you're using doesn't give you definitive answers; it suggests the places where you should look first for problems.

BG: Yes, it's called qualitative modeling. This is not a quantitative population model, the kind that we hear the most about, where you put some numbers in and you crunch them and you get some numbers out. This type of analysis is totally dependent on the interaction that occurs among groups of organisms.

YS: Can you summarize that in a non-technical way?

BG: Think of it this way. Organisms can act either positively or negatively on each other, or there is no interaction. In any system, you have different levels of interaction, from the levels where the interactions are simple to those where they become more complex and less predictable, which is what happens as you add predators to the system. And so what we tend to see in these ecological systems—and this is one of the things that we need to understand better in Yellowstone Lake—is that one consequence of added predator-prey links is increased oscillations that slow the recovery from disturbance.

YS: Models concerned with system stability and its relationship to system complexity have been a hot topic among ecologists for quite a while. How does this apply in Yellowstone Lake?

BG: Well, with loop analysis, you're not going to get a final prediction of how many lake trout there will be, or at what level they're going to stabilize. What you do is focus on whether the system is going to be stable. If you can develop a set of scenarios, then you can ask the model to experiment with different scenarios; by changing various aspects of the interactions you can watch how that system reacts. And that is why I say this competition between cutthroat trout and lake trout is so important. New competition changes things dramatically in the system, and so we ought to know, or at least not just be guessing, about what that will mean in the long run. And that is where this model is very useful, because you can learn a lot about the potential changes, and not have to wait 20 years.

YS: Of course there are more than cutthroat trout and lake trout in the lake. Not much has been said about what might happen to the other fish species.

BG: I think that may actually be the worst part about it. If the lake trout acts as a generalist predator, and is able to prey on all the other species, then it isn't dependent upon the cutthroat. That means that if cutthroat numbers go down, the lake trout just switches prey. Doing that, it can maintain itself at a higher level and higher density than it can if it's feeding just on cutthroat trout.

YS: We know something about the natural history of all those other fishes, including the non-native ones. Can't we predict anything about which ones the lake trout is liable to favor right off?

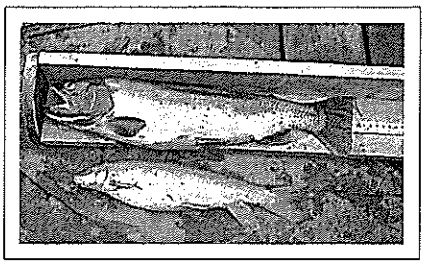
BG: It's hard to say, because of the thermal stratification issue.

YS: Explain thermal stratification.

BG: Well, the lake trout are very sensitive to temperature; they're rarely found at much above 60°F. Each year, the lake stratifies, meaning that from top to bottom there are three different temperature zones. The warmer upper waters are called the epilimnion, the middle zone of rapidly decreasing temperature is the thermocline, and the bottom zone, called the hypolimnion, is a broad deep area of water ranging from 34° to 48° F. After the lake stratifies in early summer, lake trout move down below the thermocline to the hyperlimnion and stay there. But they do make feeding forays up through the thermocline and into the epilimnion and shoreline areas looking for food.

The lake is usually only stratified from mid-July through mid-September, so you're talking about a 60- to 90-day period during which the lake trout are distinctly separated from the cutthroats that favor the warmer, shallower water. The early-season angler harvest this year clearly showed that the lake trout were in the shallower water for a while between ice-out and the advent of thermal stratification, and then just disappeared from the harvest as they moved down below the thermocline. Redside shiners and lake chubs hang around in the shallower lagoon areas of the lake, and the juvenile lake trout might go after them there. Although big lake trout don't usually enter shallow water except during spawning, the scientific literature suggests they will if food is scarce.

YS: That leaves the long-nosed sucker, another non-native, as a potential prey species.



Cutthroat trout (above) and long-nosed sucker from Yellowstone Lake.

BG: The long-nosed sucker would certainly be a prime candidate in the deeper water during the summer.

But the other thing that is very worrisome about this whole situation is that its effects don't just involve the different fish species and how they will deal with each other. When you talk to the people who work in places where cutthroat were present and lake trout were introduced on top of them, the cutthroat virtually disappeared—not completely in all cases, but statistically they might as well have been gone. If that happens here in Yellowstone, we can hardly imagine all the ramifications.

YS: Imagine a few of them for us.

BG: Start with the vertebrates. What will happen to the mammals that depend upon those fish?

YS: Nothing good, it appears. The grizzly bears have spent the last 25 years readjusting to feeding on the cutthroat spawners, and the trout have become a significant food source.

BG: I think the effects on the avian predators may be even greater. There is a whole community of birds that moves into the Yellowstone Lake area during the breeding season, and without the cutthroat, reproductive success may plummet. A really important thing that we have to realize is that the lake trout will not replace or substitute for the cutthroat as prey for all these birds.

YS: We're already hearing casual talk about the lake trout as a "replacement" for the cutthroat trout, from people who don't know much about trout natural history; they somehow think that one fish is the same as another, but the differences are profound in this case. We know that the lake trout won't be available to any of the birds except maybe the cormorant,

which dives very deep. Lake trout spawn in deep water during the late fall, so they won't replace the cutthroat trout spawning runs that the bears and other mammals feed on in the lake's tributary streams. Lake trout aren't the same as cutthroat trout, and they won't serve as an ecosystem replacement species.

BG: I think it's really important to get that message across. For one thing, the fishermen will be quick to grasp what it means to the future of fishing. Those thousands of people who fish Yellowstone Lake now don't have the equipment to fish for lake trout, and probably aren't interested in trying.

YS: It's a completely different kind of fishing.

So far, we've mostly been talking in generalities about how lake trout and other species might interact. But you've spent half your life studying the specifics of the life history of these cutthroat trout, and that natural history has a lot of implications here.

BG: We have found it useful to imagine the cutthroat trout in Yellowstone Lake as a complex metapopulation.

YS: A what?

BG: A metapopulation is essentially a group of subpopulations that interact but are isolated enough in reproduction that they develop distinct characteristics. There is some genetic exchange between these subpopulations over time, and they might blink on and off as the habitat blinks on and off.

YS: How do subpopulations appear?

BG: By adapting to the specific habitats in spawning tributaries and different parts of the lake. Because cutthroat trout return to spawn in the same stream in which they were born, over time members of the individual subpopulations must adapt to conditions in the specific tributary they use for spawning. One study done on homing behavior in Yellowstone Lake took place in Arnica Creek. About 25 percent of the fish that were marked returned to Arnica Creek to spawn. None of them went anywhere else. It wasn't a big study—only about 600 fish—but all the spawners returned to Arnica Creek.

Another kind of homing is adult homing, where we're looking at repeat spawners. You mark them as they come into a stream the first time and see if they come back in subsequent years. That is how we know there is about one or two percent straying to different streams. On the other hand, we can't even be positive about that one or two percent. For all we know, the true straying rate is closer to zero; just because they enter the stream doesn't mean they stay and successfully spawn. For example, salmon do what's called "proofing" a stream, which means they might swim up the stream, kind of check it out, and then swim back down and eventually end up in another stream to spawn.

YS: So, the subpopulations of cutthroat trout in Yellowstone Lake—are they identified solely through where they go to spawn, or do some of the spawners from several streams end up congregating in one part of the lake and get identified also as a subpopulation in that way?

BG: When we analyzed different spawning runs and looked at the timing of the spawning from location to location, certain characteristics, such as the size and aspect of the drainage, accounted for two-thirds of the variation in when the fish moved into the stream to spawn. So that would suggest that these fish are keying into hydrological characteristics of a specific drainage basin. We would expect something like that; it's intuitively sensible. On the other hand, those same two characteristics also explained about two-thirds of the variation in the size of the fish, and this was somewhat harder to understand. It's more complicated than that. You see, when you talk about aspect in a more or less circular lake basin, you're not only talking about the orientation of the stream drainage, but also the location of the stream in the lake basin. It was obvious, however, that it wasn't directly related to stream size, the biggest fish were not found in the biggest streams or vice versa. Hydrology is important, but so is the location of the stream along the lakeshore. When we examined data from the lake, we found that fish size differed from one place to another. Further analysis showed that size and growth were linked to differences in general productivity in different parts of the lake.

So even when they're in the lake, it appears that there are *lake* subpopulations of this meta population that kind of hang out together. There is some tagging data from the 1950s that support that interpretation. The fish displayed a good bit of loyalty to an area of the lake, just as they did to their spawning stream. The integrity of the individual subpopulations, that is the extent to which they are devoted to one area, seems highest in the arms of the lake and in West Thumb.

We need to know more about that, and we now have some potential new techniques for learning more. We've been working with Jerry Smith at the University of Michigan on using the microchemistry of the otolith, a small bone in the fish's head. Smith has discovered that when the otolith is forming in the fish, it develops a permanent chemical "fingerprint" that can be identified with the stream where the fish hatched. If we can work out the technique, suddenly we have a situation where every fish we capture can be traced to its stream of origin.

YS: For more than half a century, Yellowstone Lake was operated like a huge trout factory. Millions of eggs and fish were removed, and many other fish were moved around in the lake and elsewhere in the park. This raises the question of how much we have already altered these subpopulations. Not only did we overharvest them for decades, we tinkered with them genetically by scrambling the spawn. Is there any way we can track that and figure out how much change we caused?

BG: Intuitively it seems we may have lost components of the metapopulation that may never come back; the whole idea of chaos theory is that where you get to depends on where you start, and Yellowstone Lake has never before been like it is now, so how can we expect it to restore itself completely to some past state?

Besides that, the environmental conditions are always different. We now have a new non-native predator—the lake trout—with great potential for changing things. And even before the lake trout got there, there were the other non-native fish introduced. For all we know, there was once a Yellowstone cutthroat trout subpopulation that lived in the shallow lagoons but they were excluded by all the non-native minnows that we introduced in the early 1900s.

But I also think there is tremendous

resilience in the metapopulation. When you consider that we are now approaching 40 years since the hatchery was closed, and remember that the lake's powerful selective forces are based on things we didn't affect much, such as hydrology and prey base and the lake's physical characteristics, it would seem that the trout populations would sort themselves out.

YS: So even if the metapopulation and the subpopulations aren't identical to what they would have been if we hadn't interfered so much the past 100 years, they're still cranking along in a viable wild system?

BG: Something like that.

YS: Back to the variations that the lake cutthroats display: you've stressed the complexity of the system. Can you give an example?

BG: A really obvious one is the outlet stream: the Yellowstone River itself. Those fish had to develop a mirror image of the spawning behavior of the fish that spawn in tributary streams, because adults actually go *down*stream to spawn, and the young fry swim back *up*stream to get to the lake. That's just the opposite of what all the other cutthroat trout in Yellowstone Lake do; all the others go upstream to spawn, and downstream to the lake.

But I think that Pelican Creek and the upper Yellowstone River probably provide the most complex examples of all. When you look at the whole Yellowstone Lake basin, with dozens of spawning streams, you see everything from tiny streams less than a kilometer long to big streams like Pelican Creek, to real rivers like the Yellowstone above and below the lake. The larger ones, like Pelican Creek, especially, and also the upper Yellowstone, are so much more complex. They have many tributaries of their own, and large, diverse basins. For example, my guess is that there are fluvial [*river-dwelling*] populations in the upper Yellowstone that have very little contact with Yellowstone Lake, just like there are trout in the river below the lake that never leave the river. There are probably all kinds of combinations of fish spending different versions of their life history in that upper Yellowstone River basin.

The same with Pelican Creek. We found some incredibly complex things going on there when we were tagging fish during the spawning runs. We had more fish coming out than we had going in, and they weren't all just two-inchers making their first trip down to the lake. We had sub-adult fish, 13 and 14 inches long, coming out of Pelican Creek in the spawning season; these were fish that had never spawned. Those fish had probably been living in the creek several years, and were making their first trip out to the lake. We also saw fish going up into Pelican Creek that weren't mature. They showed no sign of being ready to spawn. Maybe they were going up there just to prey on young cutthroat, or some other species.

One of the most unusual situations around the lake is what's happened at Sedge Creek. Sedge Creek is a tributary that has been isolated from Yellowstone Lake for about 8,000 years by a thermal area that acts as a barrier between the lake and the creek. Genetic studies of the trout in Sedge Creek show that it's like they all came out of a stamp mill. They're identical, no genetic variation at all. The population geneticists would say that that's a prescription for extinction, because if any random event threatened them, there would be no flexibility to deal with it and they'd perish. Well, that may be true, but in the meantime they've been highly selected for exactly the habitat they're in.

One of the things that is interesting about all of this is that even when you look at the Yellowstone cutthroat trout across its whole range, there isn't much genetic variability. For years people have argued that "a Yellowstone cutthroat is a Yellowstone cutthroat is a Yellowstone cutthroat." Yet there is a lot of variation in their life history, depending upon what they have had to adapt to, including all the things we've talked about: hydrology, food, chemistry, and so on. Yellowstone cutthroats just haven't been separated from each other long enough to display the genetic variability measured by the most commonly used analytical techniques.

Westslope cutthroats, on the other hand, have a tremendous amount of genetic variability, possibly because during the Pleistocene they were divided up into small isolated pockets here and there. That didn't happen to the Yellowstone cutthroat.

YS: The young cutthroats in the lake are an important part of this story, because of their unusual vulnerability. For 10,000 years or so, they didn't have to worry much about being preyed upon by a bigger fish, and now suddenly they do, and they're not prepared for it. Can you explain how that works?

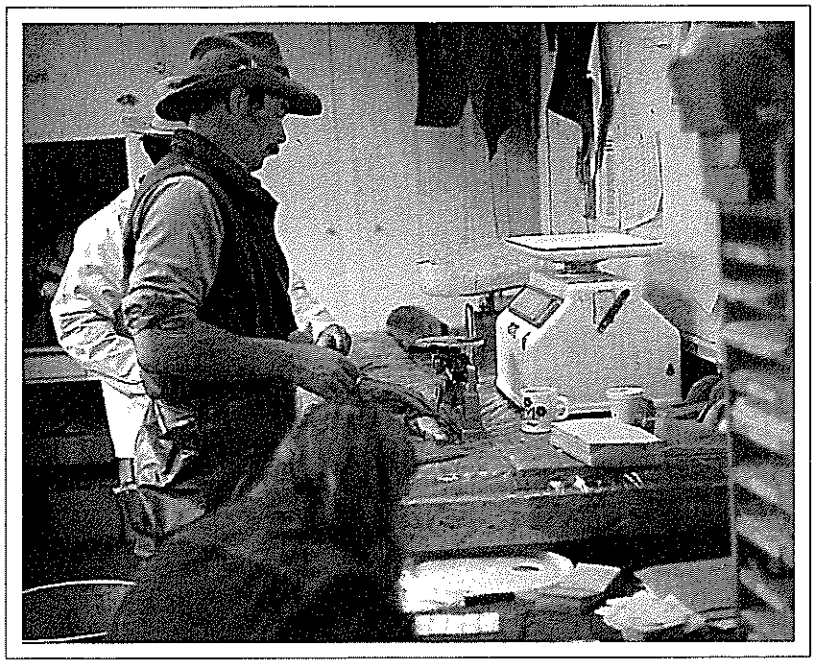
BG: In general, a month or two after they hatch in the tributary streams, the young larval cutthroat trout leave the gravel and move back to the lake. Once they enter the lake, the majority of them move into open and deep water areas, where they feed primarily on crustaceans and zooplankton. As they grow older and mature, they need larger food items in order to support this growth, so they begin to move into the more productive littoral [*shallow*] zones of the lake. They still feed on plankton, but aquatic insect larvae and adults become much more prominent in their diet.

YS: At what size do the cutthroat trout switch from eating zooplankton and start taking aquatic invertebrates?

BG: Somewhere between 13 and 14 inches, which is why the 13-inch maximum size regulation works on Yellowstone Lake. If they had picked 14 inches as the maximum size limit, there would have been too many fish harvested because there would have been too many available.

By the way, food habit studies have shown another interesting variation in the lake's cutthroat trout populations. In some of my research, we looked at the percent of the littoral zone in various areas of the lake versus the size of the fish in those areas. We found a positive relationship; the areas of the lake with different proportions of shallow water had different size of fish. Where the water temperatures were higher and the water was shallower, the fish were larger. People had suspected that, and they attributed it to angling pressure, but we demonstrated that it wasn't due to angling pressure. It's just one of those interesting dimensions of the lake ecosystem, that it doesn't produce uniform-size trout everywhere.

YS: Back on the subject of the lake trout, this new method of tracing the cutthroat trout raises an interesting question. Could the chemical analysis of the otolith in the lake trout in Yellowstone Lake tell us where they're from?



Bob Gresswell conducting analysis on cutthroat trout at the U.S. Fish and Wildlife Service laboratory at Yellowstone Lake.

Jeff Lutch and Rick Swanker pulling gillnets on Yellowstone Lake. Photos courtesy of Fish and Wildlife Service, Yellowstone Fisheries Assistance Office.

Cutthroat trout spawning at Clear Creek in the park. It is these massive movements of trout into dozens of Yellowstone Lake tributaries that make the fish available and important to many species of predators.

BG: Presumably, if you gave the analyst samples of all the waters in the region from which the lake trout might have come, it could.

YS: Considering all these things we know about the various subpopulations of cutthroats in Yellowstone Lake, can you give us some examples of how those variations will play out in the lake trout situation?

BG: The cutthroat trout that are focused on the lake throughout their life history, in all aspects, may be most vulnerable to predation by the lake trout. On the other hand, things probably won't be as bad for cutthroat trout that live in tributary streams of the lake: part of their lives are going to be more protected because the lake trout don't generally go into the streams. All of the cutthroat trout will be affected by predation to some extent, but in subpopulations in places like the Yellowstone River, Pelican Creek, Arnica Creek, and Beaver Dam Creek, they may do better.

On the other hand, regardless of our model predictions, it appears that if you go in and hit those mature lake trout hard in the lake, like with gillnetting, you can reduce their numbers and reproduction, and it will be good for the cutthroats.

YS: So far, most talk about control of the lake trout has centered on a regular gillnetting program that will concentrate on lake trout. Now that we've had a second season to study the situation, do you see other things that might help with that reduction?

BG: The model suggests that we ought to think a little more seriously about food habits of both species and determining where the lake trout are spawning and ways to interrupt that spawning. It's not clear yet how we can do that, but I think that the first thing we need to do is find out what the adult lake trout are eating: what species do they eat, and at what time of year. Then we need to find out where they're spawning and when.

YS: How do we find that out?

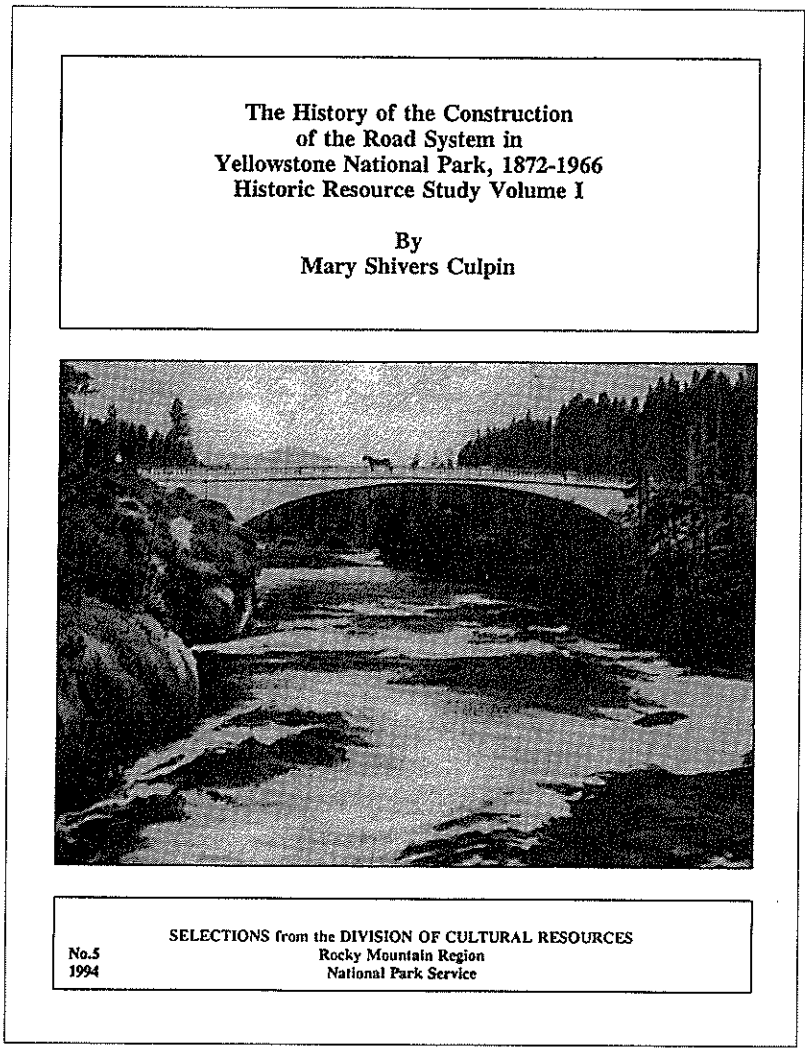
BG: One technique would use what are called "Judas fish:" lake trout that you capture and attach radios to and release. They'll lead you to the spawning areas.

Review Essay

A History of Yellowstone's Roads

by Eric Sandeen

The History of the Construction of the Road System in Yellowstone by Mary Shivers Culpin. U.S. Dept. of Interior, National Park Service, Rocky Mountain Region, 1994, 530 pages.

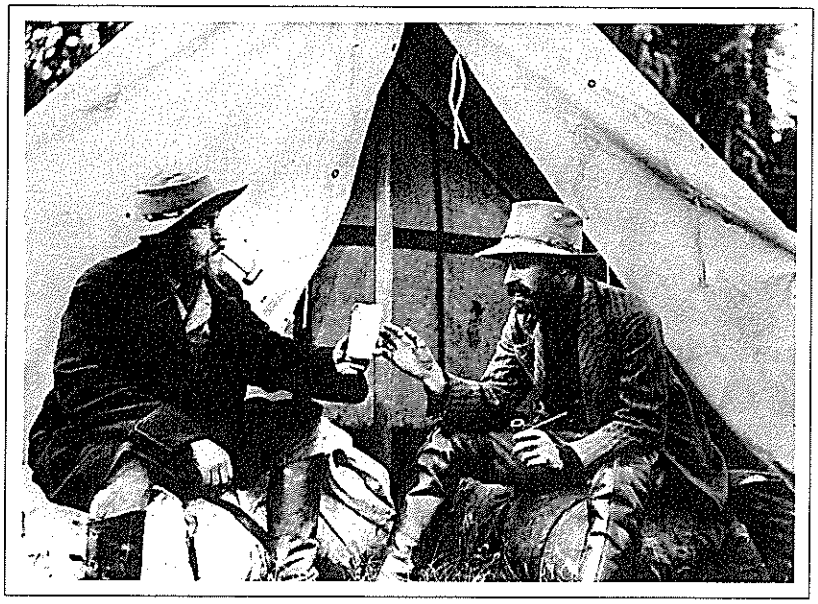


The History of the Construction of the Road System in Yellowstone began as a response to the Federal Highway Administration's multi-decade construction project in Yellowstone National Park. This hefty volume was intended as a management tool for park personnel, even though it was commissioned only to meet the compliance needs of the National Historic Preservation Act. In that sense, this is an expansive document, which, through the scope of terrain that it surveys and the detail of its point of view, attempts to create a basic resource for those interested in historic preservation, cultural and natural landscapes, ecology, and park development.

In another sense, however, the volume retreats from a level of interest to which it does not feel that it can lay claim. Academic historians, Mary Shivers Culpin informs us, might be put off by the necessary repetition of a government report. While her work will probably not be required reading for seminars, I want to pay special attention in this review to ways in which her work connects with broader cultural concerns—a wider landscape, if you will—especially at the end of the nineteenth century. I wish to suggest that the viewpoints of those of us in universities who look at cultural landscapes complement the day-to-day outlook of "practitioners" who are at work "in the field." To play with a metaphor: it is worth considering how we can create something like an ecology of concern, using specific sites such as Yellowstone as common terrain.

Culpin's work describes the development of the road system from the creation of the park to the implementation of the Mission 66 program in the 1950s (aimed at upgrading park services and facilities). She then returns to examine the history of particular road segments, paying particular attention to the Grand Loop. Finally, she includes the nomination of the Grand Loop as a National Historic District and surveys some management issues. Historic bridges were photographed and documented according to the ongoing Historic American Engineering Record (HAER) project (page 481), but these photographs and drawings are not included in the volume. The volume does contain useful photographs of Yellowstone, however, along with two historic maps. This is a government report and shows clearly the template of those who commissioned the work.

Culpin is right: there is repetition here, but there are also enough details in this lengthy work to keep any park *aficionado* occupied. Park administrative history, the placement and condition of roads and



Lt. Dan Kingman, United States Corps of Engineers, early pioneer of park roadbuilding esthetics, and Lt. R.C. Stivers, 9th Infantry, 1885.

trails, the function of the Army Corps of Engineers and other entities, and the steady inundation of tourists are all dealt with in sufficient detail in Culpin's work. Since I am not an historian of the park, the specifics of Culpin's account are beyond my criticism; I would merely note that what she says correlates well with the standard accounts of the development of Yellowstone.

Of more general interest is her account of the development of a landscape esthetic within the governmental agencies responsible for opening this remarkable territory "for the benefit and enjoyment of the people," as Congress had proclaimed in 1872. If the reader wishes to explore the larger issue of the visual presentation of the park to visitors, Culpin assists by focusing our gaze onto the road system, the most obviously intrusive imposition of the human order within Yellowstone. The road and trail system in Yellowstone expanded very quickly—to more than 100 miles by 1878—but these corridors through the wilderness were used as passageways to what the first superintendent called "scenic and interesting views." Ruts incised by heavy vehicles and then widened by wagons of different wheel bases, tree stumps at roadside, vandalized signs (reported as early as 1879), and the dual curses of mud and dust clearly delineated the discomfort of travel from the invigorating promise of tourism. The focus during the early years had been on the construction of the roads themselves. Through the work of two men, Lieutenants Dan Kingman and Hiram Chittenden of the Army Corps of Engineers, attention was drawn to the view from the road, the presentation of the natural wonders of the nation's first national park to the eye of the tourist.

In 1883, the Corps of Engineers began supervising the construction of roads and Lt. Kingman gradually reshaped the human landscape of Yellowstone. The roads, he concluded, "should have something of the solid, durable, and substantial quality that usually characterized the works constructed by the national government" (page 26). The park should be protected from "mammoth hotels," "the race course," "the drinking saloon and gambling table," and "the noise and smoke of the locomotive" so that it would belong to the whole people (page 27).

His successor, Hiram Chittenden, continued this good work over two tours of duty in the park, extending into the early part of this century. He supervised the clearing of dead timber within 100 feet of roadways, the placement of signs and mileage posts on major roadways, the positioning of guardrails "at the most precarious points," and the alignment of slopes and cuts. Thus he hoped that the roads would "themselves be made one of the interesting features of this most interesting place" (page 49). He was also an

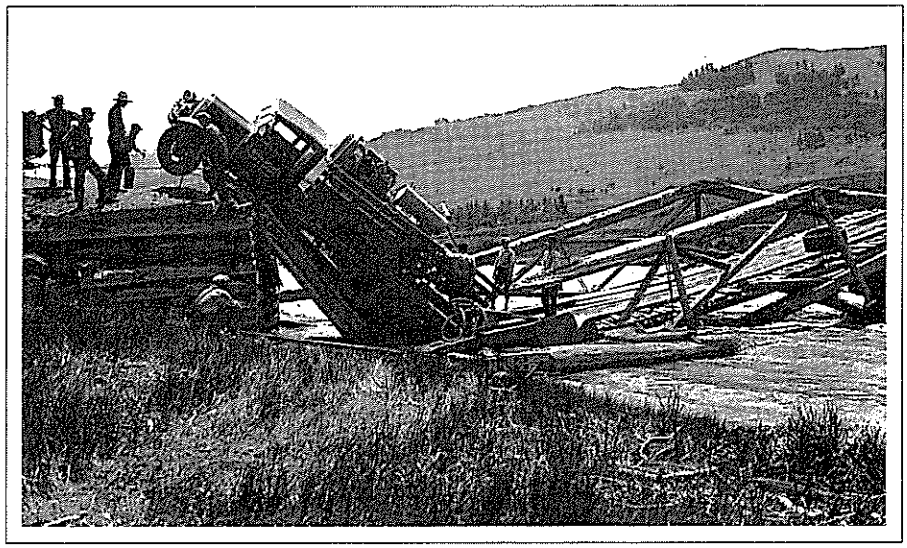
Road Crews on Mt. Washburn, 1903. All photos courtesy Yellowstone Park Archives.

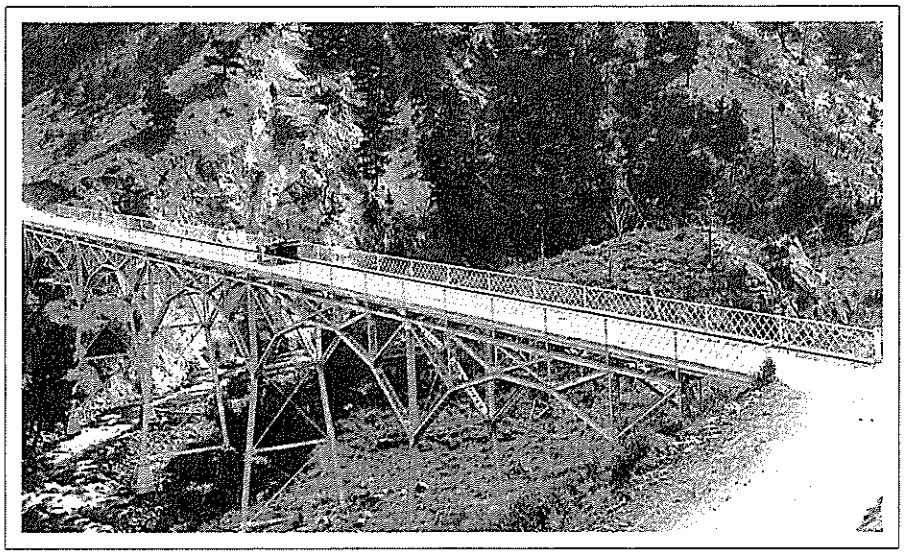
effective advocate of the construction budget, which, he informed his superiors, was intended for an area as large as the state of Connecticut.

According to Culpin, Kingman and Chittenden influenced the following 1918 policy statement of Franklin Lane, the Secretary of the Interior, concerning construction and improvements within the newly formed National Park System:

> In the construction of roads, trails, buildings, and other improvements, particular attention must be devoted always to the harmonizing of these improvements with the landscape. This is a most important item in our program of development and requires the employment of trained engineers who either possess a knowledge of landscape architecture or have a proper appreciation of the aesthetic value of park lands. All improvements will be carried out in accordance with a preconceived plan developed with special reference to the preservation of the landscape, and comprehensive plans for future development of the national parks on an adequate scale will be prepared as funds are available for this purpose (page 87).

This proclamation occurred at an important moment. Automobiles had begun to enter the park in 1915 and were poised for a new invasion after the conclusion of World War I—visitorship rose from slightly more than 62,000 in 1919 to more than 100,000 during the 50th anniversary year of 1922. The race was on.





Above: The Lamar River Bridge broken by overload, 1932. Below: Gardner River Bridge, 1917.

At the same time, two important figures, Horace Albright, who became superintendent of the park in 1919, and Stephen Mather, the first director of the National Park Service, began to exert their enormous influence. These are well-studied careers, which I will not attempt to rehearse here (Culpin, too, wisely leaves these extraordinary personalities off stage and deals with them through their administrative decisions).

Through Mather we can see the overwhelming impact that the automobile has had on Yellowstone. The development of good road systems outside the parks had by 1922 made the park roads seem substandard. The Park-to-Park Highway movement, which encouraged tourists to pioneer the road between, say, Yellowstone and Crater Lake, promised more road-weary families who would be accustomed to viewing scenery at speed and would not tolerate traffic jams or the unseemly jostling of worn-out roadbeds. Mather looked down the road and saw what was coming. Against the phalanx of approaching headlights, his argument focused on the preservation of a Yellowstone experience that was anachronistic, that encouraged people to step out of the twentieth century and, if not into the forest primeval, then at least into a more relaxed tourism that predated the internal combustion engine:

> The automobile should revolutionize the park tour, just as it changed travel conditions everywhere and turned into memories cherished methods of seeing and doing things. However, the old atmosphere of the Yellowstone is still to be enjoyed, not perhaps on the roads, certainly only a few hundred yards distant, where the trails take their winding course through the forests (page 110).

The view from the road, the necessary veneer of exurban detritus at roadside, the willful immersion into the primitive environment that lay beyond (if only people could be coaxed away from the

road)—these basic themes of twentieth-century tourism were established early on.

Superintendent Albright improved the view from the road. Starting in 1919, "vista cuts" were made at roadside, to further enhance the experience of the windshield tourist (page 110). Shortly thereafter, he began tidying up the roadside. Through his chief of landscape engineering, Daniel Hull, he ordered that "any new barrow pits, sprinkling stations, and telephone and electric service lines should be placed in the least noticeable positions. In the past, most of these services had been placed in the 'easiest' location, without regard to the effect on their landscape" (page 113). He encouraged Stephen Mather to rule in 1921 that no new roads would be built in Yellowstone, so that all resources could be directed to the existing system, but still, appropriations for improvements languished and the roads began to deteriorate.

John D. Rockefeller, Jr. entered the park in 1924. Already he was at work on his legendary acquisition of land assembly in the Tetons, south of Yellowstone. His practiced vision, softened by the delicate historic recreation at Colonial Williamsburg and civilized by his donations to the restoration of Versailles, spotted the most visible eyesore immediately: the stubble and fallen timber by the side of the road. While he acquired the land that would become the best viewing platform for Grand Teton National Monument, he also contributed money to his new friend Albright for the removal of trees and underbrush in Yellowstone (page 129).

In 1926, responsibility for Yellowstone roads passed to the Bureau of Public Roads, a sign of the increasing national concern for a highway network and, Albright complained, a sure indication that construction costs would rise. Between that year and the beginning of World War II, road traffic would increase fivefold (page 152).

A fascinating subject, which bears further investigation, is tourism within the park during the Great Depression. The New Deal story is more familiar and, in all likelihood, more significant for the road system that Culpin is studying. "It was during these years of extensive road reconstruction and bridge building that the National Park Service wrote stringent specifications for special landscape features such as masonry guardrails, wooden guardrails, and stone paving. The specifications covered the materials, construction, and treatment of the features" (page 148). But during the early part of the Depression, when times were notoriously tough, visitorship actually rose 5% (page 143). It is clear what Albright saw in this. Parks would exert "a strong influence for stabilization and good citizenship." "[I]n a time of anxiety and restlessness, they were immensely useful to large numbers of people" (page 143). For a student of American culture, the value-laden words "citizenship," "anxiety," "restlessness," and "useful" beg for exploration from the tourist's point of view.

Another explosion of tourist interest detonated quickly after World War II: from about 350,000 visitors in 1946 to more than 825,000 only a year later. By 1953 the park was so overrun that Bernard DeVoto advocated closing Yellowstone because of the "nationally disgraceful situation" regarding support and maintenance (page 175). The Mission 66 process initiated by the Park Service may have turned attention to the historically underfunded road system, but it also produced the transplanted superhighway interchange at the Old Faithful junction with the Grand Loop. Culpin allows herself an editorial comment against this disorienting concrete merry-go-round, the park's most intrusive feature.

Even my brief overview of a massively detailed work indicates that the story of the roads is intertwined with the experience of the tourist, the development of a reading of the landscape (both by the tourist and by park administrators), and the construction of a relentlessly technological culture surrounding the park. In other words, the park quickly became a cultural text, important both for what it said about nature and culture and for what it was seen to argue against—the urban, or increasingly suburban, world of the vast majority of tourists who visited what one popular writer has called the last refuge.

The text of Yellowstone has most frequently been written according to the Anglo-American inscription that begins in the 19th century. Thus we have the history of explorers, scientists, and photographers, so well chronicled by such eminent historians as William Goetzmann and critiqued by cultural historians like Peter B. Hales. The ecological literature regarding Yellowstone is also immense and, in the terms that I am using, could be read in individual historic contexts, as projections of contemporaneous visions of historical development and American destiny.

Yellowstone has been seen as valuable cultural terrain. John B. Jackson, one of the most prominent proponents of cultural landscape study, summarizes the importance of Yellowstone with a statement and a question: "First it was the mining lands which were officially recognized as possessing distinct characteristics of their own; then it was land suited to irrigation, then forests, until much of the American landscape became a composition not only of political units but of natural environments. And was it not this new kind of definition of land that inspired the creation in 1872 of Yellowstone National Park?"(*American Space*, page 27). For Roderick Nash this is not a rhetorical question. In *Wilderness and the American Mind* he portrays Congress as forming the national park only after assurances that the terrain had no higher economic use.

Such debates over cultural and economic value—and the representation of natural space as either a presence or an absence—are extensive and endlessly fascinating. However, I would like to put the articulation of Yellowstone as a cultural text into conversation with theories about what was occurring in vastly different locations in American culture. The point of view that I am taking owes a debt to Alan Trachtenberg's book, *The Incorporation of America*, which draws together phenomena from both West and East into a study of a consolidating American culture at the end of the nineteenth century.

Culpin's work gives us enough clues to see how such a larger realm might be formed. Occasionally, one of her sources will make an explicit comparison to this broader world. For example, Lt. Kingman advocates a good road system and ex-