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THE ASSIGNMENT OF PROPERTY RIGHTS ON THE WESTERN FRONTIER:
LESSONS FOR CONTEMPORARY ENVIRONMENTAL AND RESOURCE POLICY

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The Assignment of Property Rights on the Western Frontier: Lessons for Contemporary Environmental and Resource Policy

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ABSTRACT

In addressing environmental and natural resource problems, there is a move away from primary reliance upon centralized regulation toward assignment of property rights to mitigate the losses of open-access. I examine the assignment of private property rights during the 19th and early 20th centuries to five natural resources, mineral land, timberland, grazing and farm land, and water on federal government lands in the Far West. The region was richly endowed with natural resources, but assigning property rights to them required adaptation from established, eastern practices as defined by the federal land laws. The property rights that emerged and their long-term welfare effects provide a laboratory for examining current questions of institutional design to address over-fishing, excessive air pollution, and other natural resource and environmental problems. A major lesson is that property rights allocations based on local conditions, prior use, and unconstrained by outside government mandates were most effective in addressing not only the immediate threat of open-access, but in providing a longer-term basis for production, investment, and trade. Another lesson is how hard it is to repair initial faulty property allocations. Accordingly, path dependencies in property rules are real, and they have dominated the economic history of resource use in the West.

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“This is what stretched westward from the 100th meridian, this complex, misunderstood two fifths of the continental United States where men had come before law arrived and where before there were adequate maps there were warring interests, white against Indian, cattleman against sheepman and both against nester, open range notions against the use of the newly invented barbed wire, Gentile against Mormon, land rights against water rights, appropriation rights to water against riparian rights to water, legitimate small settler against speculator and land-grabber. The public domain as Powell knew it was all of these, its only unity the unity of little rain.” (Wallace Stegner, 1954, *Beyond the 100th Meridian: John Wesley Powell and the Second Opening of the West*, 218).

I. Introduction.

In addressing environmental and natural resource problems, there is a move away from primary reliance upon centralized regulation toward assignment of property rights of some sort to mitigate the losses of the “Tragedy of the Commons.”¹ For instance, a recent survey worldwide found that tradable use permits were used in 9 applications in air pollution control, 75 in fisheries management, 3 in water allocation, and 5 in land use regulation.² These institutional innovations have taken place as the resources have become more valuable, as they have faced growing open-access or common-pool losses, and as dissatisfaction has increased with existing regulatory policies.³

The advantages of property rights arrangements include better alignment of incentives for investment in the resource, provision of collateral for accessing capital for investment, more flexible exchange, greater information generation, and improved cost savings in meeting conservation or environmental objectives.⁴ The more complete are property rights, the more the private and social net benefits of resource use coincide, reducing externalities and the associated losses of the common pool.⁵

Despite the attractions of property rights to address some resource and environmental problems, they remain controversial, limiting or slowing their adoption. Allocation especially is contentious because of the assignment of wealth and political influence associated with exclusive property rights. Property rights are political institutions and the underlying negotiations determine the nature of the rights arrangements that ultimately emerge, their timing, and effectiveness.⁶ As emphasized by Coase (1960), allocation rules are always important for distribution and they affect output possibilities in the presence of transaction costs.

Contemporary policy discussions about crafting responses to the common pool can receive guidance from research in American economic history on the development of property institutions on the frontier. I examine the assignment of private property rights during the 19th and early 20th centuries to five natural resources, mineral land, timberland, grazing and farm land, and water on federal government lands in the Far West. The region was richly endowed with natural resources, but assigning property rights to them required adaptation from established, eastern practices as defined by the federal land laws. The property rights that emerged and their long-term welfare effects provide a laboratory for examining current questions of institutional design to address over-fishing, excessive air pollution, and other natural resource and environmental problems.

As the above quote suggests and as we will see, western institutions encountered many of the same information, political, and planning problems that are encountered today. Some were successful, whereas others were not. A major lesson is that property rights allocations based on local conditions, prior use, and unconstrained by outside government mandates were most effective in addressing not only the immediate threat of

open-access, but in providing a longer-term basis for production, investment, and trade. Western mineral rights stand out in this regard. In contrast, federal government limits on allotment size, use, and exchange had long-term negative consequences. Homestead distributions of 160 acres for farming only are the prime example.

Another lesson is how hard it is to repair initial faulty property allocations. Whereas Coase emphasized transaction costs in private negotiations, political transaction costs are especially important in the assignment and subsequent modification of property rights.⁷ Once an allocation rule is established, it becomes very difficult politically to modify. Many constituencies develop a stake in the *status quo* and the distributional implications of any change in it can be both large and uncertain. These factors complicate the development of bargaining positions in negotiations for institutional change. Moreover, these same problems raise the transaction costs of private efforts to make property rights structures more efficient.⁸ Accordingly, path dependencies in property rules are real, and they have dominated the economic history of resource use in the West.

II. Allocation Rules and Transaction Costs.

There are a number of ways to assign property rights:

First-possession.

First-possession assigns ownership on a first-come, first-served basis or first-in-time, first-in-right. First-possession rules are attractive because they recognize incumbent parties, who have experience in exploiting the resource and hence, may be the low-cost, high-valued users.⁹ Incumbents also have a direct stake in access to the resource and will be important constituents in a property rights distribution. These parties are concerned about any past investments in specific, non-deployable assets. By recognizing such

investments first-possession rules encourage future outlays. Allocations that do not consider the position of incumbents will face opposition, raising the costs of rights assignment and enforcement. Grandfathering in initial allocation often has been a necessary ingredient in building the political support for property rights allocations.¹⁰

There are other reasons why first-possession rules can be efficient. They recognize first-movers, innovators, entrepreneurs, who initially experiment with and use a resource. Society benefits from innovative, risk-taking activities. Further, under first-possession the market can determine optimal claim size, whereas under other allocation arrangements bureaucratic or political objectives may define the assignments. If these are not consistent with optimal production size, then further trade is required, and if transaction costs are high, such exchange might be limited. Hence, first-possession can economize on transaction costs.¹¹

First-possession has been criticized on fairness grounds because it discriminates against new entrants, and existing holdings may be large. There are wide-standing views that “people should get what they deserve and deserve what they get.” If first-possession ownership is viewed as rewarding those who by luck and connections got early access, then it may be opposed politically.¹²

First-possession also has been criticized for leading to rent dissipation if homogeneous claimants race to establish property rights (Anderson and Hill, 1990). But if the parties are heterogeneous with respect to cost and the resulting rights are secure and permanent, then full dissipation will not occur. Moreover, the “winners” of such a race may be the most efficient producers.¹³ First-possession rules often include beneficial use stipulations and these can instill heterogeneity by requiring that claimants place the asset

into production. This requirement can act as a sorting device for potential claimants.¹⁴ There also are costs of measuring and verifying past use claims, and other potential rent-seeking actions to secure the most favorable baseline period and criteria for allocating property rights. There are, however, costs with any rights allocation rule and there is no reason to believe that first-possession is more costly than other assignments. Generally, if the transaction costs of subsequent exchange are high, then it makes sense to assign rights to low-cost users with histories of past involvement in the resource.

Uniform Allocation.

Uniform sharing rules meet egalitarian goals by providing equal-sized allotments or equal opportunities. If there are no restrictions on subsequent exchange of property rights and transaction costs are low, there are few efficiency implications. The resource still migrates to high-valued users and to optimal production sizes. But if exchange costs are high, then inefficiently small (or large) distributions can persist. Uniform allocations, however, avoid the measurement costs of verifying claims of past production or of documenting precedence claims that are part of first-possession assignments. They also can circumvent the costly pursuit of or rush for property rights when first-possession is known to be the allocation rule. They work best when there are no incumbent users whose informal claims may not be consistent with more equal distributions.

Auction.

A third allocation mechanism is auction, and there are various types.¹⁵ It can directly place the asset into the hands of those who have the highest value for the asset. It thereby avoids the transaction costs of re-allocation. Auctions transfer rents to the state (as the seller). Auctions also generate information about resource values. As with

uniform allocations, auctions work best for unallocated resources where there are no existing claimants and where resource values are high. By granting more of the rents to the state, auctions reduce the distributional implications of first-possession. The amounts and distribution of rents, however, depend upon auction design, which can be complex. There are other costs to auctions. The state must be able to measure and enforce resource boundaries and the individual allocations that are auctioned off. The terms of the auction may also be influenced by competing claimants who lobby for rules that provide them with specific advantages.¹⁶ It is often argued that auctions can transfer rents to the state without important distortions or incentive effects for resource users. But caution is in order. The effect depends on meeting restrictive conditions in auction design that may not be feasible. In a similar setting, Johnson (1995) has shown that the imposition of taxes on quota rents in ITQ (individual transferable quota) fisheries could lead to reduced incentives of fishers to conserve (invest in) the fish stock.

Transaction Costs.

Property allocations are affected by transaction costs. They arise due to limited and asymmetric information about the open-access problem; the physical nature and value of the resource; and number and heterogeneity of the competing parties.

Information and Transaction Costs.

Garrett Hardin (1968, 1247) asserted that “mutual coercion, mutually agreed upon by the majority of the people affected” in the form of regulations, prohibitions, or property rights would be agreed to because “the alternative of the commons is too horrifying to contemplate. Injustice is preferable to total ruin.” But Hardin glossed over some key information problems. The losses of the commons and the design of the most

effective arrangements to address them are not always so apparent to the people affected and information about those losses often is asymmetrically distributed and not easily or credibly conveyed from one party to another. Hence, critical parties may not see the need for action. Others may adapt well to or benefit from open-access, at least in the short term, and resist what they believe to be unnecessary regulation.¹⁷

There typically are disagreements about the seriousness of the problem, as well as when and how it is to be addressed. For these reasons, empirical regularities are that most environmental and natural resource commons dilemmas and (*ex post*) inappropriate institutions are not responded to until late when the problems have become very serious. By that time, disputes over their magnitudes decrease and the costs of not taking more appropriate actions swamp concerns over the distribution of the costs and benefits involved. Unfortunately, also by that time, many of the resource rents have been dissipated and the environmental losses made irreversible.¹⁸

Moreover, the private and political costs of adjustment can be very high, and the process can take a long time. Once property rights are assigned, individuals make production and investment decisions on the basis of them. Some involve fixed capital investments and other input obligations. Communities and other economic and political constituencies form around these practices and develop expectations for resource use and economic opportunity around them. More appropriate rights allocations may involve very different input mixes and production processes, requiring those who have had a stake in the old arrangement to adjust. But the economic alternatives for them may be very uncertain and limited, fueling political opposition to any change and demands for side

payments. These political side payments in themselves change the rights structure that emerges.¹⁹

Resource Characteristics and Transaction Costs.

More mobile or unobservable resources are associated with more uncertainty and with higher measurement and enforcement costs in assigning property rights. As a result, ownership is sometimes granted only to the flow of output (rule of capture) because extraction is more easily measured than is the stock. This is an incomplete assignment of property rights, however, and it can still lead to rent dissipation and premature depletion of the stock.

More valuable resources also are associated with higher enforcement costs because there are more claimants and potential entry. At the same time, as open-access losses increase for valuable resources, the returns to the assignment of property rights rise. Capturing a portion of rents that are saved is the motivation for individual parties to establish ownership institutions.²⁰ As outlined by Demsetz (1967) more valuable resources tend to have more precise property rights because the greater benefits from definition and enforcement offset the higher costs of doing so.

Number and Heterogeneity of Competing Parties and Transaction Costs.

Both of these factors raise the costs of assigning property rights. The larger the number of claimants, the greater is the potential for free riding, holdup, and defection. In contrast, smaller, more homogeneous groups are better able to find consensus on the allocation of property rights. This suggests that the assignment of ownership to new resources with no pre-existing claimants can occur at less cost than is the case for established resources with heterogeneous incumbent claimants and new entrants. Ostrom

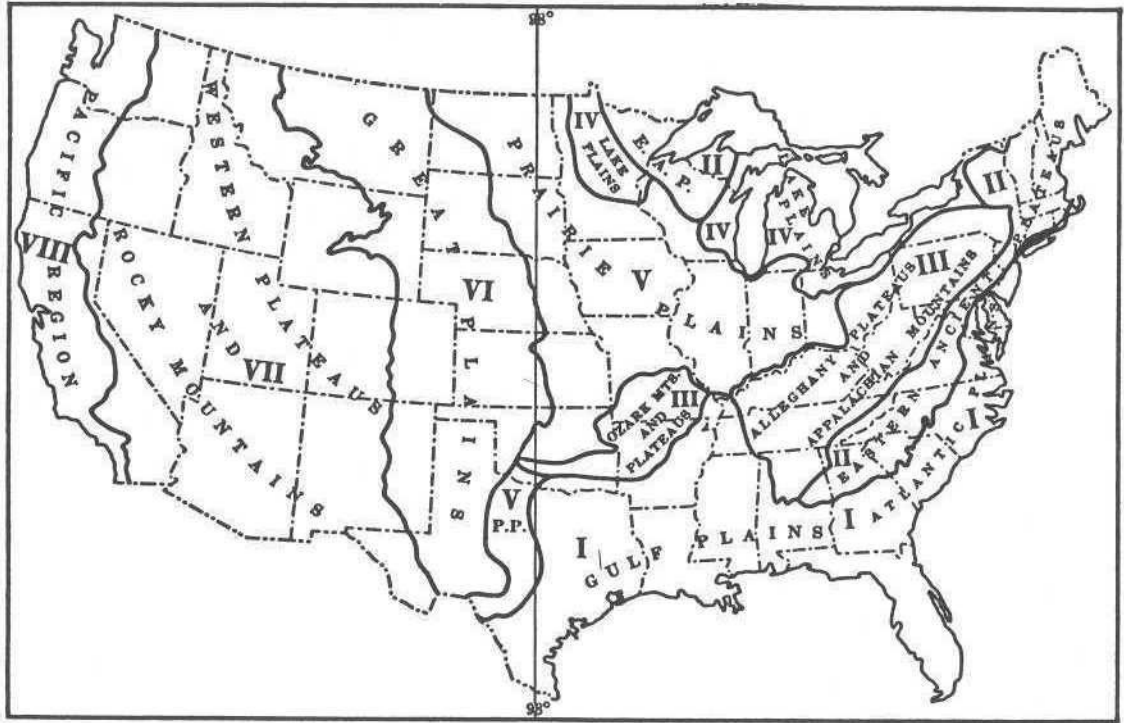
(1990) and others have shown that small homogeneous groups with frequent interaction can effectively reach agreement on resource allocation and use. These groups often use community property rules to mitigate open-access problems and enforce them through norms and customs. These arrangements, however, may not be sustainable in the face of exogenous increases in price and entry by large numbers of heterogeneous new claimants.

III. American Land Policy and the Allocation of Property Rights: The Special Problems of the Far West.

Early American land policy developed around agriculture with Northwest Ordinance of 1785, the various Pre-emption acts, other statutes that progressively lowered land prices, and most importantly, the Homestead Act of 1862 and related land laws.²¹ Under that law any family head, who was at least 21 years old and who was a *bona fide* settler, could claim between 40 and 160 acres and upon paying fees and commissions and satisfying the 5-years continuous residence and improvement (*cultivation*) requirement, receive title.

Federal land policy provided an *ex ante*, systematic framework for surveying, demarcating, and allocating government land to private individuals. The Midwest, where the policy most applied, was characterized by extensive areas of very rich soil, relatively flat terrain, abundant precipitation, and a temperate climate. Through 1880, about the time that the frontier moved beyond the 98th meridian (Figure 1), millions of acres of federal land had been distributed for agricultural use to the states for schools, universities, and internal improvements, to railroads to subsidize their extension, and to individuals through sale, military warrants and scrip, and provisions of the public land laws.²²

Figure 1
The Far West



Source: Hansen and Libecap (2004a, 107).

The Far West, however, was at once remote from established federal land policy and at the same time inhospitable to it. There also were different resources beyond agricultural land that private claimants desired. Accordingly, when settlers followed the movement of the frontier across the continent, the new conditions they encountered required modification of established property rights policies. This situation allowed for local, private arrangements to emerge that in some cases were incorporated into state and federal law and remain in force today, whereas in other cases, they either were constrained by exogenous formal distributional mandates and or never developed officially due to limited information about appropriate production and allotment size. The lingering effects of these varying institutional responses for resource allocation and use were sharply different. They molded the economic history of western regions.

IV. Mineral land.

The development of private mineral rights on federal land has been more thoroughly examined than for any other western resource. Major works include those by Umbeck (1977a, 1977b, 1981), Hallagan (1978), Libecap (1978, 1979), Morriss (1998), Zerbe and Anderson (2001), Clay and Wright (2005), and Stewart (2006b).

Western mineral rights developed abruptly with the discovery of gold in 1848 at Sutter's Mill in California.²³ Within weeks thousands of prospectors poured in the area, and the population of California jumped from approximately 50,000 in 1848 to 89,000 in 1849 and to 220,000 in 1852, with most concentrated in or near the gold region in the Sierra foothills.²⁴ These prospectors, however, had no official sanction to claim mineral land since it was not addressed in federal land law and initially, there was no civilian government to provide a legal framework for assigning property rights. As a result, miners devised local, private property arrangements within mining camp rules. For the next three decades or so, other prospectors followed as the gold and silver rush moved to Nevada, Montana, Colorado, Idaho, the Dakotas, and Alaska. Eventually, well over 600 mining camps were established around the West.²⁵

Since private mineral rights were based on local negotiations with virtually no outside constraint, the market determined the allotment mechanism, individual claim size, as well as conditions for exchange, maintenance, and enforcement of property rights. For this reason, western mineral rights provide a baseline for comparison with the other property rights arrangements described below.

Mining camp rules were drafted quickly because the number of individuals in each area was small, and they had relatively homogeneous backgrounds and expectations.

Further, there were high expected gains of avoiding disruptive conflict over mineral ground. Rules were drafted whenever 20 to 30 prospectors congregated in a new mining district, and Zerbe and Anderson (2001, 119) report that in cases the populations were 75-90 percent American or of European origin. Reid (1980, 18) characterized most miners as possessing above-average levels of schooling, with many being doctors, lawyers, and other professionals. Umbeck (1981, 53) also noted that prospectors had the same limited prospecting skills and early on, none had information advantages regarding the location of ore.²⁶ By contrast, (Zerbe and Anderson, 2001, 135-136 and Stewart, 2006b, 21) point to the absence of cooperation in the Sonoran mining camp in California, which was populated by large numbers of Mexican and American miners, who had very different conceptions of cooperation, justice, and the law.

First-possession to a single, specific location of mineral land was the allocation rule.²⁷ The first prospector to arrive at a location thought to have deposits of valuable ore was granted private claiming rights. Each party had, at least in principle, an equal chance at first choice of a spot. Accordingly, first-possession encouraged socially valuable search and exploration. And those who discovered a new district typically were granted two mineral claims, whereas all others were allowed a single claim.

Each mining claim had to be marked and worked according to local mining camp rules. For example, one district in 1852 required miners to work their claims at least one day out of three during the mining season, and another in 1853 specified that a miner was to dig a ditch on his claim “one foot wide and one foot deep” within three days of locating a claim.²⁸ Abandoned claims could be occupied by others. In the meantime, others were prohibited from entry until the claim was deemed to be abandoned.²⁹

Indeed, given the uncertainty of the location of ore, prospectors expected to locate and move numerous times before striking it rich, so that they needed a flexible way of obtaining and relinquishing the right to search for ore in any particular place (Clay and Wright, 2005). As uncertainty was reduced through ore discoveries, accommodating search became less important than supporting investment and production so that enforcement of valuable claims against trespass became more critical. Mining camp rules provided for procedures for arbitration of disputes and for punishing violators of the rules. Most mining codes specified that property conflicts be resolved in courts before juries of a dozen or more miners.³⁰

Although there was variation both across the mining camps and across time, mining codes always placed a limit on claim size that varied according to the type and expected value of the claim. Importantly, these claim sizes, however, were determined by local factors, not outside government requirements. Smaller claims were allowed in potentially richer stream beds where gold was thought to concentrate and water for extraction was nearby, whereas larger claims were allowed on drier hill sides that offered lower prospects.³¹ Enforcement costs were likely higher for the more valuable stream claims necessitating smaller individual holdings, than for the less attractive hillside claims. In the early period of a mining district's development, all placer (surface) and quartz (deep vein) ore claims tended to be small, for example, 50 to 100 feet wide traveling to the center of a stream for placer claims and 200 feet slices along the exposed vein for quartz claims.³² But mining camp rules were flexible, so that as ore played out, claim sizes were extended.

While placer claims were bounded in terms of surface area, quartz claims were

assigned to the ore veins themselves and were separate from surface ownership. Extra lateral rights were granted whereby the vein owner was allowed to follow the deposit wherever it traveled beneath the surface. Naturally, disputes occurred because of the limited information that existed about the location of subterranean ore. Moreover, veins frequently merged. Sorting through conflicting claims required action by the courts in determining who the wielded the legitimate property right.³³

In general there were no restrictions on the private sale of mineral claims. In the very early development of some mining districts there were limits on trading, possibly due to the costs of marking, enforcing, and exchange during a time of great uncertainty regarding the location of ore and associated movement of prospectors from point to point. But as conditions settled, sale became routine, first to allow entry to those without any land in the district and then, to consolidate claims for more capital intensive production. Some claims sold for a great deal and mining companies incorporated and sold shares on the San Francisco Stock Exchange and other western financial markets to raise capital.³⁴

Camp rules initially were informal and gradually were given more structure as mining values rose, the number of claimants and congestion increased, and as the technology of mining and the nature of the ore and extraction changed.³⁵ They were incorporated into territorial and state law. For example, in 1851, the California Legislature recognized the rights of miners to establish their own rules regarding mining claims in an amendment to the Civil Practice Act. The amendment required that the courts should receive proof of the customs, usages, and regulations established in the mining camps unless they conflicted with laws of the state.³⁶ Libecap (1978) analyzed the refinement of Comstock Lode mineral rights over time by the Nevada Territorial and

State Legislatures and Judiciaries as property values changed with new ore discoveries.

Because of the remote location of the ore, the rapid spread of local rules and the high costs of dislodging them the Federal Government had little choice but to accept the mining camp practices in the Federal Lode Law of 1866 and the Mining Law of 1872 that provided for fee simple title.³⁷ There also were no other competing constituencies for federal mining land. Ore discoveries preceded agricultural settlement in most areas, and in any case, mining regions generally were not suitable for farming.³⁸ This was not to be the case for other western resources, but it allowed miners a relatively open hand in forging local property rules and in galvanizing territorial and state legislatures and courts to respond to the demands of the mining industry and in obtaining federal recognition of their property rights.³⁹

Mining involves high risks and costs in finding and developing ore deposits. Most sites turn out either to have no ore or not to be profitable. Moreover, there are significant fixed-capital investments with long lead times for extraction, transport, and refining that are vulnerable to unanticipated changes in prices and costs and to expropriation through high tax rates or government seizure. The American hard-rock mining law that developed out of the mining camps, however, provided secure ownership. There has been no history of high taxation, significant payments for receipt of title, or threatened nationalization. The accompanying security of property rights encouraged exploration and production. Further, American mining engineering schools and technologies became world leaders (David and Wright, 1997). The result, as emphasized by Wright (2006, 4-275-77), was that the mining industry grew and became a central contributor to the broader development of the American economy. Overall, U.S. industry became more mineral

intensive in production than the country's physical resource endowments would have otherwise suggested.⁴⁰

V. Range Land.

Another group that settled the West early, faced new conditions, and had to institutionally innovate was ranchers. In the 1870s and 1880s, cattle herds were driven onto the western Great Plains by ranchers to take advantage of rich pasture lands. There was no specific provision in federal land policy for formal ranch claims. Accordingly, to avoid the losses of competitive overgrazing and to reduce conflict over land, ranchers, as with miners, divided the land on the basis of first-possession: "A custom has grown up and become thoroughly established among people of this community that once a stock man has developed water on and taken possession of the range by fully stocking the same that he will not be molested by other stockmen in his possession and enjoyment of such range."⁴¹

The size and nature of rancher allocations were determined by the market through collective action within livestock associations. Because of the broken terrain and limited precipitation, livestock carrying capacities of the western range were low. With 25 acres or more required to sustain a single cow for a year, upwards of 10,000 acres were commonly required in the West to support enough animals to achieve economies-of-scale in grazing.⁴² These allotments certainly were beyond anything possible formally under the Homestead Act.⁴³ By contrast, it was possible to assemble huge ranches with fee simple title in Texas because federal land laws did not apply there.

Initially, the lack of ability to obtain formal fee simple title to federal range land did not matter. Individual ranches were made up of a combination of fee simple holdings

obtained under the land laws, as well as land purchases from railroads and state school land sections and much larger informal claims.⁴⁴ Local grazing rights included occupancy or beneficial use requirements. There were no restrictions on transfer. Patented ranch properties could be bought and sold and these included memberships in livestock associations.⁴⁵

Dennen's (1976) examination of livestock associations shows how they constrained entry and use of rangeland and that they were effective in controlling open-access losses. The rules included restrictions on the number of animals that could be placed in common herds; limits on who could participate (only local ranchers with patented homesteads and locally-recognized rangeland claims); delineation of individual informal land holdings; registration of cattle brands; and specification of the labor each rancher was to contribute for managing the herd. Common herds were maintained to monitor the drift of livestock and to direct them to fresh grass stands; to control breeding within the herd; to cooperate in the branding of young animals; and to block entry by outsiders. There were annual cooperative roundups for branding and for collecting yearlings for sale. Livestock organizations reduced cattle mortality during severe winters by limiting grazing and thereby conserving winter pastures. Association membership was highly valued when it was transferred with ranch property upon sale.

In the 1870s an invaluable tool for managing the location of livestock and entry of others onto the land was introduced. The barbed wire fence drastically reduced the cost of geographic control of cattle in a region where there were few trees and little wood available for traditional plank fencing (Anderson and Hill, 1975). With it ranchers fenced between 9 to 11, 000,000 acres of the western range.⁴⁶

The open range in the 1870s had few other recognized claimants, and it was far from established government.⁴⁷ By the late 1880s, however, with the entry of homesteaders, ranchers began facing new competitors who wanted to place the land into crops. Conflicts over land began. There were opportunities to change the land laws to allow for larger allocations more in keeping with the requirements for successful ranching operations in the Far West. In 1878, John Wesley Powell in his *Report on the Arid Lands of North America* recommended 2,560-acre pasture homesteads, and two bills to carry out his recommendations were included.⁴⁸ But nothing came of them because they were politically unattractive.

Powell's suggested minimum distributions were 16 times the size of existing homestead allotments. The proposals were considered extreme. Federal politicians were reluctant to make major modifications in the land laws.⁴⁹ Their position was hardened after 1890s when the U.S. Census declared the frontier closed, indicating that there was less and less land available for new claimants.⁵⁰ Larger land allocations would only exacerbate the problem. Libecap and Hansen (2002) point out that there was no clear scientific understanding of the area's climate or of the type of agriculture that would be effective there. The belief persisted that small Midwestern farms could take hold and that ranchers were blocking this process. A strong current of anti-monopoly bias in the distribution of property and a desire to maintain the homestead allotment at 160 acres prevailed.⁵¹

The Homestead Act was modified only slightly in 1904 with the Kinkaid Act that authorized 640-acre claims in western Nebraska; in 1909 to allow 320-acre homesteads; in 1912 to reduce the residency requirement to 3 years; and in 1916 with the Stock-

Raising Homestead Act that also allowed for 640 acres of grazing lands in other selected states.⁵² All of these changes, however, were still too small for a viable cattle ranch.

Gradually, homestead claims were staked in the midst of rangelands, breaking up the ranches.⁵³

The quasi-legal practices of ranchers were attacked and their fences removed by the General Land Office. As the ability of the associations to control entry declined, the incentives of members to violate internal rules increased, and the groups, along with their informal land allocations began to break down.⁵⁴ In the absence of fencing, the only way that ranchers could maintain their informal claims to land was to reduce the incentive to enter it by overgrazing: “The only protection a stockman has is to keep his range eaten to the ground and the only assurance that he will be able to secure the forage crop any one year is to graze it off before someone else does.”⁵⁵

But overgrazing to mark and protect rangeland claims was costly. It made cattle herds more vulnerable to drought since grass stands were driven to low levels with little reserve when precipitation was scanty. The costs of overgrazing to define and enforce land claims against other potential users were reflected in lower calf crops, higher death losses, smaller cattle weights, and diminished animal values (Libecap, 1981a, 23-28). The lack of otherwise enforceable property rights to the range contributed to its deterioration as emphasized by the Department of Agriculture in its 1936 study of the condition of the western range resource.⁵⁶

Because ranchers could not obtain title to semi-arid rangelands and because these lands ultimately also were inhospitable to homesteaders, approximately 80,000,000 acres in western states (excluding Alaska) were retained under permanent federal ownership

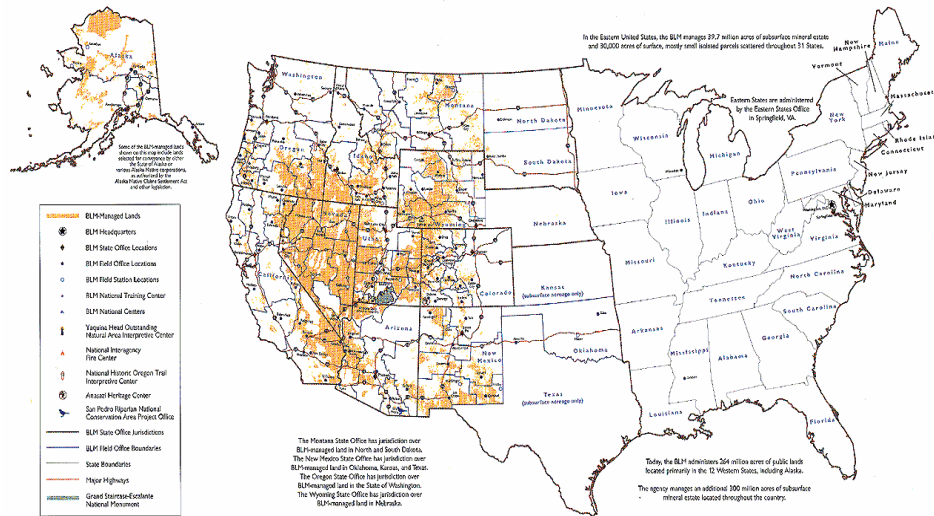
with enactment of the Taylor Grazing Act of 1934.⁵⁷ Most of the lands were placed in grazing districts and grazing permits or leases were distributed and managed by the Bureau of Land Management (BLM).⁵⁸ This reservation of state ownership, pointedly, did not occur in Texas where the range was transferred to private claimants under state law.⁵⁹

Since 1934, various political constituencies, ranging from ranchers to mining companies to conservation and recreation groups, have competed to influence agency policy over access and use of the public domain. Private grazing leases that had been transferable with ranch properties became more insecure as limits were placed on them and as lands were dedicated to other uses. The resulting tenure uncertainty affected grazing practices, investments, and rangeland values.⁶⁰

Currently, the BLM administers some 177,053,843 acres of range land in the continental United States, almost a quarter of the acreage in 11 western states, including nearly 70 percent of Nevada, over 40 percent of Utah, and over 20 percent of Wyoming, Oregon, and Idaho.⁶¹ The vast majority of these lands have no important amenity values or other critical externalities associated with their use that would justify government ownership and management.⁶² They remain as a legacy of a federal land policy that held private distributions inappropriately small, limiting fee simple titling and the establishment of viable ranches based on it.

Figure II

Public Lands Managed by the Bureau of Land Management (BLM)



Source: http://www.blm.gov/nhp/facts/maps/landmap_m.html

VI. Farm land.

Unlike miners and ranchers, homesteaders could claim federal land using existing land policy. Individual ownership of a single plot of farm land was allocated under the Homestead Act and similar land laws through a combination of first-possession and uniform allocation. When settlers found sites, they had to rush to file a “homestead entry” for 160 acres at the local General Land Office before it was claimed by others. There were beneficial use requirements so that each entry had to be occupied and improved for 3-5 years before title could be obtained from the General Land Office. Abandoned claims were open to new entry. 160-acre distributions that had worked well in the Midwest and were applied in the West.⁶³

Individuals were not to file homestead entries for sale to others. Applicants for title from the General Land Office were to swear that they: “did not apply to purchase the same on speculation, but in good faith to appropriate it to his own exclusive use and

benefit; and that he has not directly or indirectly, made any agreement or contract, with any person or persons whomsoever, by which title he might acquire from the Government...should inure” to others.⁶⁴ Once title was obtained from the General Land Office, however, prohibitions on sale could not be enforced. As a result, small homestead consolidation did take place, but only gradually. Farmers who migrated to the Great Plains and Far West to stake homestead claims had few other employment options and this raised the transaction costs of exchanging their properties. Consolidation of farms often took place only at death or when the homesteader retired from farming.⁶⁵

The Great Plains and Far West were semi-arid, with annual rainfall of 20 inches or (much) less and erratic distribution.⁶⁶ By contrast the Midwest was characterized by less variable precipitation of 30 inches or more. Nevertheless, migrants brought with them the cultivation practices, crops, and farm sizes that were familiar and successful in their areas of origin and so long as there was no drought, these actions worked well.

Because homesteaders did not understand the climate and the eventual need for larger farms, they typically did not seek larger allocations nor did they lobby for major changes in the land laws.⁶⁷ Unlike miners and ranchers, homesteaders did not attempt to get around federal policies. Folk theories, such as “rain follows the plow,” where precipitation was believed to increase with cultivation, and pseudo-scientific farming prescriptions, such as “dryfarming doctrine,” where proper tillage was believed to overcome drought, were thought to make small farms viable despite the region’s dry climate (Libecap and Hansen, 2002).

One consequence of these small-farm allocations was extensive farm failure.⁶⁸ The region west of the 98th meridian became known for periodic “homestead busts” when

drought caused wheat yields (the most common crop) to collapse along with farm incomes. Homesteads did not have enough wheat in cultivation to offset the drop in yields and maintain a minimum family income. Small farms also typically did not have cropland in fallow, a practice that could mitigate the effect of drought by collecting moisture and nutrients while the land was left idle. Only larger farms could afford to keep land out of production. Additionally, homesteads were too small to diversify from wheat into livestock to smooth incomes. Libecap and Hansen (2002, 104) estimate that the drought in eastern Montana between 1917 and 1921 caused typical homestead net income to fall from \$2,225 annually to -\$114.

Hansen and Libecap (2004a, 115) analyze the effect of drought on small homestead farms in three eastern Montana counties, Cascade, Carbon, and Fergus using county directories, dating from 1916 through 1930. Over 7,000 farms are in the data set. The analysis reveals that by the end of the period, the number of farms had fallen by 43 percent and farm size had doubled as properties were abandoned and consolidated. In Cascade and Fergus Counties an average-sized farm in 1916 had a 2/3's probability of failure during the drought years and chances were 4 out of 5 that they would not survive from 1916 through 1930.⁶⁹ By contrast larger farms tended to endure drought more successfully.

Small, Great Plains farms not only were less likely to survive drought, but they were more vulnerable to commodity price fluctuations. Alston (1983, 888-95) shows that across the country mortgage debt and foreclosure rates were highest and average earnings were lowest on the northern Great Plains during the fall in commodity prices in 1921-40.

The adjustment process toward larger farm sizes, however, took time. Over 60 years of farm consolidation was necessary to achieve more optimally-sized farms on the Great Plains. Meanwhile, there was dramatic out-migration. The population of many of the 363 Great Plains counties peaked in 1910 and two-thirds had their largest populations in 1930 or earlier.⁷⁰

A second consequence of small farm allocations was over cultivation and lack of investment in erosion control that had serious environmental effects with the Dust Bowl of the 1930s. The Dust Bowl was a classic common-pool problem. Small homestead farmers cultivated more of their land to meet income targets, leaving it exposed to damaging wind erosion. They were less likely to adopt strip fallowing practices that could slow the flow of wind. Their farms were too small to internalize the benefits of downwind erosion control, and they bore high opportunity costs because strip fallow required between a third and a half of a farm to be left idle, a cost they could not bear. The large number of homesteaders also raised the costs of collective action to privately organize to combat erosion. Small farms were checker boarded across the land, surrounding somewhat larger farms, a condition that increased the potential for externalities from those farms that failed to practice erosion control.

To effectively address erosion, all of the cultivated acreage in an area of 50,000 to 500,000 acres or more would have to be “treated” with wind breaks and strip fallow. Even optimal farm sizes for production, estimated at 1,280 acres at the early 1930s, were too small.⁷¹ Most farms on the Great Plains, however, were far smaller. Hansen and Libecap (2004b, 679-80) analyzed the relationship between farm size and fallowing using census data for 285 Great Plains counties between 1930 and 1964. They found that over

the 35-year period mean farm size grew by 74 percent and the fallow share of crop land rose by almost a factor of 4. Later droughts in the 1950s and 1970s were not accompanied by the severe wind erosion that occurred in the 1930s.⁷² The larger farmers that predominated by those years could internalize more of the returns from investing in erosion control through strip fallow investments, and they did so.

Hansen and Libecap (2004b, 682) also found that counties with less fallowing (higher cultivation shares of total farmland) had more serious erosion, controlling for other natural factors. They argued that if the cultivation share had fallen by one standard deviation below the mean share (fallow had increased), the predicted probabilities of “no” or “light” wind erosion would have risen by 33 percent. Alternatively, if the cultivation share were raised to 100 percent (no fallowing), as was the case with many small homesteads, the predicted probability of “severe” wind erosion jumped by 123 percent and the predicted probability of “no” wind erosion practically disappeared.

VII. Timberland.

In the East where there were large tracts of timberland, such as in the Great Lakes states, there were unrestricted cash and script sales of land by the Federal Government.⁷³ But this was not the case in the West where the land effectively was reserved for agricultural settlement. Accordingly, those who claimed timberland in the West also had to innovate around the formal land laws. They did so by making first-possession “farm” entries to multiple 160-acre plots under the Homestead Act, Pre-emption Act, or the 1878 Timber and Stone Act. The Timber and Stone Act allowed individuals to purchase up to 160 acres of timberland for \$2.50 per acre for domestic use in buildings, fencing, or fuel.⁷⁴ Lumbering involved fixed capital investments in sawmills and spur railroad lines

and other forms of transportation to move the logs to mills and lumber to markets. These investments needed a ready and continuous supply of saw timber. There also were economies-of-scale in cruising timber for the best stands and in harvest.

To assemble enough forest land, lumber company officials negotiated with land agents who hired entrymen to occupy and “farm” the land until title could be obtained from the General Land Office. Once title was received, it was transferred to the land agent, who in turn sold the property to the timber company for a pre-negotiated price, usually \$6 to \$7 per acre.⁷⁵ Libecap and Johnson (1979, 136-8) analyze the costs of having to circumvent the land laws through fraud. The California Redwood Company used agents to hire 400 entrymen in 1883 to acquire 57,000 acres of land using both the Timber and Stone and Preemption/Homestead Acts. Because the entrymen could purchase the land directly under the Timber and Stone Act without occupation or construction of buildings, the evasion costs were less with that law than with the use of the more complex Preemption/Homestead process. Libecap and Johnson found that the extra costs of deception were \$670 per 160-acre plot under the Timber and Stone Act and \$870 under the Preemption Act. These added costs were substantial, accounting for approximately 60 to 78 percent of the final sales price of \$1,120 per plot paid by timber companies to the land agent for the property.

Libecap and Johnson conjecture that if this case were typical and the same process were used to acquire the 4,000,000 acres of federal timberland transferred through the Timber and Stone and Preemption Acts at the six major land offices in the Pacific Northwest between 1881 and 1907, then fraud may have increased land acquisition costs by an additional \$17 million and thereby delayed titling by up to 6

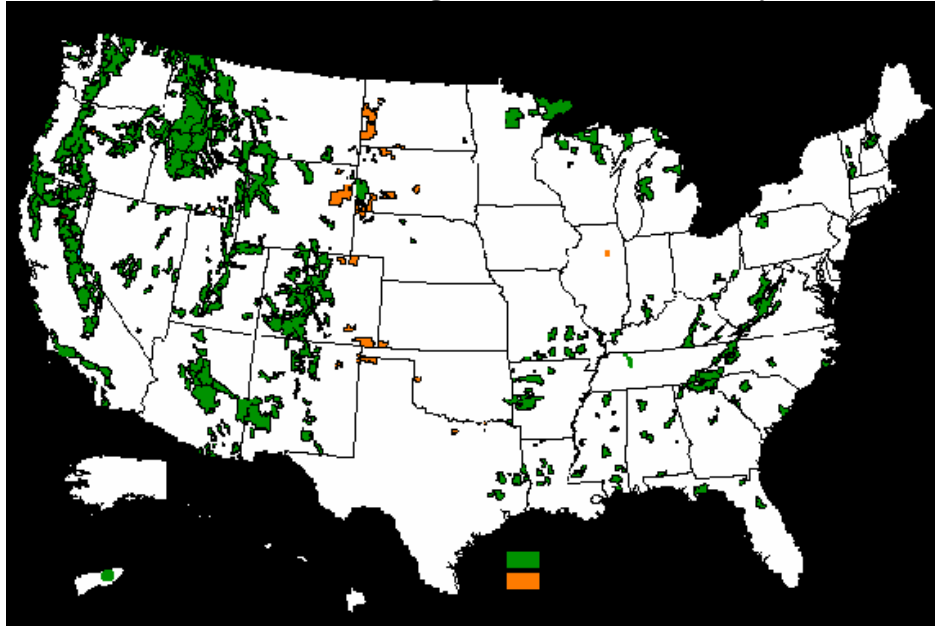
years.⁷⁶ During that time the land would have been vulnerable to open entry and the illegal harvest of concern to early conservationists such as Gifford Pinchot, who became the first Chief Forester of the U.S. Forest Service in 1905.⁷⁷

The Public Lands Commission of 1879 investigated the problem facing both ranchers and lumber companies in the West. In 1880 the Commission issued its report to Congress, calling for the reclassification and sale of the varied western lands according to their best uses, including the use of 2,560-acre individual allotments.⁷⁸ There was, however, no Congressional action. Instead, there was a gradual tightening of the land laws. The General Revision Act (Forest Reserve Act) of March 3, 1891 repealed various land laws, slowed the transfer of homestead titles, and created the National Forest Reserves.⁷⁹

The law authorized the President “to set apart and reserve, in any State or Territory having public land bearing forests, in [sic] any part of the public lands wholly or in part covered with timber or undergrowth, whether of commercial value or not, as public reservations.”⁸⁰ Under the new law, the Forest Reserves were to be permanently managed by the Federal Government with private timber harvest permits and grazing leases possible, but no longer fee simple title. By 1900 over 46,000,000 acres were placed in the new reserves, and today, the National Forests and grass lands encompass 193,000,000 acres, about the size of Texas.⁸¹ As with BLM lands, the management of the National Forests by the Forest Service has been criticized for being excessively costly and dominated by constituent group politics.⁸² Also, as with BLM lands, most National Forests have neither important amenity values nor significant externalities from land use

that would merit government ownership. They too were retained by the government because of an inflexible land allocation policy.

Figure III
National Forests and Grazing Lands Administered by the Forest Service



Source: <http://www.fs.fed.us/recreation/map/finder.shtml>

VIII. Surface Water.

In the Far West, surface water is allocated through first-possession under the appropriative rights system. This arrangement allows individuals to claim, move, and use water based on priority of claim.⁸³ Those with the earliest water claims have the highest priority and those with subsequent claims have lower-priority or junior claims. No two parties on a waterway have the same priority, so that there is a ladder of rights, ranging from lowest to highest in ranking. Water is not tied to the land, and therefore can be sold or leased separately from it.

Under the appropriative rights system, individuals were granted usufructory or possessory rights to water, rather than fee simple title.⁸⁴ The sizes of their claims were based on the market. There were no outside restrictions on individual claims, except that

each party could own only what could be placed into beneficial use. Because beneficial uses were difficult to measure, the basic test of meeting the requirement has been physical diversion. These use requirements and the absence of fee simple title to water likely reflected the extreme importance of water in the region. It could not be hoarded, wasted, or abandoned and still be owned. Any of these actions would result in water being assigned to the next priority claimant in a region of general water scarcity.

Wyoming law, for example states: “Because water is so important to the economy of this state, its use is always limited by a concept of public trust; the only uses for which water rights may be established are those which receive ‘public recognition’ under the law of the state.”⁸⁵

There were no restraints on transfer so long as no harm was inflicted on other diverters, who sequentially used some of the same water. An upstream farmer who diverted water for irrigation consumed only part of it, with the remainder percolating through the ground back to aquifers, streams, or to ditches for repeated access by other downstream parties. Small water exchanges among miners or farmers within a watershed were therefore unlikely to have much impact on others. But larger trades that involved changes in the location, timing, or nature of use, were likely to have some external effects on others. Removal of significant amounts of water out of a watershed reduced downstream flows and therefore decreased the water available for lower-priority claimants. As a result, all western states have regulated such transfers. To mitigate adverse third-party effects, state water agencies typically allowed changes in diversion and location for only historical consumptive uses.⁸⁶

The appropriative rights system is quite different from that which exists in the eastern U.S., where surface water rights are based on riparian land ownership.⁸⁷ Land owners have rights to access the water adjacent to or passing through their properties for reasonable use and they can utilize the water so long as doing so does not harm other riparian claimants down stream.⁸⁸ These rights are appurtenant to the land and are transferable only with it. The arrangement works well where precipitation and streams are plentiful and more-or-less uniformly spread.

In the semi-arid Far West, however, where there is a general absence of water and what exists is irregularly located, there was a need for institutional innovation that would allow water to be claimed and transferred to settlement locations, often out of the watershed. For example, prospectors who located ore in remote mountain sites required more water for placer and hydraulic mining techniques than was available locally. Similarly, those farmers whose properties were not near major water sources required additional irrigation water to increase farm yields and to smooth them during drought.

Western semi-arid conditions meant that water would have to be brought via aqueducts, ditches or canals to the locations remote from the point of diversion. And for this to occur, the system of water rights had to be modified from the riparian system. Appropriative property rights were developed through local contracting unencumbered by outside constraints, in much the same way as western mineral rights or livestock associations were formed.⁸⁹ Appropriative water rights were often incorporated into mining claims and codes and into mutual ditch companies or irrigation districts organized by irrigators to bring water to their properties.

These local rules were recognized subsequently by the states. The most arid western states—Arizona, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, and Wyoming—constitutionally or statutorily adopted the appropriative system.⁹⁰ States with more water maintained a hybrid system of both riparian and appropriative water rights-- California, Nebraska, Oklahoma, Oregon, Washington, North and South Dakota, and Texas.⁹¹

At the time of the development of the appropriative rights system, there were single, homogeneous constituencies in each area—miners in mining camps and farmers who typically were members of ditch companies or irrigation districts. They had similar interests in the diversion of water from streams to support economic development in mining and farming. This condition allowed for the smooth development of the appropriative rights system.

Appropriative water rights have supported the development of mining and agriculture in the semi-arid West. They provided security for investment in mining and agricultural water infrastructure, including elaborate irrigation networks provided by mutual ditch companies, irrigation districts and the Reclamation Service (later, the Bureau of Reclamation) to promote the region's flourishing agriculture.⁹²

The prior appropriation system also formed the basis for moving water from one location to another to provide for urban water supplies. Most dramatically, Los Angeles acquired the appropriative water rights held by Owens Valley farmers between 1905 and 1935 and constructed the 250-mile Los Angeles Aqueduct between 1907 and 1912. The aqueduct cost \$25,000,000; was an engineering marvel; and made the growth of Los Angeles as the largest metropolitan area in the West possible, providing as much as 80

percent of the city's water supply.⁹³ Other western cities, such as Las Vegas, Phoenix, San Diego, and Tucson also have purchased or leased agricultural water rights to meet growing urban demand. Indeed, appropriative water rights are the foundation for a growing water market.⁹⁴

IX. Conclusion.

On-going efforts to mitigate the losses of the commons in various environmental and natural resource settings have brought renewed consideration of the use of property rights arrangements. These include individual transferable quotas (ITQs) in fisheries, tradable emission permits in air pollution control, and exchangeable development permits in land use planning. While attractive because of their ability to better link private and social net benefits in decision making than is possible with traditional command-and-control regulation, property rights instruments face complicated institutional design and implementation problems.

For example, disputes over the types and distribution of ITQs to be granted in U.S. fisheries resulted in a four-year moratorium on their expansion in 1996.⁹⁵ Five U.S. marine fisheries operate under ITQ regimes (as compared to over 40 in Canada): the Mid-Atlantic surf clam and ocean quahog fishery, the Alaskan halibut fishery, Alaska sablefish fishery, the South Atlantic wreckfish fishery, and Alaska crab fisheries. These ITQs are more limited and are a weaker property right than found in many other major fishing countries.⁹⁶ Some U.S. ITQs are reserved for community development and not granted to individuals. There also are formal limits on the size of individual quota holdings and their transferability. In the Alaska halibut fishery, for example, only transfers from larger to smaller vessel classes are permitted, and no individual is allowed

to own more than 0.5 percent of the total quota. There are other controls on share consolidation to limit holdings and to maintain a targeted number of vessels in the halibut fleet.⁹⁷ ITQ policies are molded by distributional concerns and the political influence of small vessel owners and fish processors.

These actions are quite similar to the constraints placed on homestead allocations and the rejection of the larger land claims of ranchers and timber companies. The experience on the western U.S. frontier helps to explain the political support for such restrictions, but also suggests that they may have unanticipated long-term consequences and weaken the ability of the ITQs to conserve the fishery stock and provide sustained financial benefits to fishers.

Overall, the development of property rights to natural resources in the western U.S. in the 19th century provides a number of conclusions about the design and allocation of property rights. One is that first-possession or recognition of existing resource use practices and allowing local conditions to determine production size is likely to be the most effective allocative mechanism. Its empirical regularity on the frontier suggests that first-possession has had important efficiency attributes. The most successful allocations, mineral rights, membership in livestock associations, and appropriative water rights were all determined locally.

Outside government constraints on who could obtain property rights and mandates for uniform (small) allocations to meet distributional objectives had negative results for timber, range, and farm land. Small homesteads failed, stranding farm investments and necessitating out-migration. In their desperation to earn an income on farms that were too small, homesteaders over-cultivated and under-invested in erosion

control with serious environmental effects. Ranchers and timber companies could not obtain title to sufficient range and timberland. By default much of the current federal holdings of 391,340,229 acres in the continental U.S. (21 percent of the total area) were left to long-term political and bureaucratic management as the “public lands.” Allocations and uses of those lands have shifted as the political influence of various interest groups has waxed and waned.⁹⁸ Agency capture has encouraged subsidies and inefficient use, and uncertainty of control has reduced resource values and incentives to invest in the resource stock. For the most part, this large, residual public domain represents an outcome that could not have been envisioned by Thomas Jefferson and the other early drafters of federal land laws.

A second conclusion drawn from the Far Western frontier is how long property rights allocations endure, even in the face of accumulating evidence that some are *ex post* inappropriate. The private transaction costs of adjustment to new arrangements and the political transaction costs of changing property assignment rules are very high. Hence, there is opposition to change and pressure to maintain the *status quo*, resulting in path-dependencies in property distribution patterns and use. A related, third conclusion is that substantial resource rent dissipation is tolerated because of the distributional implications of changing property rights allocations. Only late in resource use, after many of the rents have been lost are institutional changes typically enacted, and even then, they will be incrementally and incompletely adopted to mitigate political opposition.

Finally, the experience of property rights on the Far Western frontier reveals their critical importance in directing resource use, trade and investment. These benefits were recognized by the region’s early settlers who had to devise their own arrangements to

meet new conditions and to avoid the potential losses of open access. In the most successful cases they were free to do so and in the other cases they were constrained by formal land policy with less positive long-term results. The rich and compelling economic history of the Far West has evolved around these different institutions and it provides valuable lessons for contemporary efforts to address the Tragedy of the Commons.

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¹ Open-access losses were famously described in Garrett Hardin's 1968 *Science* article (Hardin (1968)). The implications of open access, however, had been understood for a very long time. Scott Gordon (1954) described them 35 years earlier, but yet 46 years later, Grafton, Squires, and Fox (2000), could still describe the dramatic wastes of over fishing and regulation in the Pacific Northwest halibut fishery, and a 2003 *Nature* article by Myers and Worm (2003) could report that the world's major predatory fish populations were in a state of serious depletion. A similar conclusion for deep-sea fisheries was reported by Devine, Baker and Haedrich (2006), also in *Nature*. See Stavins (2003) for discussion of the movement toward market-based instruments.

² Tietenberg (2003, 1)

³ Stavins (1998).

⁴ For example, consider success under the Clean Air Act Amendments of 1990 in designing air pollution emission permits for lowering the cost of meeting air quality targets (Tietenberg 2003, 12; Stavins 2003, 4; 1998, 6-13). Alston, Libecap, and Schneider (1996) describe the importance of title for land use and long-term investment on the Amazon frontier.

⁵ Libecap (1989), Dahlman (1979).

⁶ See Libecap (1989, 10-28).

⁷ I am not referring to the exchange of property, but changes in the property allocation rule: who can own, in what amounts, and what can be done with the property.

⁸ The private and political transaction costs of assigning and modifying property rights has been the overall thrust of my research as outlined below. For spill over between private and political transaction costs as revealed in efforts to regulate oil production in U.S. states, see Libecap and Wiggins (1985).

⁹ See discussion of first possession in Epstein (1979), Rose (1985), and Lueck (1995, 1998). Various property regimes are discussed by Ellickson (1993). Alston, Libecap, and Schneider (1995) find that the original settlers on the more remote Amazon frontier in Brazil had lower opportunity costs than those who came later and who often purchased land from the initial claimants after roads were built and transportation costs to market had declined. The early settlers were younger and had less wealth and education.

¹⁰ On the American frontier, "squatters" moved ahead of the federal land survey. When the land was subsequently surveyed and opened for claiming, "claims clubs" formed to prevent outsiders from encroaching on pre-existing holdings. See Gates (1979, 152). See also Tietenberg (2003, 10) for contemporary arrangements in resource and environmental cases.

¹¹ See Epstein (1979).

¹² Alesina and Angeletos (2005, 960-80). Equity issues in the allocation of property rights or property-like use rights are also the theme of Raymond (2003).

¹³ Johnson and Libecap (1982) show that heterogeneity among fishers limits rent dissipation even under open-access and the rule of capture.

¹⁴ Anderson and Hill (1990) criticize the occupancy requirements of the Homestead Act. In contrast, if beneficial use encouraged sorting, homesteaders may have been more likely to have past farming experience and be successful in their endeavors. Hansen and Libecap (2004a, 123-4) do not directly test this proposition, but their data on Eastern Montana homestead failure during drought provide mixed support for it. The data set is small (40 observations) and it shows that previous Great Plains farm experience increased survival chances, a finding consistent with the proposition, whereas farm experience elsewhere in the Midwest lowered survival chances. The type of farming experience mattered. Indeed, those homesteaders who were not from the Great Plains and had no farming experience were more likely to survive drought than those not from the region with farming experience (the wrong kind).

¹⁵ For summary of auction issues, complications, and applications, see McAfee and McMillan (1987, Milgrom (1989), and Klemperer (2002).

¹⁶ See discussion by McMillan (1994) regarding the experimentation and costs of designing auctions for the spectrum.

¹⁷ As Johnson and Libecap (1982) argue with regard to fisheries, more experienced, “better” fishers may do better under open-access than under regulation that places uniform restrictions on all fishers.

¹⁸ For example, see Wiggins and Libecap (1985) regarding the delay in responding to open-access in oil pools. Johnson and Libecap (1982) point similar delay problems in fishery regulation.

¹⁹ Libecap and Wiggins (1984, 1985) describe how the opposition of small, high-cost oil producing firms to regulations to limit common-pool losses in Texas resulted in favorable, but costly prorationing rules that encouraged dense, deep drilling and that exempted stripper wells from any regulation. Their opposition also blocked state-mandated unitization laws that were adopted in every other oil-producing state. Texas still has no mandatory unitization law.

²⁰ See the framework provided by Alston, Libecap, and Schneider (1996) with regard to the demand for property rights on the Amazon frontier.

²¹ 12 Stat 392. See discussion of federal land laws in Donaldson (1884), Robbins (1942), Peffer (1951), Hibbard (1965), and Gates (1979).

²² There is disagreement as to the beginning of the Far West—the 98th or the 100th meridian. Webb (1931) chose the 98th and Stegner (1954) the 100th. Either identifies the onslaught of drier conditions. For the most part, the 98th meridian is used in this paper as the starting point.

Gates (1979, Appendices A, B, and C).

²³ Morriss, et al (2004, 748).

²⁴ Morriss, (1998, 594), Umbeck (1977b, 214).

²⁵ Shinn (1948, 160-2)

²⁶ In studying oil field unitization efforts Wiggins and Libecap (1985) argue that negotiations are easier when all parties are similarly ignorant about true resource locations and values and that sharing agreements become more difficult when some parties have asymmetric information advantages.

²⁷ Umbeck (1977a, 436), Morriss (1998, 601), Zerbe and Anderson (2001, 133).

²⁸ Quoted in Kanazawa (2005, 11); Zerbe and Anderson (2001, 132) discuss work requirements.

²⁹ Naturally, there were disputes over whether a claim was abandoned or whether it was jumped. See McCurdy (1976, 243-44).

³⁰ Stewart (2006b, 8).

³¹ Zerbe and Anderson (2001, 129-30);

³² Umbeck (1977b, 217, 1981, 54-5), Libecap (1989, 39).

³³ For discussion of litigation on the Comstock, see Libecap (1979) and for extra lateral rights, Libecap (1978, 345), David and Wright (1997, 222).

³⁴ Morriss (1998, 602).

³⁵ Morriss (1998, 604).

³⁶ California General Laws, 1850 – 64, § 5522 (1868)

³⁷ Lode law of 1866—14 Stat 251, repealed 1872, Mining Law of 1872, 17 Stat. 91. Gerard (2001) provides a nice overview of the process of filing mining locations on federal lands and then securing title under the Mining Law of 1872. He also examines the incentive to patent claims as the costs and benefits of title changed in the early part of the 20th century.

³⁸ McCurdy (1976, 247-52), however, describes conflicts between miners and farmers who had established farms over trespass and damage from hydraulic mining operations. .

³⁹ The Mining Law of 1872 allowed claimants to file “locations” or claims on federal land, which could be held subject to fulfilling annual assessment work. The claimant did not have to obtain title, and there were costs and benefits of doing so. As detailed by Gerard (2001), the primary benefits of titling were to reduce claim disputes and disagreements as to whether or not the claimant was fulfilling the required assessment work.

⁴⁰ In the latter part of the 20th century as the mining industry’s political influence waned and as new competitors emerged for access to federal lands, the Mining Law of 1872 has come under attack. See Morriss, et al (2004).

⁴¹ Statement by William Jones, rancher, Eddy County New Mexico, April 10, 1917, quoted in Libecap (1981a, 16),

⁴² Libecap (1981b, 151).

⁴³ Webb (1931, 357), Morriss (1998, 654).

⁴⁴ Libecap (1994, 270)

⁴⁵ Dennen (1976, 433-34).

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- ⁴⁶ Libecap (1981a, 20), Morriss (1998, 656-7).
- ⁴⁷ Native Indian tribes of course competed with ranchers for the land which was grazed by buffalo and other wildlife, but their claims generally were not recognized. For discussion of the effects on buffalo herds as the commons emerged with the decline in Indian enforcement, see Lueck (2002).
- ⁴⁸ Powell's report, "Report on the Lands of the Arid Region," 45th Congress, 2nd Session, House Executive Document 73, was transmitted to the Commissioner of the General Land Office on April 1, 1878. Another edition of 5,000 copies was made in 1879 by Congress. One bill allowed for 9 or more individuals to organize into irrigation districts and take up land when certified as irrigable and the other authorized pasturage homesteads of at least 2,560 acres granted as part of grazing districts made up of 9 or more individuals pooling their animals in common herds.
- ⁴⁹ For discussion of the reaction to Powell's report, see Stegner (1953, 219-42). Peffer (1951, 8-62, 135-68) describes the political controversy over homestead farm size, the claims of ranchers, and efforts to adjust the federal land laws.
- ⁵⁰ U.S. Department of the Interior, Bureau of the Census (1892, xviii).
- ⁵¹ Hansen and Libecap (2004a, 106).
- ⁵² 35 Stat.693. See Gates (1979, 504-7) for discussion.
- ⁵³ Hansen and Libecap (2004a, 111) discuss the impact on farm size of homestead settlement. This phenomena is described in Fletcher's (1960) classic.
- ⁵⁴ Osgood (1929, 186) discusses the break down of local groups as outside competition for land rose, Libecap (1981a, 31-7) describes the actions of the General Land Office to counter the large claims of ranchers and to remove their fences, and Morriss (1998, 666-75) discusses the Johnson County war in Wyoming as ranchers attempted to police their land claims and cattle ownership against intruders.
- ⁵⁵ USDA researchers, W.C. Barnes and James T. Jardine, quoted in Libecap (1981a, 24).
- ⁵⁶ Although the underlying source of the problem, the inability of ranchers to obtain secure property rights was not recognized. See USDA, 1936, *The Western Range*, 74th Congress, 2d series, Senate Document 199.
- ⁵⁷ June 28, 1934, 48 Stat 1269.
- ⁵⁸ The politics of grazing allotments are described by Libecap (1981a, 45-64) and Raymond (109-52).
- ⁵⁹ Notice the absence of BLM land in Texas as compared to New Mexico, for example.
- ⁶⁰ Libecap (1981a, 65-102).
- ⁶¹ Libecap (1981a, 2). See also *Public Lands Statistics*, fiscal year 1998 for range land totals in the US and Alaska, and fiscal year 1996, Table 1-3 for more detailed breakdowns of federal land ownership by state, including that administered by the USDA Forest Service, and Department of Interior, National Park Service, <http://www.blm.gov/natacq/pls98/98PL1-4.PDF>.
- ⁶² Rangelands of valuable heritage and character are another matter and have been placed in National Parks and Monuments.
- ⁶³ Allen (1991) argues that the Homestead Act in the West was designed to promote dense settlement in order to reduce federal enforcement costs in Indian conflicts over land.
- ⁶⁴ Quoted from Henry Copp, *Public Land Laws*, in Libecap and Johnson (1979, 131).
- ⁶⁵ Hansen and Libecap (2004a, 125-6) discuss homestead consolidation and the greater change in farm size between 1920 and 1982 in the Great Plains, where homesteads were too small relative to the Midwest, where small farms were more viable and New South Wales in Australia, where larger initial claims were possible.
- ⁶⁶ Webb (1931, 17), Libecap and Hansen (2002, 92).
- ⁶⁷ There were cases where Homestead claimants fraudulently involved family members and others to make multiple entries. But this practice was not widespread given observed distribution of farm size in the northern Great Plains where 160-acre units were most common. See Hansen and Libecap (2004a, Tables 2 and 3).
- ⁶⁸ In general, early farm settlement was more successful in the Midwest. See Ferrie (1994) and Stewart (2006a) for discussion of the benefits of the capital gains in land values as a source of wealth accumulation.
- ⁶⁹ Hansen and Libecap (2004a, 117).
- ⁷⁰ Hansen and Libecap (2004a, 125-8).
- ⁷¹ Hansen and Libecap (2004b, 672).
- ⁷² Gutmann and Cunfer (1999) provide another thorough examination of the origins of the Dust Bowl and place more emphasis on temperature.
- ⁷³ For discussion of harvest practices on Great Lakes timberlands, see Johnson and Libecap (1980).

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- ⁷⁴ 27 Stat. 348, Gates (1979, 485-93) discusses the law and its use.
- ⁷⁵ Libecap and Johnson (1979, 135-6).
- ⁷⁶ Libecap and Johnson (1979, 137-8).
- ⁷⁷ See Johnson and Libecap (1980) for examination of the claims of conservationists regarding the harvest of timber.
- ⁷⁸ U.S. House of Representatives (1880, ix, xix, xxiii). See also Donaldson (1884, 541-42).
- ⁷⁹ 26 Stat. 1096-97. Gates (1979, 399-400), Libecap (1994, 272). The Forest Reserves were transferred from the Department of the Interior to the Department of Agriculture in 1906.
- ⁸⁰ Quoted in Gates (1979, 565-6).
- ⁸¹ Gates (1979, 580) and U.S. Forest Service, <http://www.fs.fed.us/aboutus/>.
- ⁸² See for example, Sedjo (2000).
- ⁸³ Burness and Quirk (1979). See also Dunbar (1983, 1985), Kanazawa (1998), and Morriss (2001, 865, 867-91).
- ⁸⁴ Getches (1997, 83).
- ⁸⁵ Wyoming Rules and Regulations, State Engineer, Ch1, Sec 4. Water is property of the state. WY ST 41-3-101 says that individuals can have rights for beneficial use and they can be sold with the land or detached from the land.
- ⁸⁶ Anderson and Johnson (1986) and Johnson, Gisser, and Warner (1981) describe how specifying a property right in water in terms of consumptive use with options for third party grievances can be an effective method for promoting transfers.
- ⁸⁷ Morriss (2001, 868). Rose (1990) discusses the evolution of property rights and experimentation with riparian rights.
- ⁸⁸ Getches (1997, 33).
- ⁸⁹ Glennon (2002, 14-21); Getches (1997, 74-189). Kanazawa (2005) points out that every mining district that was exclusively “dry” adopted first possession, and every district that was exclusively “wet” did not. Anderson and Snyder (1997, 37-44) provide a summary of irrigation institutions that developed to transport and allocate water for agriculture.
- ⁹⁰ Getches (1997, 81).
- ⁹¹ Getches (1997, 8).
- ⁹² The Reclamation Service was established by the 1902 Reclamation Act, 32 Stat. Pt. 1, 388. It became the largest single water supply organization in the country. See Gates (1979, 654-59), and Pisani (1984).
- ⁹³ It is now around 34 percent following a variety of environmental court cases. See Libecap (2006a, 2006b, Chapter 8).
- ⁹⁴ See Glennon, Ker, and Libecap (2006).
- ⁹⁵ Sustainable Fisheries Act, 16 USC 1801.
- ⁹⁶ Arnason (2002, 12, 52-7), Leal (2005).
- ⁹⁷ Doyle, Singh, and Weninger (2005).
- ⁹⁸ Fiscal Year 1996 Public Lands Statistics, <http://www.blm.gov/natacq/pls98/98PL1-3.PDF>, continental states only.