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Are All Commons Tragedies?

The Case of Bison in the Nineteenth Century

— ◆ —

PETER J. HILL

Economists tend to rely upon tried and true examples to make their theoretical points. Since H. Scott Gordon’s 1954 article “The Economic Theory of a Common-Property Resource: The Fishery,” economists have recognized that the overexploitation of an open-access resource—the “tragedy of the commons”—arises when individuals’ incentives aren’t aligned with maximizing the overall gains to society. Gordon’s model has been widely applied, and the near extinction of the bison on the American frontier has been frequently held up as a confirmation of the model.

However, just as Ronald H. Coase (1974) showed that a lighthouse is not the best example of a public good, and Steven Cheung (1973) explained that bees, in most cases, do not provide an unpriced externality, we also need to rethink how we present the overexploitation of open-access resources and its applicability to bison. In particular, economists should be careful not to ignore an important element in our tool kit, opportunity costs, when we discuss overexploitation. This means that the rapid depletion of a particular resource may or may not represent a tragedy of the commons, depending on alternative uses of all the scarce resources in question.

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In this article, I argue that the iconic depletion of the bison in nineteenth-century America was *not* a tragedy of the commons. First, because bison were a means of converting grass to meat, one has to include the opportunity cost of the grass in any calculations of the wastefulness of killing bison. If an alternative way of using grass existed, and it did in the form of domesticated cattle, then depletion of the bison was not necessarily wasteful. In addition, open access can also lead to dissipation of rents through the excessive use of resources in harvesting.¹ But it does not appear that there was a substantial waste of resources in the bison-harvesting activity itself. Finally, if there is a lag between the presence of a less-efficient method of harvesting grass (bison) and a more efficient converter of grass to meat (cattle), that lag can also represent resource waste. However, data on the lag between the elimination of the large bison herds and the introduction of cattle suggest this wasn't the case. Of course, there is still the question of the amenity (nonconsumptive) value of bison. That issue is dealt with in the last part of the article.

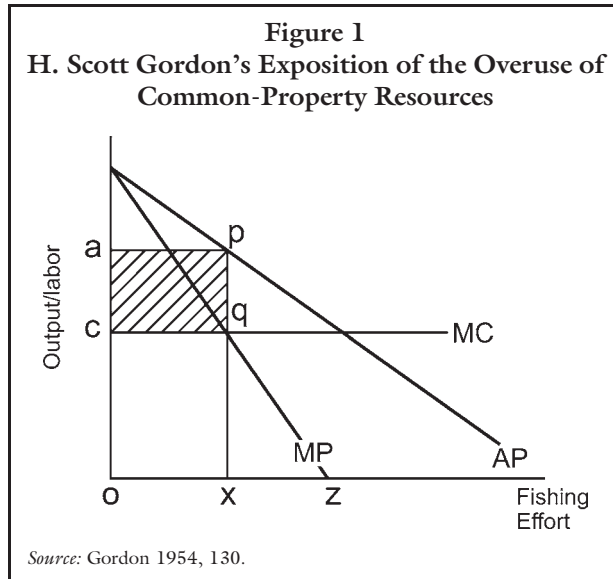
The Theory of Overexploitation

One can understand the problem of not correctly identifying the valuable resource that is being wasted by examining M. Scott Gordon's classic graphical representation of overexploitation (1954, 130). In figure 1, overall gains to society (rents) are maximized at the intersection of the marginal product curve (MP) with the marginal (opportunity) cost curve (MC). The rent rectangle $apqc$ is the greatest gain to society from the activity because the extra benefit of undertaking the activity (the marginal product) exceeds the extra cost of undertaking the activity for every unit of effort up to point x . However, in an open-access situation, harvesters do not stop at point x where rents are maximized. Entry into the market occurs because the entrant's share of the catch is AP (the average product of effort), not MP (the output from one more unit of effort), so output expands until $AP = MC$, or until rents are entirely dissipated.

The problem with the application of this model to all situations of rapid depletion is that one has to correctly identify the valuable resource. Gordon discusses the particular case where fish are the resource that is being wasted and fish is the most valuable product from the fishery. Even though his exposition may be correct, one cannot apply it to situations where the resource being harvested is not the most valuable one. Bison were valuable for their ability to convert grass to meat, but they were not the most efficient method of doing so.²

1. This is the case in fisheries, where fishers race to capture the unowned resource, the fish. Too many boats and too much fishing gear have been committed to open-access fisheries. Donald Leal (2005) provides numerous case studies and empirical evidence of resource waste in fisheries where property rights do not exist.

2. Again, there were uses for bison other than as meat and hides, and private entrepreneurs recognized those values, so preservation for amenity value did occur.



In figure 1, the rent rectangle represents the maximum profit from the resource—the fish—and the only opportunity cost that is relevant is that of the harvesting effort. But in some cases this approach fails because it ignores the opportunity cost of putting these inputs into alternative uses. In other words, the rent rectangle from harvesting fish has to be compared to the alternative rents from other uses of the ocean. Consider the case of codfish. Some have viewed the rapid depletion of codfish in the early twentieth century as an example of rent dissipation through overuse, but it is important to note that the depletion of cod resulted in an increase in the lobster population (Pease 2009). The better use of the cod’s habitat, from the human point of view, may be lobster. Therefore, one should remember that there are opportunity costs in the production of any biological population, and one must take into account those opportunity costs when evaluating the argument that rapid use of the resource represents overuse.³

One can formalize overexploitation as the use of a resource, such as bison (B), at time t , even though

$$DPV(B)_t > H(B)_t.$$

$DPV(B)_t$ is the discounted present value of a unit of a resource that remains alive at t , and $H(B)_t$ is the harvest value of a unit of the resource in year t . The terms *exploitation*, *waste*, and *rent dissipation* can be applied to the harvesting of an animal even though its discounted present value (alive) is greater than its value dead. Of course, the killing of the lower-valued animal rather than waiting until it becomes

3. It is more likely that a true tragedy of the commons can occur with a fixed-stock resource such as oil.

more valuable in the future happens because the individual looking at the harvest potential does not have property rights to the discounted present value of future flow of returns from the asset, but can claim the harvest value. However, the discounted present value of the future flow of returns is a net figure:

$$DPV(B) = \frac{\sum_{t=1}^n (R_t - C_t)}{(1+i)^t} \quad (t = 1, \dots, n).$$

R represents the value in the marketplace for a resource in year t , i is the discount rate, and C is the opportunity cost of the resources necessary to produce the resource in that year. In this article, I focus on C , the opportunity cost of resources necessary for production of the asset, and I illustrate confusion about the tragedy of the commons with a discussion of the American bison.⁴ The resource involved that had an opportunity cost was the grass of the Great Plains, which could be used to produce cattle as well as bison.

Bison as a Tragedy of the Commons

A casual search of environmental and natural-resource texts as well as of standard principles texts shows that the bison are one of the most oft used examples of the problems of an open-access resource. For instance, a leading environmental text says:

The problems created by open-access resources can be illustrated by recalling the fate of the American bison. Bison are an example of “common pool” resources. *Common pool resources* are characterized by non-exclusivity and divisibility. . . . With all hunters having completely unrestricted access to the bison, the resulting allocation would not be efficient. No individual hunter would have an incentive to protect scarcity rent by restricting hunting effort. . . . One of the losses from further exploitation which could be avoided by exclusive owners—the loss of scarcity rent due to overexploitation—is not part of the decision-making process of open-access hunters. (Tietenberg and Lewis 2012, 29–30)

And an economics text says, “The sad list of animal species that have been extinguished by man’s predation results from the fact that property rights in these animals did not exist, perhaps because they could not have been enforced had they been established, but in any event because they did not exist. . . . Nobody owned the bison or the passenger pigeon; and in recent years whales and kangaroo have been sadly victimized by the absence of ownership” (Dales 1992, 53).

4. Although the animals discussed in this paper are most accurately described as bison, the common term for them is *buffalo*.

Similar arguments are made by Randall Holcombe (1988), Michael Copeland (1990, 21), and Robert Higgs (2005). The only dissenter is Dean Lueck (2002).⁵ In fact, casual reading of environmental texts and articles and books on property rights indicate that the bison is second only to fish in the ocean as an example of the overexploitation of an open-access resource.

The most complete discussion of the rapid near extermination of the bison is in a recent article by M. Scott Taylor (2011). Taylor argues that the rapid slaughter occurred because of a technological innovation in tanning bison hides in 1870 or 1871 in Germany and England. This innovation created a demand for bison hides, and hunters responded by killing bison just for the hides and shipping them to foreign markets. Taylor concentrates on the technological innovations and market forces that led to the rapid slaughter of the bison. His analysis is thorough and convincing. He errs, though, in the same way that others have in seeing the slaughter as a “dramatic example of resource overuse arising from open access” (3166). He concludes, “The slaughter of the North American buffalo surely represents one of the saddest chapters in American environmental history” (3171).

The belief that the bison were valuable and were nearly exterminated because of the existing institutional framework leads to the claim that if private-property rights to bison had existed, they would have been preserved. I argue that such is not the case; even if there had existed private-property rights to bison on the Great Plains in the latter part of the nineteenth century, they would have been exterminated almost as rapidly as they were under open access. There was no tragedy in an economic sense in the killing of the bison; it was simply a rational economic act by people who wished to maximize the value of the grass on the Great Plains.⁶ In fact, the rapid development of the hide market provided a fortunate set of circumstances for the establishment of cattle on the Great Plains. The cattle producers did not have to eliminate bison, the major resource competing for grass, and there was a market for one of the products of bison slaughter, hides. Thus, rather than simply killing and wasting the entire resource, the hide market

5. Lueck (2002) provides the most complete explanation of the evolution of property rights to bison and understands that the alternative of cattle production hastened the killing of bison, the essential argument in my paper. However, he also uses the terms *open-access exploitation* (648), *waste* (636, 638), and *rent dissipation* (634) to describe the last decade of bison harvest. Later in this paper, I take up the issue of whether these terms can be applied to the rapid extermination during the period of hide hunting.

6. One can argue that there was a tragedy of the commons, or overexploitation, by the nomadic tribes on the Plains for a period of time. Lueck labels the period 1860–80 as open access for the Native Americans as displaced tribes competed with incumbent tribes. And Bruce Benson (2006) discusses in some detail the rapid decimation of bison herds by the Indians once they had the horse and the gun. However, even in this case, one would only call this waste if one assumed the Indians were going to remain a nomadic people on the Plains for a long period of time. In such a case, they were killing off a replenishable resource necessary for their survival into the twentieth century. But if the Indians accurately foresaw what was coming, that settlers would come to control most of the land, it made sense for those Indians to harvest rapidly a resource that they would not control or have access to in future decades.

provided an economic value for the bison, who otherwise would have just been slaughtered and left to rot.⁷

The facts concerning the demise of the bison are straightforward. Approximately 30 million bison were roaming the Plains in the early part of the nineteenth century (Flores 1991).⁸ By 1886, there were probably less than 1,000 in the United States and Canada. Two hundred of the remainder were in Yellowstone National Park, and there were a few other small remnants of wild herds, plus 250 on private ranches (Hornaday [1889] 2002).

Most of the early market trades were for buffalo (bison) robes—hides with the hair on. A quality robe required harvesting in the wintertime, and Indian women tanned these hides. The robes were a valuable trade commodity for Indians. In the 1840s, the St. Louis market averaged 90,000 robes per year, and it grew to 100,000 during the 1850s and 1860s (Sunder 1965, 17). However, it appears that reasonably secure common-property rights existed for most of this period (Lueck 2002), and the rapid extermination of the bison was not seen as a major problem.

Application of the Theory of Overexploitation

It is interesting to examine the period from 1870 through 1886 to test more completely the hypothesis that the rapid extermination of the bison represented the overexploitation of an open-access resource. I choose this period because at least 10 million bison were extant at the beginning of the period and because settlement had pushed far enough to the west that people would have been aware of the possibility that the bison were an economic resource that should have been preserved if this were the case. This is also the period that most of the discussions of overexploitation seem to refer to in that they focus on the near extermination and the massive harvesting of bison by white hunters, with millions of carcasses left to rot on the Plains.

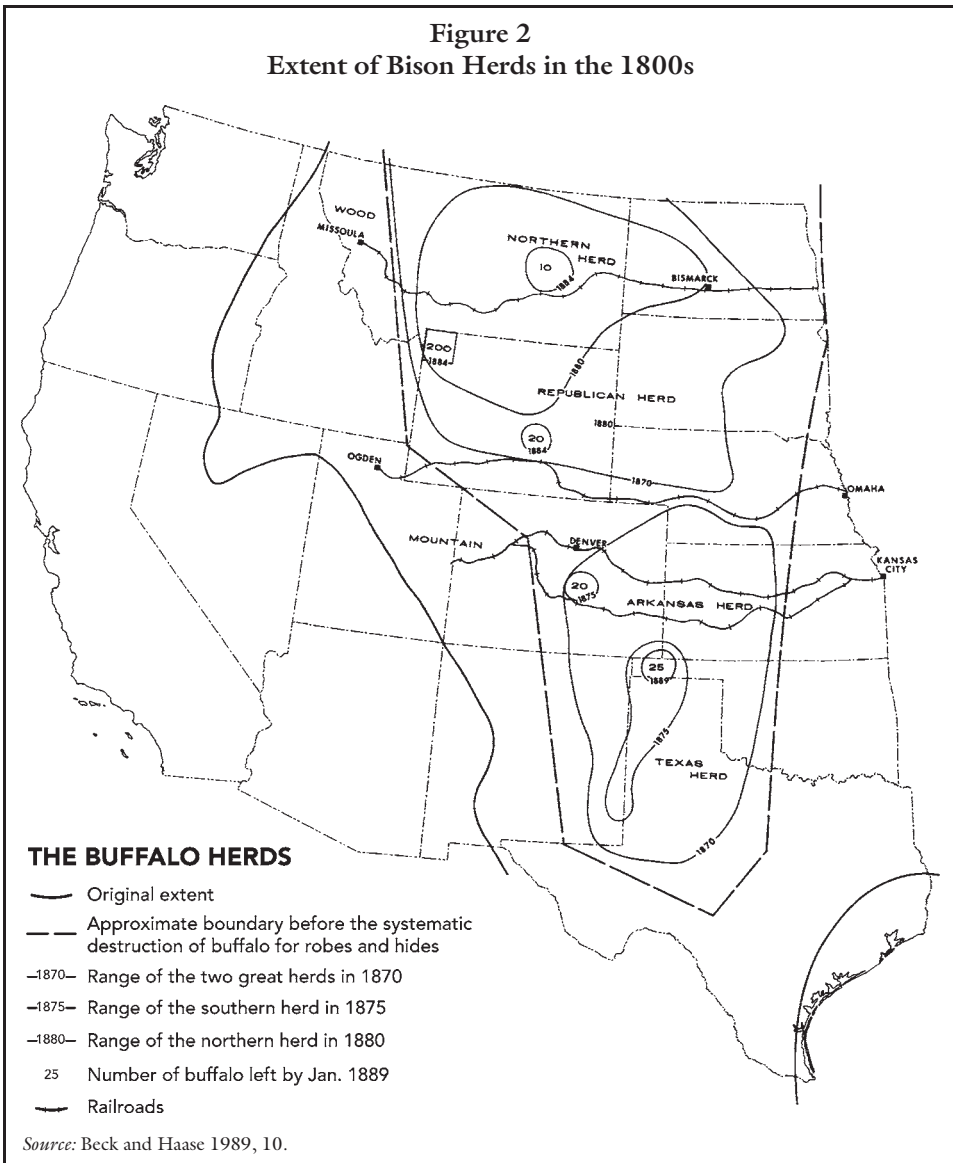
Railroads were reaching the West, so that it was possible to conceive of transporting bison meat to eastern markets. The first railroad reached Cheyenne in 1867 and Salt Lake City by 1869. Railroad service existed in Denver in 1870 and had gotten to Dodge City by 1872; it reached Bismarck in 1873 and Miles City by 1881. This was also the period in which gradual Indian pacification was occurring, making it feasible for bison ranchers to consider commercial production. In 1874,

7. The removal of the bison was for the cattle producers a positive externality. As James Buchanan and William Stubblebine (1962) point out, a subsidy is not always necessary to reach the efficient output in the presence of such externalities, particularly if the externality is inframarginal. The hide hunters provided the removal service through market incentives—namely, the price of hides—without the usual suggested remedy of a government subsidy.

8. Dan Flores (1991) has made the most reliable estimate of early bison populations in that he uses the 1910 agricultural census of cattle on the Great Plains to arrive at the carrying capacity for bison a century earlier. Other estimates based on contemporary evidence put the size of the herd much higher—between 60 and 100 million (Roe 1970; Hornaday [1889] 2002).

the Comanche were defeated in Texas, and in 1877 Crazy Horse surrendered, thus ending major threats of Indian depredation on the northern Plains. Figure 2 shows when railroads crossed the Plains and the extent of the bison range at various dates.

The other significant event of the period was the development of the ability to tan bison hides so they could be used as leather. C. C. Rister places the important innovation in Pennsylvania in 1871 when fifty-seven hides were consigned to tanners there (1929, 43). Taylor argues that English and German tanners were the first to discover a workable process for tanning bison hides (2011, 3168). In either case, by 1871 technological change in tanning meant that bison hides became almost identical



to cattle hides for commercial use. This resulted in a great demand for bison hides over the next decade, which meant that white hunters and the hide trade replaced the robe trade, which had largely been controlled by Native Americans. With hides fetching from \$3.00 to \$3.50 apiece at the railhead, thousands of hide hunters outfitted themselves with wagons, Sharps rifles, and crews of skinners. They could kill several hundred bison in a day, and their hides were stacked green, bundled, and hauled to railroads, where they were shipped east for tanning.⁹

The trade speeded up the harvesting of the bison remarkably. The western Kansas herd was eliminated in less than four years (1871–74); the herds in western Texas were exterminated during the period 1875–79; and the bison of eastern Montana were killed off between 1880 and 1883. In the face of such a rapid harvest, it is not surprising that the traditional model of the overexploitation of an open-access resource is applied to this near extermination. And it was the case that the conditions necessary for overexploitation were present. A valuable resource was unowned. Anyone could kill bison on the Plains as rapidly as they wished.

However, the tragedy of the commons was not a tragedy. The reasons are obvious if one recalls that exploitation is defined as occurring when harvest occurs at time t even though

$$DPV(B)_t > H(B)_t$$

and where

$$DPV(B) = \frac{\sum_{t=1}^n (R_t - C_t)}{(1+i)^t} \quad (t = 1, \dots, n).$$

Certainly after 1870, with the gradual pacification of the Indians and the coming of the railroads, ranchers saw the opportunity cost of bison on the grasslands as rising dramatically. This increase in opportunity cost wiped out the future value of bison—because in the near future the revenue from selling bison products would fall below their opportunity cost, the lost profits from having bison on the land instead of cattle—and meant that the killing off of the bison was a necessary condition for a more efficient form of production. No longer was the discounted present value of a bison greater than its harvest value. Bison herds both consumed the grass and disrupted cattle production, so their removal was virtually an economic necessity, not a tragedy or a waste of resources.

If it were the case that bison represented a viable form of production, one would have expected to see at least some entrepreneurs attempting to establish rights to bison and to raise them for the market. This project would not have been feasible after homesteaders entered the scene, but it is interesting that there is no record

9. Taylor estimates the rents to hide hunting compared to alternative occupations and finds those rents to be large (2011, 3179).

of ranchers prior to homesteading thinking of the bison as an alternative to cattle. Granville Stuart, an early rancher and entrepreneur, reports that

[i]t would be impossible to make persons not present on the Montana cattle ranges realize the rapid change that took place on those ranges in two years. In 1880, the country was practically uninhabited. One could travel for miles without seeing so much as a trapper's bivouac. Thousands of bison darkened the rolling plains. There were deer, antelope, elk, wolves and coyotes on every hill and in every ravine and thicket. In the whole territory of Montana, there were but 250,000 head of cattle including dairy cattle and oxen.

In the fall of 1883 there was not one bison remaining on the range and the antelope, elk were scarce. In 1880, no one had ever heard tell of a cowboy in "this niche of the woods" and Charlie Russell had made no pictures of them; but in the fall of 1883, there were 600,000 head of cattle on the range. ([1925] 1967, 2:185–88)¹⁰

If Stuart and other ranchers entering the range saw thousands of bison and nevertheless chose to replace them with cattle, that would indicate that they did not foresee bison as a viable economic converter of grass to meat. This was not because the meat was unpalatable or unattractive. Railroad crews depended heavily on bison for their sustenance, and early residents of forts often engaged in meat trade with Indians. But the major problem with the use of bison was a production one. In other words, in order for an open-access resource to be converted to private property, both the exclusion problem and the production problem have to be solved. On large ranches, it might have been potentially possible to solve the exclusion problem for a period of time, but the production problem loomed large. Even if something like the Individual Transferable Quotas that have worked in open-access fisheries¹¹ could have been established among a group of ranchers for bison, or even if there had been a single monopoly owner, it is unlikely that those bison would have been allowed to remain.

Of course, the difficulty of maintaining some sort of exterior fence to contain the migratory herds was not inconsequential. The National Bison Association

10. Stuart's statement that there were "but 250,000" "in the whole territory" refers to cattle in the mountain valleys of western Montana. There were few bison there. On the Plains (the eastern two-thirds of Montana), there were almost no cattle and no agricultural activity until 1882–83. Ernest Staples Osgood makes the same point: in the 1870s, "the center of the stock-raising industry still remained in the Beaverhead and Deer Lodge valleys" of mountainous western Montana (1929, 56). Osgood concurs with Stuart that the stocking of cattle came to central and eastern Montana after 1880, as "[b]uffalo hunters were clearing the way for them" (79).

11. Individual Transferable Quotas have successfully alleviated the open-access problem in numerous fisheries. These quotas establish harvest rights for each fisher and are set at a level that prevents over-exploitation (Leal 2005).

recommends a fence at least six feet high in order to contain bison. But the most serious production problem was not establishing property rights or even containing the bison to a particular area. Because of their intractability, bison cannot be gathered and trailed. There are no records of trailing a herd of bison from one location to another. Art Ray, a participant in a 1906 roundup, said, “Bison is nothing at all like a cow critter. A bison ain’t afraid of nothing and don’t stick with the herd like a cow will. And strong—a big bull could toss a horse and rider 50 feet! Weren’t no good to argue!” (qtd. in Kidder 1965, 60).

Bison are one of the large animals that Jared Diamond lists as having been subject to well-organized but unsuccessful efforts at domestication (1997, 167). One bison historian reports that even when raised from calves and gentled over a long period of time, “[bison] have almost always sooner or later turned on their trainers, and some of these latter have been killed by them” (Roe 1970, 897–98). And conventional wisdom among bison trainers is that 90 percent are seriously injured or killed by the animals they are working with (“One for the Record Books” 2008).

This meant that in order to market meat from a bison, the animals had to be killed on the site, where the meat was dressed, loaded onto a wagon, and then moved to a railhead. After 1872, refrigerated rail cars were available, so it would have been feasible to have slaughtered bison and moved them by wagon to the railroad, where they could have been transported to eastern markets. But the high cost of doing this is captured in several historical sources of data and anecdotes. John Hanner reports that “[e]ven in cold weather when meat could easily be saved, overland carriage across the plains was so demanding of time and effort that only bison killed within a short distance of a rail depot were normally butchered” (1981, 248).

Joel Allen (1876, 190) and William Hornaday ([1889] 2002, 498) provide estimates of the amount of meat and hides shipped on the Atchison, Topeka, and Santa Fe Railroad during the years 1872, 1873, and 1874. Depending on how one estimates the live weight and dressing percentage of a bison, the number of bison whose meat was shipped to market represented between 0.7 percent and 1.7 percent of the total number of bison slaughtered, where the number slaughtered is estimated from the number of hides shipped. Both Allen and Hornaday report that the railroad shipped 459,453 hides during that period and 2,250,400 pounds of meat. For this amount of meat, estimating the average weight of a bison at 1,200 pounds and the dressing percentage as 60 percent yields a figure of 3,125 bison. That would represent 0.7 percent of the total slaughter that was sent as meat. Allen does not tell how he arrives at his calculations, but he reports that the amount of meat would have represented between 3,000 and 8,000 bison. Even at his upper estimate of 8,000, that would mean that only 1.7 percent of the bison killed were marketed as meat.

The reason for the limited marketing of meat from bison was the cost of transport compared to the cost of transporting cattle. Jimmy Skaggs reports that “[f]or a flat fee, usually \$1.00 to \$1.50 per head, a trailing contractor furnished the drovers, wagons, supplies, and competent trail bosses and sold the cattle for the rancher on

a northern market” (1973, 3). Ike T. Pryor, who trailed thousands of head of cattle north, estimated his expenses for a 3,000 head herd as “[t]he salaries of [eleven drovers] . . . including the boss, were \$30.00 each for the ten men, including the cook, and \$100.00 a month for the boss. This gave an outlay of \$400.00 a month; and estimating \$100.00 for provisions, there was an expense of \$500.00 a month to move a herd of 3,000 cattle 450 to 500 miles” (qtd. in Skaggs 1973, 3).

Since the distance from most of the Texas trailheads to some of the farthest places of delivery was 1,800 miles, each head in a 3,000 head herd would cost \$1.33.¹² Paul Wellman reports a similar figure of \$1.00 per head for moving 3,000 head from Texas to Montana ([1939] 1967, 111). Skaggs also reports that ranchers used a rule of thumb of 60 cents per head for every 1,500 miles traveled (1973, 8). A federal government study in 1886 estimated that the cost for 1,000 miles of travel at 50 cents per head or 75 cents for 1,500 miles (U.S. Congress 1885–86, 4).

The difference in the cost estimates from 60 cents to \$1.50 most likely reflected the probability of loss on the trail. The lower numbers usually represent an estimate of the cost of provisions and labor, and the higher estimates include coverage for loss to Indians, thieves, and disease. For instance, in 1885 a firm located in Abilene, Texas, wrote a letter to a Mrs. S. A. Camel of Abilene, reporting that 96 head of her cattle had been inadvertently trailed to Montana and sold there (Skaggs 1973, 7). The trailing firm, the Spur ranch of Abilene, remitted the proceeds of the sale minus the cost of trailing paid to the trailing company (\$83.00) and \$60.00 for the loss of 3 head. The average cost was thus \$1.49 for trailing the cattle north, including the cost of loss.

The comparison that I want to make is between the costs of moving cattle from pasture to railheads by trailing versus the cost of hauling slaughtered bison to the same railheads. Because in those conditions it is unlikely that there was much of a chance for Indian theft or other depredation, I have used \$1.00 per head for 1,500 miles as my basic cost.

For bison, the alternative was to kill them wherever they were found, dress them, and load them in a wagon. Therefore, one needs the cost of wagon transportation. Robert Fogel cites a U.S. Department of Agriculture study reporting that wagon haulages averaged 20.5 cents per ton-mile in 1906 (1964, 56). He argues, “There is no evidence that wagon rates fell over the 50 years leading up to 1890. There were no major innovations in wagon construction nor any marked improvements in roads” (56). However, the 1906 data have to be adjusted for price changes, and because of falling prices throughout the end of the nineteenth century, in 1870 the wagon haul

12. The distance from Ft. Worth, Texas, to Miles City, Montana, is 1,549 miles; from San Antonio, Texas, to Miles City, 1,812 miles; from San Antonio to Bozeman, Montana, 1,823 miles; from Ft. Worth to Bozeman, 1,560 miles; and from San Antonio to Williston, North Dakota, 1,813 miles. Early trail herds varied in size from 70 to 25,000, but 3,000 was settled on as the optimal size (Anderson and Hill 2004, 144).

rate would equal 30.6 cents per ton-mile. This cost can be compared to one cent per ton-mile for trailing cattle.¹³

Finally, one has to recognize the fact that it was slaughtered meat that was delivered when bison were hauled by wagon, but it was live meat (cattle on the hoof) that was being transported in the case of cattle. Dressing percentages average around 60 percent, so 40 percent of a ton-mile of driving cattle was waste. A one cent per ton-mile charge for trailing cattle thus converts to 1.67 cents.

My final estimates indicate that the cost of delivering bison meat to the railhead was approximately 30 cents per ton-mile compared to 1.67 cents for delivering cattle. Given the large difference between these rates, it is not surprising that ranchers were loathe even to consider bison as a viable alternative to cattle production on the Plains. This also explains why bison were a common source of meat for travelers across the Plains, railroad crews, and early settlers. In those cases, a bison could be killed within a short distance of the point of consumption and transported to that place. But in order for viable economic production to occur, there had to be a way of transporting meat to distant markets.

Transporting cattle had an additional advantage in that they could be moved live to the slaughterhouse, eliminating any danger of spoilage. In contrast, because bison had to be slaughtered at the place where they were found, they could be transported only in the wintertime, by refrigerated car, or after preservation, such as the pickling of tongues. Because all of these alternatives cost much more than trailing cattle to the railroad and then hauling them live to the eastern slaughterhouses, it is clear why ranchers did not consider bison a viable option. It is also of importance that trailing cattle to market was the dominant way of moving livestock from western ranches until the 1930s.¹⁴

The Possibility of Short-Term Waste

It is understandable why observers thought that they were seeing the overexploitation of an open-access resource and why modern analysts have repeated the same story.

13. If it took 2.5 head of cattle (800-pound animals) to make a ton, that would mean it cost \$2.50 for trailing a ton 1,500 miles. This amount implies a ton-mile cost of \$.0016 for trailing cattle. One also has to adjust these figures, which are from the 1880s, for price changes. I assume the figures given are for 1886 and have converted them to 1870 dollars using Warren and Pearson's Wholesale Price Indexes (Carter et al. 2006, Series Cc113-24, 3:182-83). Prices were falling during this period, so if it cost \$2.50 to trail a ton 1,500 miles in 1886, that would be equivalent to \$4.11 in 1870. This would convert to \$.0003 per ton-mile. However, this figure is based on an optimal size trailing herd of 3,000 head. Assuming that one should double the cost because not all ranchers could put together an optimal size herd for trailing to the railroad, it would still have cost less than \$.01 a ton-mile to trail cattle from a ranch to a railroad yard. So I take \$.01 as an upper-bound estimate of the cost of trailing cattle to market. Finally, I have not included the additional cost of refrigerated cars in the case of the shipment of slaughtered bison, which would only have increased the attractiveness of cattle.

14. This information comes from Robert Barthelmeß, curator, Range Riders Museum, Miles City, Montana, whom I interviewed by telephone, August 1, 2005.

And it is possible that there was some waste in the process. There is little doubt that in the long term large herds of bison were not economically viable on the Plains. They were doomed by the greater profitability of cattle. In the 1880s, a bison hide that was delivered to Miles City, Montana, was worth about \$3.00, but a cow delivered to that same point was worth \$20.00 to \$25.00 (Anderson and Hill 2004, 100). But did the rapid removal of the bison represent wasteful activity? In other words, if ranchers would have had complete property rights to the bison when they arrived with their cattle herds, would they have found a less wasteful method of disposing of the bison?

If there was waste, it was because the process of eliminating bison used too many resources or resulted in a harvesting process that did not allow the maximum value to be obtained from them. In terms of the market for bison hides, the rapid rate of harvest did not drive down the price of hides, and so it does not appear that the harvest was too rapid in the sense of oversupplying the hide market.¹⁵ Therefore, waste, if it occurred, was because of overcommitment of resources to harvest or to killing of bison, for which no economic value was obtained. With respect to the first question, it is not clear that a slower process would have used fewer resources. The supply curve of labor appears to have been close to perfectly elastic, and the other resources (ammunition, skinning knives, and wagons) also would have cost approximately the same with a slower process of killing.

Therefore, the main costs appear to have been (1) getting accurate information about where to hunt bison; (2) harvesting before cattle were present, resulting in an unused resource (grass) for a period of time; and (3) harvesting at a rate that resulted in wasted carcasses. The information problem was a real one in that the hunters were pursuing a migratory herd, and it was difficult to know where and how many bison would be found. In fact, in the fall of 1883 some hunters outfitted themselves in Miles City and went out to search for nonexistent herds (Hornaday [1889] 2002, 512). However, more accurate information was rapidly generated about the extermination of herds and any overcommitment of resources was short-lived.

In terms of a lag between the killing of bison and their replacement by cattle, it appears to have been brief.¹⁶ Cattle trailing started from Texas in 1866, and by 1874 the Western Trail went through the heart of bison territory.¹⁷ Douglas Branch reports that “[w]hile buffalo in countless numbers were roaming in western Kansas, in 1868 at Abilene, in eastern Kansas, there arrived fully seventy-five thousand cattle from Texas prairies” ([1962] 1997, 150).

15. Taylor (2011) finds that the rapid entry of buffalo hides into the hide market in the early 1870s and the complete exit of those hides from the market had no noticeable impact on world hide prices. He estimates that even in the peak year of 1875, bison hides were only 3 to 4 percent of total world hide exports.

16. Given positive costs of information, it is difficult to imagine a situation where there would be no lag between the killing of bison and the presence of cattle. Some adjustment time to new conditions almost always results whenever resources are transferred from one resource to another.

17. It took from two to three months to make the trip from the southern ranges to the northern ones.

In eastern Montana and western South Dakota, the main harvest occurred from 1881 through the summer of 1883. In the fall of 1881, however, 5,000 head of cattle were trailed to the mouth of Otter Creek in southeastern Montana, and by October 1883 there were 600,000 head in the region (Fletcher 1960, 54). Hanner estimates that by 1890 there were more cattle on the High Plains than there were bison in 1870 (1981, 261).

Perhaps the greatest rent dissipation came from the race to kill bison that resulted in wasted carcasses. Hornaday estimates that in early hunts only one-third of the kills resulted in a marketable hide (1889 [2002], 512). But the hunters seemed to have adjusted rapidly to coordinate their killing with the capacity of their crews to skin and prepare hides. One hunter reported that “[w]e never killed all of the buff we could, but only as many as our skinners could handle. Every outfit had its quota, which was determined by the ambition and the number of skinners. My regular quota was twenty-five a day, but on days when my crew weren’t tired, I sometimes would run this up to 50 or even 60. But there I stopped, no matter how plentiful the buff were. Killing more than we could use would waste buff, which wasn’t important; it also would waste ammunition, which was” (qtd. in Dary 1974, 103).¹⁸

One should also remember that there was little effort to change the institutions to slow down the hide harvest. Several states passed statutes to regulate the harvest (Hanner 1981, 255–63), but enforcement was lax and had little effect on harvest rates. Why didn’t institutions evolve to change the open-access nature of the bison? Numerous institutional adaptations on the frontier created property rights when resources became more valuable (Anderson and Hill 2004). But people did not see the bison as becoming more valuable; instead, they saw them more and more as a nuisance and so devoted few resources to changing the rules to protect them.

Thus, one cannot answer the question of waste definitively. There was undoubtedly some rent dissipation because of the open-access nature of the resource, which meant for a rapid removal of bison. This level of waste or dissipation, however, was hardly sufficient on its own for the bison to qualify as a tragedy of the commons. It appears that bison harvest evolved quickly to a relatively efficient operation, and it also seems that the timing was close to optimal from the ranchers’ perspective.

The Nonconsumption Value of Bison

But so far all of this discussion has concentrated on the bison’s commercial value. What about other values? Wasn’t there a tragedy in terms of the desire to see these majestic shaggy animals alive? Didn’t they have an existence value that meant that the killing of several million bison did represent a tragedy? It is difficult to calculate

18. The same hunter, in estimating his costs, said, “At the very outside cartridges cost 25 cents each” (qtd. in Dary 1974, 103). A bison hide sold for \$3.00, so cartridge costs were a significant part of the hunter’s outlay.

how many bison are necessary to satisfy the noncommercial demand for bison, but it is clear that when the numbers of bison reached a small amount (probably less than 100,000), entrepreneurs recognized that the marginal value of preserving a bison had increased and took steps to preserve them. Rancher Charles Goodnight captured a few bison calves near his ranch in 1878, and they became the foundation of a herd that still exists (Lunsford 2005). In the winter of 1872–73, a Pend d’Orielle Indian who lived with the Flatheads found eight orphaned bison calves and captured them. By 1884, his herd had increased to 13 head, and he ended up selling them to Charles P. Allard and Michel Pablo. It is interesting that the purchase price was approximately \$154 per head at a time when cattle were selling for around \$25 per head (Kidder 1965, 58). The bison were run on the Flathead Reservation in northwestern Montana, and the herd grew to 300 head by 1896. When Allard died, his share of the herd was sold in small lots to several buyers, but Pablo kept his herd intact. He cared enough about preserving them that he posted the following bulletin:

Notice: All persons are warned that the bison on this Reservation are private property, and are so regarded by the United States Government, whether grazing on Indian Tribal lands or on land open to homestead entry.

Any person found annoying, injuring or killing any of them will be punished as the law provides.

I hereby offer a reward of \$100.00 for the arrest and conviction of any person who kills or injures any of the bison or for any evidence leading to arrest and conviction. Signed M. Pablo. (qtd. in Kidder 1965, 59 n. 18)

In 1906, Pablo learned that the Flathead Reservation would be open to homesteaders and believed that it would be difficult to maintain his herd, so he attempted to sell it to the U.S. government but was unsatisfied with the price offered. He finally sold the herd to the Canadian government for \$200 a head (Kidder 1965, 60). The roundup was difficult, taking more than five years to complete.

The efforts to preserve the bison once their marginal value as an ecological curiosity rose were successful. There currently are numerous bison ranches, some of them attempting to produce bison for the meat market. Herds also exist on public preserves such as Custer State Park in South Dakota, Yellowstone National Park, and the National Bison Range. The National Bison Association reports that there are 450,000 bison in North America, with about 220,000 of those in the United States.¹⁹ Approximately 90 percent of the bison in the United States are in private hands, with the remainder in public parks and preservers.

19. For this information and more from the National Bison Association, see <http://www.bisoncentral.com>.

Conclusion

The history of the American bison is one of rational individuals operating under an institutional framework that did not create a tragedy of the commons. It is true that property rights were not well defined and established for bison on the open prairies, but because bison were not a valuable resource, property-rights entrepreneurs put little effort into establishing rights for them. And even if there had been well-defined and enforced property rights, cattle would still have replaced bison as the primary converter of grass on the Great Plains. The adjustment from bison to cattle may not have been perfect, but there is no evidence of large-scale rent dissipation. When bison did become valuable as they came close to complete extermination, entrepreneurs established rights to live animals and prevented their complete demise. Thus, economists who wish to describe how rational individuals under an open-access resource will overuse that resource should turn to some other example than that of the American bison. And economists should recognize that other situations of rapid depletion of a resource do not necessarily represent the tragedy of the commons if the analysis has ignored important opportunity costs.

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