

Land Use on the Green River: Changing Emphasis, Changing Times

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ABSTRACT

For almost forty-five years, Flaming Gorge Dam has impacted the Green River—a legacy from the early twentieth century fashion of routing water to spur the growth of agriculture in the arid west. The arrangement worked well as a strategy for settling the west but through scientific insights and a growing public environmental awareness, a new goal of minimizing the ecological impact of the dam has been introduced. Additional values have now emerged, which compete with the original emphasis on water storage and power production, and this can be seen in the progression of stakeholders on the river, downstream from the dam. Recreation and tourism have become popular and economically important activities in the area. In addition, the regulation of the Green River has had a profound impact on native fish, now rare and endangered, and the area of the river below the Yampa confluence has become a vital refuge for species recovery. Society's changing values and economics will complicate future management of the river, and careful examination of the costs and benefits of the dam will become an important management strategy.

INTRODUCTION

There are numerous stakeholders interested in the management of Green River, and of Flaming Gorge Dam, which restrains its waters twenty-six miles south of the Wyoming border. The most obvious of these interested parties, and perhaps the ones who stand to lose or gain the most, are those who benefit from the storage of water and generation of electricity by the dam. But the river, its waters, and the surrounding land have many other values, as evidenced in the long list of public issues in the 2005 Environmental Impact Statement (EIS) for Operation of Flaming Gorge Dam.

Each public issue has an outspoken group behind it, and each group values different, often conflicting, aspects of the Green River Basin. Each group has a unique history and economic status in the region, and each has their own impacts on the river and surrounding

landscape. The serial discontinuity concept can be related to the progression of interest groups, as the dam has varying effects on land-use in the downstream direction.

HISTORY OF HUMAN SETTLEMENT

Early Residents

The first known inhabitants of the Green River Basin have been named the Fremont Culture. These semi-nomadic people, who inhabited the area from 600 to 1200 AD, slept in pithouses in tributary canyons and other sheltered spots. Their rock art can be seen today on overhangs and canyon walls throughout the basin. After this, the area was inhabited by nomadic hunter cultures—the Shoshone to the north of the Uinta Mountains, and the Utes to the south. The native peoples probably had little impact on the river, due to their nomadic and semi-nomadic hunter-gatherer lifestyles. The Utes, however, did engage in burning of vegetation to drive crickets, a source of food (Sutton 1995).

European Arrival

Mountain Men

The first written account of the Green River is from the journals of the Spanish missionary, Friar Escalante, who crossed the river to reach the Utah Valley in 1776 (Webb 1994). American settlers didn't explore the area below Flaming Gorge until almost fifty years later. In 1825, a party of trappers led by William Ashley floated down the Green River in hide-covered boats, from north of the Uinta Mountains to the White River junction, the first time anyone had attempted such a feat (Webb 1994). This marked the beginning of a parade of trappers to the river, and Brown's Park, then known as Browns Hole, became a favorite haunt of the mountain men. By 1837, a trading post was established there called Fort Davey Crockett (Wilder 1994).

Cowboys and Cattle Rustlers

Cattle were brought into the Brown's Park Valley in 1870, primarily because it had milder winters than surrounding uplands, but also because it was isolated, making it a good place to hide herds of cattle from the law (Wilder 1994). These were rough times, and it was hard to tell the difference between cattlemen and cattle rustlers. By the 1880s, a number of settlers

inhabited Brown's Park, and a general store was opened there (Wilder 1994). This was the true 'Old West' of the movies, inhabited at one point by outlaws, Butch Cassidy and the Sundance Kid. The area eventually became more civilized, agriculture was developed along the river bottoms, and the major occupations became farming and ranching (Webb 1994).

Rise of the Water Barons

To grow crops and raise livestock in such an arid climate, water needed to be stored during times of plenty. Due to the promotion of the agrarian lifestyle as a wholesome moral pursuit, farms were springing up all across the west, and everyone wanted his share of the water flowing down the Colorado River. After years of debate, six states and the federal government ratified the Colorado River Compact in 1929—a treaty apportioning the water in the Colorado River between the upper and lower basins. The Compact requires a specific flow to be maintained at Lee's Ferry, Arizona, which is the dividing line between the two basin halves.

After World War II, the Bureau of Reclamation (BOR) hatched plans to build several dams on the Green River, in such places as Echo Park and Split Mountain in Dinosaur National Monument, to conserve the ephemeral water supply of the region, and meet the requirements of the Colorado Compact. Conservationists vehemently opposed the Dinosaur dams, but agreed to dams at Flaming Gorge and Glen Canyon as a compromise (St. Clair 2000). Construction of Flaming Gorge began in 1956, was finished in 1962, and the reservoir filled completely by 1974.

CURRENT SITUATION

Today, Flaming Gorge Dam dominates land use in the Green River Basin. The dam is operated by the BOR, as part of the Colorado River Storage Project (CRSP) and is used for water storage and diversion, power generation, and some flood control, as well as recreation opportunities on the reservoir and in the tailwaters. The way the dam is operated—how much water is released and when—has either negative or positive consequences for each of these uses. But dam operations also have consequences for another, important land use—wildlife habitat for endemic native species.

Due to the serial discontinuity effects of the dam, land use and stakeholders change as downstream distance from the dam increases. For the purposes of this paper, the study area is

divided into three zones—at the dam, the dam to the Yampa River, and Yampa River to Split Mountain.

Land Use At the Dam

Water Storage

In the arid climate of the Colorado Basin yearly precipitation is erratic, and previously the Green River was known to dry up in periods of severe drought (Webb 1994). Most precipitation falls in winter as upland snow, and is released as spring run-off when the snow melts. The authorizing function of the Flaming Gorge Dam under the CRSP is to store water to meet supply obligations at Lee's Ferry, while still allowing upstream states to use the water apportioned to them, even in dryer years.

The reservoir capacity is 3.5 million acre-feet. The Utah Division of Water has control over water rights in the reservoir, and it segregates these rights to various conservation districts, irrigation companies, and farmers for "beneficial consumptive use" (Crozier 2004). Agricultural irrigation is the major consumptive user of water in the region. In the upper Colorado Basin as a whole, 90% of water consumed is for crop irrigation, and 88% of irrigation is for livestock feed (Kelly).

Water supply has been dropping in recent years. In 1999, Flaming Gorge water supply was approximately 2500 acre-feet (BOR 2005). This figure dropped below 1500 acre-feet in 2000, and has since been less than 800 acre-feet per year (BOR 2005).

Due to the large cost of constructing the dam, a powerplant was built at its base to provide revenue for the repayment of the project. The federal government also loaned farmers the money for construction of irrigation systems to funnel the water to crops. These loans were made interest free, and repayment amounts were set at the irrigators "ability to pay," which was very low in some cases (McCool 2003, GAO 1996, Reisner 1986).

This amounts to large government subsidies to farmers, indeed, the total US government subsidy per hectare of irrigated Western crop land is approximately \$980 per year—for a grand total of \$4.4 billion per year to subsidize irrigation to farmers in the West (Pimental 1997). The lack of interest payment on irrigation loans amounts to a subsidy of ninety cents on each dollar (Reisner 1986).

Power Generation

The powerplant at the toe of Flaming Gorge Dam began operating in 1963, and has a maximum capacity of 152 MW. Transmission facilities are operated and power marketed by the Western Area Power Administration (WAPA). The dam provides electricity to 48,000 households as part of the Salt Lake City Area Integrated Projects. Consumer-owned electrical utilities, such as the Utah Municipal Power Agency, buy the hydropower from WAPA and sell it to consumers (James 2006).

The utilities serve rural areas that private companies do not want to supply because the cost of energy production and transmission lines has to be shared by fewer customers (BOR 2006). The usual land use in these isolated areas is farming and ranching.

Essentially, power generation is paying for the costs of dam construction, maintenance, and operation, and any associated environmental costs, such as mitigation or restoration measures (James 2006). These costs have been steadily rising. For example, the Environmental Impact Statement (EIS) required for the 2006 Record of Decision on Operation of Flaming Gorge Dam cost around \$4.3 million to produce (James 2006). The 2005 EIS estimates revenue from power generation in 2006 as \$9.6 million, which means the cost of producing the document represents half of the expected revenue this year.

Power generation also covers irrigation costs over irrigators "ability to pay." CRSP contractors are paying over 95% of the cost of irrigation features on the CRSP, and 25% of their total annual revenue requirements are due to irrigation assistance (James 2006).

Obviously, the utility companies would prefer the powerplant be operated for maximum revenue generation. In the past, this has meant storage of water when electricity demand is low, for releasing through turbines when demand is high and electricity is worth the most. Consequently, large volumes of spring runoff were stored for generating electricity to meet summer air conditioning demands and, year round, water was stored at night to meet peak demands during the day.

Since this altered flow regime was very different from natural conditions, powerplant operations have had severe consequences on the ecosystem below the dam, and in 1992 the United States Fish and Wildlife Service issued a Biological Opinion requiring modified dam

operations for the benefit of endangered native fish. This required releases from the dam to more resemble natural river flow, with constant flow rates throughout the day, and peak spring flows.

After the Biological Opinion was issued, reduced power generation resulted in a loss of \$2 million of revenue per year to the utility companies as they modified operations to produce less electricity during peak demand periods (James 2006). Dam operations are being modified again this year, with the issuance of the Record of Decision, which implements the 2000 Flow and Temperature Recommendations (BOR 2006). This will likely further impact the cost of operating the powerplant, as well as electricity generation capacity.

Flood Control

The public perceives large dams as flood-control structures, and while they all may afford some protection from small floods, generally only dams under the control of the Army Corp of Engineers are designed and operated to control flooding (Knudsen 1997). Dams owned by the Bureau of Reclamation, such as Flaming Gorge, are usually designed with the dual purpose of water storage and power generation.

The operation of these two kinds of dams is markedly different. While a storage/electricity dam aims to keep a full reservoir to conserve water for withdrawals and maximize head potential for power generation, a flood control structure needs to be empty enough at critical times to handle large run-off events (Knudsen 1997). This can lead to a dangerous situation at a storage dam when a storm event occurs.

On June 21, 1997, a warm rain caused rapid snowmelt in the mountains above Flaming Gorge Dam. The water level rose so fast, it roared through the outlet works with enough force to tear a steel plate from the wall of the pipe. Water infiltrated the interior of the dam, and flooded the control room, knocking out electronic equipment and preventing control of the outlet works. Thankfully, the outlet was brought under manual control before significant damage occurred downstream (Knudsen 1997).

The real danger is public complacency—a Bureau of Reclamation review in 1997 found less than 1 in 10 downstream jurisdictions had plans in place for warning and evacuation in the event of an uncontrolled release of water or worse, total dam failure (Knudsen 1997). Flaming Gorge Dam has been classified by the National Performance of Dams Program as a high hazard potential, defined as “those where failure or misoperation will probably cause loss of human life”

(NPDP 2006). Even with this worrying designation, there is no Emergency Action Plan in place for the dam (NPDP 2006).

Flaming Gorge Dam to Yampa River

The first fourteen miles below the dam are within Flaming Gorge National Recreation Area and managed by the US Forest Service. The terrain is steep and wooded, and is used for limited recreation activities (BOR 2006). After this the terrain becomes flatter and more accessible. The river then runs for sixteen miles through Brown's Park, which is managed by the Bureau of Land Management (BLM) and is primarily used for cattle grazing, as well as recreation at the many camping and boat launching sites (BOR 2006). The river then flows through Brown's Park National Wildlife Refuge for 20 miles, which is under the administration of the US Fish and Wildlife Service, and is used for wildlife mitigation (BOR 2006). The last 20 miles before the Yampa River run through the Canyons of Lodore in Dinosaur National Monument, which is managed by the National Park Service as a recreation area (BOR 2006).

Recreation

The clear, cold water releases from the dam provide several recreation opportunities in this reach. Some of the popular activities are river rafting, fishing, wildlife viewing, hiking, camping, and touring archaeological and paleontological resources. According to the EIS, 92,000 people visit the river to recreate each year, with sixty percent of the visitation concentrated in the months of June, July, and August. The economic value of these recreation visits is estimated at almost \$5 million annually (BOR 2006).

River Rafting

River rafting (or scenic floating) is wildly popular, and boaters may wait hours in peak summer months to put in to the river at the boat ramp below the dam. The EIS estimates 25,000 people visit the river for 'scenic floating' each year. The value of these visits is estimated at \$1.2 million, or 24% of the total value of recreation below the dam.

Reduced river flows associated with hydropower dams are considered by some as a direct threat to adventure-class white water rafting (PCOA 1986). In 1986, a representative of the American Canoe Association told the President's Commission on Americans Outdoors:

“Free-flowing river resources essential to white water sports are being destroyed by hydroelectric power development... These losses are continuing although participation in canoeing, rafting, and kayaking has been growing rapidly. The combined effect of these two trends is to force more people onto fewer white water rivers. The result is crowding, safety problems, competition between private and commercial white water users, and other stresses on the resource base.”

Although many professional river rafting organizations, such as the Colorado Plateau River Guides, profess publicly to be in favor of dam decommissioning, regulated river flows as a result of hydroelectric power generation are generally considered to extend the river rafting season and improve rafting conditions (Mount 2006).

Fishing

The tailwaters of Flaming Gorge Dam provide a world-class fishery of non-native trout, which thrive in the cooler water released from the reservoir.

The EIS segregates fishing recreation into three categories: guide boat fishing, private boat fishing, and shoreline fishing, which is lumped together with hiking. Annual visitation is estimated at 30,000 for boat fishing, and 35,000 for shoreline fishing/hiking (BOR 2006). In particular, guide boat fishing accounts for over \$2 million dollars in income annually (BOR 2006). These figures reflect the enormous popularity of fishing in the region—in Colorado, sport fishing contributed one billion dollars to the economy in 1988 (Finken 1988).

It should be noted, however, that the trout fishery was established with the help of a 1962 rotenone poisoning of 600km of the Green River to remove “trash” native species (Rakesa 1999). In addition, the water conditions preferred by trout are in conflict with those native fish require, and introduced fish likely impact natives further through interspecific competition or predation (USFWS 1984).

Camping and Hiking

There are twenty campgrounds managed by the Bureau of Land Management, and five operated by State of Utah, along the sixteen miles of Green River running through Brown's Park (BOR 2006). Brown's Park National Wildlife Refuge has two campgrounds, and Dinosaur National Monument has three campgrounds in this reach, which are popular camping spots due to the rugged and beautiful terrain (BOR 2006). Only one campsite, operated by the BLM, is expected to be affected by increased flows due to new powerplant operations required by the 2005 EIS (BOR 2006).

Annual camping visits are estimated at over two thousand, with an economic value of \$25,000 (BOR 2006). Hiking is given minimal consideration in the Flaming Gorge EIS, and is not quantified except by inclusion in estimates for shoreline fishing/trail use, which has an estimated 35,000 annual visits (BOR 2006). Backpacking is not mentioned at all, although it is bound to take place. These figures should be read with caution, as there are always uncertainties associated with these kinds of recreation statistics due to the difficulties of contacting individuals engaged in solitary or remote activities.

Wildlife Viewing

The Brown's Park National Wildlife Area is mandated to provide a sanctuary for migratory birds and recreation dependent on wildlife and fish, as well as natural resource protection and endangered and threatened species conservation (USFWS 2001). The refuge possesses wetland, riparian, and upland habitat for a wide range of wildlife species. In 2005, Defenders of Wildlife listed Brown's Park as one of the country's ten most threatened wildlife refuges. The organization cites impacts from cattle, which graze on adjacent BLM land, but must pass through the refuge to reach water sources on the Green River and have completely denuded vegetation in the area (DOW 2005).

Archaeology

The Green River Basin is rich with cultural artifacts of the Fremont peoples, as well as more recent Native American inhabitants. Objects, carvings, and structures found in the area contain a wealth of information about how ancient people successfully inhabited the arid region. There are numerous cultural sites along the river that may be directly or indirectly affected by

required alteration to the river's flow regime (BOR 2006). Surveys conducted of the future reservoir area between 1958 and 1962 discovered 65 cultural artifact sites, which were later inundated when the reservoir was filled (Dibble 1963).

Paleontology

The 210,000-acre Dinosaur National Monument is famous for its paleontological resources. Dinosaur fossils were discovered here by Earl Douglass in 1909, and the area was designated a National Monument in 1915. It was this discovery and designation that led to the bitter, but successful fight against building dams here. Today, the monument, managed by the National Park Service, is a popular tourist destination—330,000 people visited the monument in 2004 (CO 2005). In 2002, a two-day Utah Geological Survey found significant fossil records in the walls of Flaming Gorge Reservoir (Hayden 2002). It is unknown whether more fossils are present beneath the reservoir surface, but, according to park personnel, no significant fossil sites are located along the Green River corridor (BOR 2006).

Cattle Grazing

As noted previously, cattle grazing occurs adjacent to the Brown's Park National Wildlife Area. Ranchers have traditionally been allowed access to watering points on the river by traversing through the refuge (USFWS 2001). The Dickinson family pays \$6,000 a year for grazing rights on two state parcels within the federal refuge (Stein 2004). The family has ranched there for a long time, and feels they have a right to water access for their cattle (Stein 2004). Environmentalists do not agree however, charging the USFWS with failing to protect wildlife resources by allowing cattle to degrade sensitive riparian corridors (Stein 2004).

Yampa River to Split Mountain

This reach picks up again in Dinosaur National Monument. The river flows through two steep canyons—Whirlpool and Split Mountain—as well as more gentle stretches like Echo Park. Land use in this area is quite different from land use upstream, as the effects of the dam become minimized due to inputs from tributaries, and other ecological effects. Recreation is still common in this reach, but is a little more sedate than activities occurring upstream. Because of the influence of the Yampa River, water in this reach is too warm and turbid to support a trout

fishery; however this influence makes this reach ideal for native fish habitat. Cattle grazing is common near the Yampa confluence.

Recreation

This reach is still within the boundary of Dinosaur National Monument, so the previous discussion on river rafting, hiking, and paleological/archaeological resources applies. Recreation is less intense in this reach however—the National Park Service operates only one campground and a picnic area in this region, at Split Mountain (BOR 2006).

Cattle Grazing

When Dinosaur National Monument's current boundaries were set by legislators in 1960, grazing privileges of inholders (those owning land within or adjacent to park boundaries) were guaranteed until the Park Service acquired the land. Several of the inholdings were bought, but there are still nine ranches with grazing privileges within the monument—families who go back many generations (Jenkins 2001).

Some families have strongly resisted Park Service attempts to buy their inholdings and have refused to abide by the rules of their grazing permits. One noteworthy case involving the Mantle family, who graze cattle at the Green/Yampa junction, was the subject of a 1993 lawsuit by the Park Service, claiming trespass of their cattle onto non-allotment land (Jenkins 2001). Cattle can have detrimental effects on riparian ecosystems through trampling, devegetation, and water pollution. Park Service staff has noted overgrazing, destruction of riparian habitat, and damage to habitat of two rare orchid species by the Mantle's cows (Jenkins 2001). There are also conflicts between recreation enthusiasts and ranchers. River trips have been ruined by piles of dead cows rotting on the banks of the Yampa River (Payne 2002). The Colorado Plateau River Guides association has expressed the opinion that cattle grazing should be eliminated in Dinosaur National Monument (Payne 2002).

In return, ranchers are concerned about the effect of increased flows on the Green River required by the new flow regime. Regulated flows by the dam have prevented annual flooding of fertile bottomlands. In comments on the Flaming Gorge EIS, ranchers stated damage to property and equipment by inundation under the new flow regime could reach \$175,000 (BOR 2006).

Habitat

Native fish in the Green River Basin are highly specialized to the unique habitats created by geomorphic features of the region (Valdez 2005). Geologic isolation, steep gradients, high water turbidity and extreme variation resulted in unique physiological and morphological adaptations which make the fish extremely sensitive to ecological changes caused by human disturbance (Valdez 2005).

The biological and physical changes due to Flaming Gorge Dam have been severely detrimental to native fish, and four species are now listed as endangered (Valdez 2005). To assist the recovery of the fish, flow and temperature recommendations for Flaming Gorge Dam releases were made in 2000 by the Upper Colorado River Endangered Fish Recovery Program (Valdez 2005). These recommendations will be implemented this year with the issuance of the final EIS, with the goal of improving native fish habitat in the Green River below the Yampa (BOR 2006). If the water quality in this region is more suitable for native fish viability, then presumably it more closely represents historic conditions, and the serial discontinuity concept is supported—dam effects lessen downstream due to tributary inputs.

HOW THE FUTURE LOOKS

In 2005, Utah tourists spent \$5.5 billion, while state farm income by cash receipts totaled \$1.2 billion, with the cattle share only \$430 million (UOT 2005, UT 2005). The Green River will probably continue to be an important recreation resource for surrounding residents. New public values have arisen in the last fifty years, and water and species conservation issues have risen in importance. Reduction of large government subsidies is considered by some to be a reasonable way to persuade farmers to practice conservation (McCool 2003, Lemly 2000, Pimental 1997).

As native fish continue to decline throughout the west, and pressure to restore riverine habitat to improve their viability increases, the Green River may become an important refuge. Compliance with the Endangered Species Act means that modifications to the flow release schedule at Flaming Gorge Dam to create a more natural flow regime and additional environmental costs to protect these endangered species are likely to continue.

As conflicting mandates bring more stakeholders to the table, more weight is being given to issues such as recreation and native species habitat. Careful examination of the costs and benefits of Flaming Gorge Dam will be an important management strategy in the future.

CONCLUSION

There is a divide within the stakeholders on the river between those who benefit from the characteristics of the wild river and those who benefit from the dam effects, and this divide can be viewed in the context of the serial discontinuity concept. Farmers, irrigators, power and water companies, and fishermen thrive in the dam and its tailwaters. Further downstream, the, cattle, birdwatchers and hunters roam, before giving way to native fish habitat within the influence of the Yampa.

New legislation and emerging values of preserving the ecological integrity of the river have altered management decisions for the dam. As far back as 1986, the President's Commission on Americans Outdoors recommended, "Federal agencies... place greater emphasis on long-term conservation of natural, cultural and historic resources and the quality of recreation opportunities and experiences."

Recreation has continued to be of greater importance to management agencies and the public, and conflicts have arisen along the river between these more modern uses and the traditional cattle ranching lifestyle. Both of these uses potentially impact native species habitat—through degradation of habitat or direct alteration of river hydrology. The advent of the Endangered Species Act and the listing of native fish in the Green River has resulted in changes to flow rates and schedules at Flaming Gorge Dam, which has reduced revenue, and increased operation costs of the powerplant.

It will be a difficult task in the future management of Flaming Gorge Dam to assess and compare the value of such different uses as irrigation for agriculture, power generation, recreation, and endangered species habitat.

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