earth Sciences
Montana State University
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Abstract:

The Gallatin Petrified Forest of Montana is a unique national resource. The extensive area of the fossil forests, the numerous petrified trees in upright positions, and the large number of vertical layers of "successive" forests is unparalleled in the world. Although a policy of collection by permit is presently in place, damage to outcrops of the petrified forest by indiscriminate collection is occurring. To assess the impact of this collection policy, a comparative examination of replicate photography of selected outcrops over a time period of 13 years was undertaken. This was followed by a field check of each outcrop to determine status, present condition, and to map its exact location. Results were then tabulated to determine the extent of changes or impacts over time and the locational factors related to these changes. Statistical tests were conducted to determine the relationship of these factors to the amount of natural- and human-induced change.

It was found that although considerable loss had resulted from collection since the policy was implemented, impacts were more severe before the policy existed. Natural erosion had a greater impact than human-induced change, but human impacts were additive to the natural changes. Size and slope of petrified outcrops were directly related to the amount of natural change occurring over time. Human-induced change was associated with the distance of the outcrops from the main trailheads and the outcrop size. Tests were inconclusive in demonstrating a relationship between change and the distance of an outcrop from a main trail or any elevation-based factor. This method for assessing change in the petrified resource provides a tool to continue monitoring impacts and evaluating future policy.

An analysis of the known outcrops through the use of low and high altitude photographs determined a spectral reflectance value for locating outcrops. An interpretive trail has been suggested to provide visitors with an accessible and informative viewing opportunity. Recommended changes in present management policy included expanding and clarifying the definition of outcrops protected from collection, making collection permits more available, posting of collection regulations on all trails in the area, and greater supervision of the area by U.S Forest Service personnel.

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APPROVAL

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James Roy Wilbur

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style and consistency, and is ready for submission to the College of Graduate Studies.

3-6-90
Date

Katherine Hanson Buxton
Chairperson, Graduate Committee

Approved for Major Department

3-7-90
Date

Steph G. L.
Head, Major Department

Approved for the College of Graduate Studies

3/16/90
Date

Henry J. Parsons
Graduate Dean

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ABSTRACT

The Gallatin Petrified Forest of Montana is a unique national resource. The extensive area of the fossil forests, the numerous petrified trees in upright positions, and the large number of vertical layers of "successive" forests is unparalleled in the world. Although a policy of collection by permit is presently in place, damage to outcrops of the petrified forest by indiscriminate collection is occurring. To assess the impact of this collection policy, a comparative examination of replicate photography of selected outcrops over a time period of 13 years was undertaken. This was followed by a field check of each outcrop to determine status, present condition, and to map its exact location. Results were then tabulated to determine the extent of changes or impacts over time and the locational factors related to these changes. Statistical tests were conducted to determine the relationship of these factors to the amount of natural- and human-induced change.

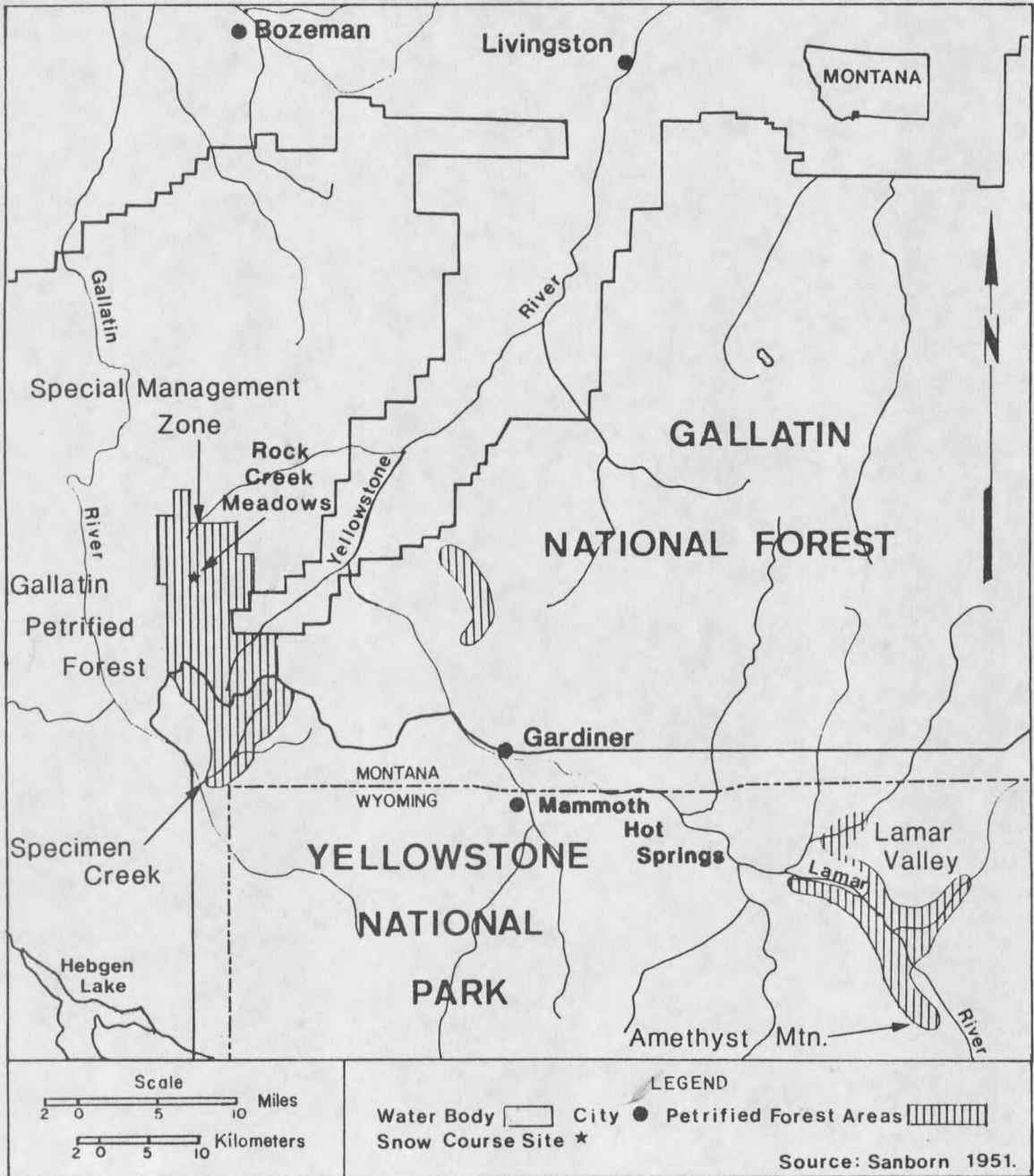
It was found that although considerable loss had resulted from collection since the policy was implemented, impacts were more severe before the policy existed. Natural erosion had a greater impact than human-induced change, but human impacts were additive to the natural changes. Size and slope of petrified outcrops were directly related to the amount of natural change occurring over time. Human-induced change was associated with the distance of the outcrops from the main trailheads and the outcrop size. Tests were inconclusive in demonstrating a relationship between change and the distance of an outcrop from a main trail or any elevation-based factor. This method for assessing change in the petrified resource provides a tool to continue monitoring impacts and evaluating future policy.

An analysis of the known outcrops through the use of low and high altitude photographs determined a spectral reflectance value for locating outcrops. An interpretive trail has been suggested to provide visitors with an accessible and informative viewing opportunity. Recommended changes in present management policy included expanding and clarifying the definition of outcrops protected from collection, making collection permits more available, posting of collection regulations on all trails in the area, and greater supervision of the area by U.S. Forest Service personnel.

INTRODUCTION

The Gallatin Petrified Forest, located in the Greater Yellowstone Ecosystem, is one of the most extensive and diverse forests of petrified trees in North America (Figure 1). The Gallatin Petrified Forest is a national resource that is exceptional in its unique characteristics. These characteristics include a large area with a diverse geography of fossil forests, a large number of petrified trees in upright positions, and numerous vertical layers of "successive" forests. In 1935, Chapman and Chapman (1935) wrote a popular description of the Gallatin Petrified Forest extolling its "abundant displays" and bemoaning its neglect due to inaccessibility and its proximity to the more widely publicized and accessible Lamar River area in Yellowstone National Park. Fisk (1976) comprehensively described the petrified forests in the Gallatin Range and agreed with Chapman and Chapman's (1935) observation of neglect due to the locality's isolation. Damage to outcrops by indiscriminate collection is referred to by several authors (Knowlton 1899; Chapman and Chapman 1935; Sanborn 1951; Ritland 1968; and Dorf 1980), however a quantification of the damage or amount of resource change over time of the resource has not been done to date. Sollid (1973) mapped a general area of petrified outcrops

Figure 1. Location Map of Gallatin Petrified Forest within the Greater Yellowstone Ecosystem, South-central Montana.



in the Porcupine Creek watershed and discussed management problems associated with commercial collection of specimens in the area outside the Park. Collection of specimens presently requires a permit, however no monitoring system has been established to measure the effect of loss of the resource resulting from this collection. Knowledge of the precise location and geographic extent of the forest is very limited and with collection allowed, the impact of the collection policy is unknown.

Management Policy

Prior to 1973, the Gallatin Petrified Forest within the Gallatin National Forest was managed with few, if any, guidelines. Collection of specimens was unrestricted and open to everyone, allowing unlimited exploitation. Collection for commercial purposes and by others occurred with reports of the use of excavating equipment, vehicles for transport, and dynamite. The use of these methods possibly caused significant damage to the petrified wood specimens as well as to the vegetation and soils of the area.

Concerned with the exploitation of this limited resource, the U. S. Forest Service, after several public meetings and an environmental analysis report, established the Gallatin Petrified Forest Special Management Zone in 1973 (Figure 1). Regulations (Appendix A) restricting

collection and use of the land within the Special Management Zone (SMZ) were implemented. Prior to adoption of these regulations the merits of prohibiting all collection of petrified wood in the SMZ were debated and considered by the U. S. Forest Service. The decision, however, to allow "hobbyist" collection was in part due to the fact that there was considerable public interest in allowing some form of collection of petrified wood to continue. The SMZ borders Yellowstone National Park to the south and the portion of the Gallatin Petrified Forest within the Park is protected against all forms of collection by Park Service regulations.

Photographic Survey

Having established the Gallatin Petrified Forest as a Special Management Zone, the U.S. Forest Service initiated a program of resource inventory in the SMZ. To accomplish this the U.S. Forest Service acquired the services of a volunteer, Theodore Van Dyne, in 1975 to search for petrified wood outcrops within the SMZ. The area Van Dyne surveyed was south of Trail Creek Trail to the Yellowstone National Park boundary and from the Gallatin Range central divide east to Specimen Ridge (Figures 2 and 3) (included portions of sections 22, 23, 24, 26, 27, and 35 of Township 8 South, Range 5 East). Once specimens were located, the volunteer numbered and photographed the outcrop and

indicated its location on an aerial photograph. Van Dyne took approximately 170 photographs and labelled 92 sites (he grouped two or three specimens in close proximity under one site number). Five years later, in 1980, a second volunteer, George Shabel, was recruited to go back and rephotograph the first series and to inventory a new area. This new area was the area adjacent to the trail from Buffalo Horn Pass to Ramshorn Peak and the southern slopes of Ramshorn Peak (Figure 2) including portions of sections 10 and 15 of Township 8 South, Range 5 East. At this time only 62 of the original 92 sites were located and rephotographed. At one site (#2-27), Shabel indicated evidence of exposed digging at nearly a dozen "medium size" pits where petrified wood has been removed and he witnessed a man hammering at one standing specimen.

In 1981, two volunteers, Mark Dosman and Ed Domanski, inventoried a third area. This area was located north of Trail Creek and Tom Miner Campground primarily on the southern face of the ridges of this area and in the Dry Creek drainage (Figure 2) including portions of sections 10, 13, 14, and 15 of Township 8 South, Range 5 East. They inventoried 71 sites. In 1985, a fifth volunteer, Ed Sparks, returned to the area of the 1975 survey to rephotograph the specimens he could locate. He was only able to locate and rephotograph approximately 40 of the previous sites, but added about 55 new sites. Unfortunately he

Figure 2. Map of Northern Part of Study Area in T.8S., R.5E. (USGS 1986).

