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Source: Human Ecology, Sep., 1998, Vol. 26, No. 3 (Sep., 1998), pp. 425-449

Published by: Springer

Stable URL: https://www.jstor.org/stable/4603290

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The relationship between Native Americans and the Euro-American settlers has evolved from the latter seeking to end the separate identity of the former to one in which the U.S. government uses Native rights to control large-scale resource problems. This new relationship arose out of a need to control water in Western states for irrigation, but has expanded into other areas. The Navajo sheep reductions of the 1930s and 1940s may be seen as an instance of this relationship. Concerns about siltation behind the Hoover Dam justified a program that dramatically transformed the Navajo economy. A second case concerns conflict over a caribou herd in northwestern Alaska. The conflict eventually led to the Federal government taking management of fish and game on Federal lands back from the state government. Both these cases show the development of a technocracy, based on Federal trusteeship over Native resources, concerned with the control of nature similar to that observed in Wittfogel's writings on Chinese irrigation.

KEY WORDS: natural resources; U.S. government; Navajo; Iñupiat.

INTRODUCTION

The history of contact between Native North Americans² and the settlers of European extraction has centered upon natural resources (Bee and

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²I have used the term "Native Americans" to refer to both American Indians and Native Alaskans. "Native American" has not fully replaced "American Indians" when referring to the indigenous peoples west of the Mississippi. At the same time, American Indian does not include the Yupiit, Iñupiat, and Aleut of Alaska. I have also used "Navajo" instead of "Dineh" as the former remains in common usage.

Gingerich, 1977; Dyck, 1987). Into the twentieth century, the pattern of contact was for the Euro-Americans to take land, sometimes through purchase, sometimes through conquest, but often through legislation, legal judgments and administrative action. From 1887 to 1933, the official policy of the United States government was to take tribal land, provide every adult with 160 acres (65 ha), and sell what land remained to non-Natives (Prucha, 1984). Through education, missionization, and the individual ownership of land, the indigenous population of the United States was to be assimilated into the nation. Everyone, except the Natives themselves, saw this prospect as inevitable. Civilization, based upon agriculture, needed the land. The Native way of life, based upon extensive land use, had to give way. The Federal government asserted its sovereignty over what had been called the Indian nations. The courts recognized Congress as the trustee of Indian affairs, making it able to do what it wanted with little restraint.

In 1934, the Federal government reversed its policy of allotment and assimilation. Under the Indian Reorganization Act of that year, Congress restored and in some cases increased tribal lands, provided for the formation of constitutional governments, and instituted educational programs that assumed the continuation of Native culture and society. This reversal was mysterious. The Federal government, with the ideology and the legal means to do so, could have ended Native American tribal land ownership. It also had, seemingly, the economic incentive to do so. This mystery deepens in that, to this day, the Federal government pours considerable money into the Bureau of Indian Affairs and other programs for Native Americans, with little apparent return to benefit itself or the general American public.

The answer to this mystery lies partially in the leverage that the government gets from its control over Native affairs and thereby natural resources. Its use of Native American rights, particularly in common property resources, has helped it to manage natural resource problems with which private land owners and political subdivisions, e.g., states, cannot deal. This control has been based not just on Native rights, but also on a science-based justification for government intervention. This intervention is similar to Worster's (1985) extension of the theory of oriental despotism (Wittfogel, 1957): the development of a technically-oriented elite that controls a significant resource over a broad area.

The next section of this paper will describe U.S. land policy during the country's first 150 years and the land and water management problems that arose from that policy. Those problems required Federal solutions. The second section will discuss the evolution of Federal-Native relations. The third and fourth sections will describe two case studies. These studies lay out the complex relationship between Native sovereignty and the Fed-

eral government. The two cases center on resource conservation, but the relationship between sovereignty and resources can include nonconservation cases, such as nuclear waste disposal on tribal lands. The first case study describes the stock reduction programs that the Federal government imposed upon the Navajo Nation between 1933 and 1946. The programs caused a major transformation in Navajo society, yet may not have accomplished the conservation goals that had originally prompted the reduction. The second case concerns the management of the western arctic caribou herd (WAH) in Alaska. In each instance, the Federal government played or plays a prominent role based, in part, upon its protection of Native rights and its appeal to scientific authority. The Navajo stock reduction is a negative example. The case of the WAH is potentially positive: if the Federal government can work out its internal competing interests and develop a supporting scientific program, a co-management agreement with tribal governments may be possible. The final section discusses the potential evolution of Native-Federal relations in resource management, in particular, the evolution of a Wittfogelian bureaucracy.

UNITED STATES LAND POLICY

In New England before the American Revolution, a unique system of land tenure developed (Benedict, 1953, Ch. 1). It was unique in both how the land was prepared for sale and how titles described ownership rights. When new towns were to be opened to settlement, a survey would be conducted before the settlers could enter. The lots for purchase were laid out in roughly equal sizes. Land titles to these lots described only the boundaries. The use to which the land was put, or could be put, was not mentioned. The owner held fee simple title to everything from the center of the earth to the sky above within those boundaries.

As Cronon (1985) has noted, this system of land tenure was ecologically transformative. Land became a commodity its owners could use as they wanted, including transforming its ecology. Property taxes, based on the "highest and best use," pushed the transformation. The need for a stream of income from the land to pay taxes dictated its commercial use, or led its owner to sell to someone else. As a commodity, land become a factor of production, changeable according to market circumstances, rather than a piece of the earth incorporating a particular ecological system.

After the American Revolution, the New England system of land tenure became the model for the disposal of the public domain. The public domain was, and is, the unoccupied and unreserved lands owned by the Federal government. Surveyors laid out townships, areas of 6 miles by 6 miles (9.6 km²). Each township was divided into 36 equal sections of 640 acres (291 ha). Land was then sold by the section, half section, or quarter section (Gates, 1968). The survey imposed this grid without reference to the underlying physical geography. East of the Mississippi River, this inattention to topography did not create problems. Rainfall agriculture and the large areas of exceptional soil meant that the arbitrary sectioning made little difference. A prospective farmer was likely succeed on what he bought.

As, however, settlers approached the 100th meridian, rainfall agriculture became less feasible (Opie, 1987). To the west of the 100th meridian average annual rainfall goes below 50 cm and also becomes less predictable. Water sources became important, and the soils were of uneven fertility. An entire section might miss a needed source of water by a few feet. Yet the survey grid went on without modification, an imposition of human geometry onto a now-forgotten ecological system. The assumption that the public domain should be handed over into private hands as quickly as possible pushed the survey westward. Until the U.S. Civil War, the only debate was over who should be the recipient of this land: small family freeholders or large landholders, using slave labor. The Civil War was fought, in part, over which system of land tenure should be imposed onto the new lands to the West (Benedict, 1953, p. 78). The North, and the small freeholder, won. Historians such as Williams (1961) have argued that the easy access to land, the lack of tenant farming, and the ideology surrounding the small family farm relieved the United States of many possible conflicts. America grew out of its problems. While the ownership of property was a requirement for suffrage in many states, ownership was ubiquitous in the northern states. The land tenure system of widespread small farm agriculture contributed to a broad-based liberal democratic political system. Simultaneously, popular democracy pushed for the opening of the public domain to all. Congress acceded to this ideal in the Homestead Act of 1863. For \$20, a person could enter a quarter section (160 acres), make certain agricultural improvements, and within 5 years receive a patent. In theory, a U.S. citizen or an immigrant intending to become one, could obtain a farm through his or her own labor. Native Americans were not and could not become citizens.

In practice, railroad and land companies took up most of the best agricultural land. What good land remained was quickly settled. Homesteaders soon crossed the 100th meridian into marginal areas. A kind of Darwinian selection took place. As one U.S. Senator put it, the government bet the farmer \$20 that he and his family would not starve to death in 5 years (Opie, 1987, p. 93). In areas where rainfall agriculture was not feasible, the only alternative was grazing. A quarter section was too small for

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grazing, however. Cattlemen would enter a homestead around a source of water, thereby controlling the surrounding public domain. Others entered more than they were entitled to. Water rights became separate from other property rights. Forests in the public domain were denuded without any rent paid to the government. Yet, 160 acres remained the limit on homesteads until well into the 1900s because the electorate would not allow it to be otherwise.

Gradually, westerners realized that agriculture was not feasible in most regions to the west of the 100th meridian without irrigation (Worster, 1985). At first private land companies and states attempted to construct irrigation systems. They soon confronted two problems: they needed large amounts of capital and they needed to control the watershed. Controlling the watershed was more than getting enough water. Rampant timber cutting and overgrazing of the public domain had created problems for controlling water flow. Managing water for irrigation meant controlling these activities. Major watersheds, such as the Colorado River, covered several states. Only the Federal government had the authority to cross state boundaries and the financial resources to build irrigation works on the scale needed. Thus, the Federal government began withholding land from private entry to protect watersheds. For the first time, it ceased to assume that all public land should become private. The Federal government began conservation measures, not to preserve the resources per se, but to aid in the further expansion of the American West.

The measures instituted around the turn of the century to protect the watershed did not, however, prevent the overgrazing of Federal lands. Grazing in the public domain was a classic instance of the Tragedy of the Commons (Hardin, 1968). Anybody could use Federal land, and ranchers put out as many head of livestock as they could. The Great Depression and the Dust Bowl compounded the problem. In 1934, Congress passed the Taylor Grazing Act. It closed the public domain to further homestead entries, except under certain conditions; it imposed a system of grazing permits and accompanying fees; and it set up grazing districts with boards to oversee them. The act ended the westward push of Euro-American settlement.

Since 1934, the Federal government has solidified its role in the management of Western land. Periodically, politicians in the Western states raise the idea that the public domain should be put in private hands, arguing that the land is used inefficiently under Federal management. At the same time, they fight vehemently against any reduction in Federal funding for water projects. Since the land is worthless without water, public ownership continues. Except for land under the national park system, Federal land is managed according to the principle of multiple use under which such different activities as mining, forestry, and recreation can be accommodated on the same area. These various activities reflect the groups who now benefit from and support Federal management. Native land is a special category of Federally-controlled land.

FEDERAL TRUSTEESHIP AND NATIVE SOVEREIGNTY

All the cultural understanding and tolerance in the world would not have changed the crucial fact that Indians possessed the land and that Euro-Americans wanted it. (Limerick, 1987, p. 190)

In the first centuries of contact, the European powers considered the various groups of Native North Americans to be nations. The indigenous nations were important to trade and held the balance of military power among the European colonies. The British considered them so important to their interests that the Crown prevented settlement beyond the Appalachian Mountain range. The American Revolution was fought, in part, to overcome English barriers to American expansion.

Even after the American Revolution, however, the United States government treated with the Natives as if they were nations. Under the United States Constitution, Congress has the power to regulate trade with the "Indian tribes." In 1790, Congress passed the Indian Nonintercourse Act, which prohibited anyone from buying Native land without Congressional approval (Strickland et al., 1982, p. 511). Only when, in the 1820s, the new nation became secure in its borders did anyone challenge this Congressional power. In the early 1830s, the state of Georgia wanted to open Cherokee Indian land to settlement. The state legislature passed a law saving that the Cherokees were under state jurisdiction. The Cherokees took their case to the United States Supreme Court. The Court found that the Cherokees and other Native American groups were "domestic dependent nations" under the wardship of the Federal government. but did nothing to enforce its own decision. The principle stood, however, that the Native tribes possessed an inherent sovereignty separate from, but subservient to, the Federal government (Wilkinson, 1987).³

Over the next 80 years, the Supreme Court laid down several principles of Federal-Indian law that remain today. It found that, as the trustee, Congress held plenary power over Native American affairs (Strickland et al., 1982, pp. 207, 220-225). That is, Congress could do what it wanted as the protector of Native rights, with the weak restriction that it must be done in the interest of the Natives. The court also developed the principle that,

³For a dissenting view of tribal sovereignty, see Metler (1978).

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because the Native American tribes were in an unequal position in any negotiation with the Federal government, ambiguous language in any treaty or act of Congress should be construed in favor of the Natives (Strickland *et al.*, 1982, p. 221). The three principles of inherent sovereignty, plenary power, and strict construction mean that Native Americans possess rights, including property rights, that have not been completely defined, that cannot be removed except through an explicit act of Congress, and that Congress can use to obtain certain ends if it believes that those ends are beneficial to Natives.

"Aboriginal title" to land is one example (Case, 1984, p. 48). Although Native Americans did not initially have a system of writing, much less a system of titles, British Colonial, and American common law recognized indigenous land rights based upon traditional use and occupancy. Aboriginal titles contain the same rights as other land titles, except that the Natives do not own the land in fee: only the national government can purchase it. Congress, however, has the power to remove aboriginal title without compensation, using its plenary power.

During the nineteenth century, Congress employed these principles to clear the way for settlement. Before the Civil War, the Federal government followed a policy of removal. Native groups east of the Mississippi River were forced to take up land to the west of the river. What is now the state of Oklahoma was set aside for the Five Civilized tribes, among them the Cherokee. Government policy followed the belief that Natives had to give way to Euro-American settlers. Their removal would allow the Natives time to "rise" in civilization.

Following the Civil War, as the railroads and homesteaders pushed west, this policy changed drastically (Miner, 1976). The war had ended all impediments to Western settlement. The Federal government, through treaties, agreements and military action, forced the Natives onto small reservations. The main food supply of the Plains Indians, the American bison, was wiped out. The tribes were reduced to living off government-provided rations.

The demise of Native American societies in the face of Western expansion seemed inevitable. Non-Native reformers hoped that while the tribes were doomed, the individuals were not (Prucha, 1976). Believing that the small freehold, family farm was the foundation of American society, the reformers pushed legislation to break up the reservations and give every tribal member an individual, quarter section farm. Under the General Allotment Act of 1887, it was assumed that the tribes would disappear. While the administration of this act was uneven over the next 40 or more years, the "inevitable" did seem to happen. After the government allotted land to individual Indians, the surplus land of a reservation was sold. Land speculators, with the money to buy large holdings, moved in. People with political influence pushed the allotment process.

Another land use regime, however, started on Native land. Indian agents, who were political appointees, could lease tribal land and resources under their control. This land included the allotments of people who had died without a will. Theoretically such holdings should have been divided among the heirs. One hundred and sixty acres were only marginally enough to support a family. Further fragmentation made farming impossible. When it occurred, the Bureau of Indian Affairs (BIA) would manage the land for the owners, leasing it to someone else, usually a non-Native. Leasing allowed local farmers, cattlemen, railroads, timber companies and the like to use Indian land without actually having to purchase it. The lessee paid much lower rents than he would have on private land, particularly since politics could influence the terms of the lease. In some wrongful instances, the lease was essentially given away or the rent not collected. Leasing Indian land also had the benefit that access was limited, unlike the public domain. Lessees of Native land also benefitted from Federal construction projects on the land. For instance, the water from irrigation projects, built under legislation meant to benefit Natives, would go to the white leaseholders of Native land, or would be declared "surplus" and sent to off-reservation farmers. Because of the sovereign status of tribes, non-Natives who used reservation resources only had to pay state and local taxes on the leasehold interest, not on all of the land's commercial resources. Local people and national corporations began to benefit from the legal status of Indian reservations.

Native rights also turned out to be significant for managing water outside the reservations. In a 1908 case, the Supreme Court developed what was called the Winter's Doctrine (Winters v. United States, 207 U.S. 564 1908). Under the Winter's Doctrine, Natives have a right to water for their reservation that is prior to any other claim. Subsequent decisions have expanded the Doctrine in two other ways (Wilkinson, 1987, pp. 70-71). First, the amount of water reserved for Indians is indeterminate until the water is actually used. Second, the water can be used for purposes other than agriculture, such as recreation parks. Water rights in the West had been based upon the principle of priority, that is, the first person to use a particular source of water obtained exclusive rights to it, even if it was on someone else's land. While this principle went against what the Federal government had wanted, the practice preceded the Federal land survey and the government had to accept it as reality. The Winter's Doctrine, however, dethroned the principle of priority by saying that the Natives had first rights. Moreover, control over Indian water rights went to the government as the trustee. The history of public land law in the United States recog-

nizes the Winter's Doctrine as the first instance in which the Federal government reserved a specific land right even when an individual held a patent to the land (Coggins and Wilkinson, 1981, p. 305). The Winter's Doctrine became an important tool because the government could use its trusteeship to manage water and watersheds for the benefit of all irrigators.

Despite the increased benefit that non-Natives had from Native land, the pressure from those who had nothing continued and so did allotment. Allotment became particularly pronounced during the 1910s. In the 1920s, however, concern over allotment's problems became so great that reform movements appeared. One group was closely allied with the growing conservation movement. The conservationists had, by the turn of the century, begun to look at the Natives' relationship with nature as a counterpoint to urbanization (Holm, 1978, Chap. 7). They saw in Indian societies an ideal that they wanted to preserve. They were confronted with politically powerful companies and individuals seeking uses of natural resources that threatened national parks, forests, and Native land alike.

The leader of the conservation-associated reform group, John Collier, became Commissioner of Indian Affairs in 1933. Congress passed legislation during his administration that reversed what had been the policy of the Federal government for almost 150 years. The Indian Reorganization Act (IRA) of 1934 was enacted during the same month as the Taylor Grazing Act. Thus, within a few days Congress ended the process by which the public domain had passed into private hands, and stopped the process of allotting Native land, reversing the assumption that the indigenous population of the United States would disappear into the indistinguishable mass of Americans.

As with Federal land, Indian land remained intact because various users with political influence benefitted from the existing ownership. Indian reservations, along with their water rights, gave some control over common property resources. More recent Federal policy has emphasized Indian selfdetermination. But "self-determination" has meant assuming management of existing Federal programs, not full self-government. Nor has this policy led to change in the non-Native use of Native land because land remains under the trust responsibility. Recent complaints about government oversight of Native leases suggest that they remain sources of enrichment for non-Natives. Originally, the government used its control to aid in the exploitation of the resources and encourage development. However, the linking of Indian reform and nature conservation, a link embodied in the administration of John Collier, suggested that Native sovereignty could also be used for environmental protection. Yet this linking was equally problematic, as the Navajo sheep reductions showed.

THE NAVAJO SHEEP REDUCTIONS

The Navajo are the largest American Indian group in the United States. The Navajo combine horticulture with pastoralism, particularly sheep herding. The Navajo got sheep from the Spanish during the seventeenth century. By 1848, when the United States took New Mexico and Arizona from Mexico, sheep had become an integral part of Navajo life. In 1863, the United States government sent a small force to capture the Navajo, with the intention of moving them to southern New Mexico and turning them into agriculturists. The force flushed out the Navajo by destroying their sheep, crops, and orchards. The move to New Mexico, what the Navajo call the Long Walk, failed. In 1868, the Navajo were allowed to return to their original land. To ensure their survival, the government issued 14,000 sheep and 1000 goats in 1869 and 10,000 more sheep a year later (Underhill, 1967, pp. 154–163).

Over the next 60 years, not only did the Navajo population triple in number, but so did their herds of sheep, goats, and horses (Kluckhohn and Leighton, 1962, p. 51). The government may have encouraged this growth (p. 73). By 1932, the estimated number of Navajo sheep had reached 1-1.3 million. Though the Navajo sold the wool from their sheep, their economy was subsistence agriculture, not commercial. As such, they did not attempt to maximize profit, but to reduce risk. Most families had goats and horses as well as sheep, and all practiced some form of horticulture. Goats were better at surviving winters than sheep, gave milk for the children and lambs, and could be eaten before the sheep. Horses survived droughts better, and the Navajo had no qualms about eating them as well. Horticulture provided a standard fare of maize, beans, and squash, but it was highly dependent upon rainfall. Livestock were the only hedge against droughts, which could occur every 3-8 years (p. 48). Conditions for each of these activities varied over the Navajos' territory. Rarely did a family stick to one type of livestock, or one activity.

The problem was that the amount of land available to the Navajo shrank (White, 1983, p. 219) as White cattlemen expanded into the public domain land surrounding the reservation. By the 1950s, the population density on the reservation was twice that of the surrounding non-Native land (Kluckhohn and Leighton, 1962, p. 53). A decline in the horse population from 1890 to 1930 compensated to a degree for the increasing number of sheep (Kelly, 1968, pp. 108–11). But the net effect was that the sheep began to exceed the carrying capacity of the land. The overgrazing was obvious from the vegetation.

In the 1930s, erosion appeared. The causes of the land erosion on the Navajo Reservation are known, but the proper weight to give any one of

them is not. Increases in the total number of livestock, Navajo settlement patterns, and herding practices certainly contributed. Other evidence, however, suggests that a new natural erosion cycle had begun during the late 1800s (Kluckhohn and Leighton, 1962, p. 50). Such erosion cycles are known from archaeological evidence and may explain the disappearance from the area of the large Anasazi settlements around 1200 AD (Tuan, 1966; though see Johnson, 1996). According to White (1983, p. 229), current evidence suggests that increases in gullying occur during multi-year wet periods. He argues that:

Although explanations of gullying are as yet tentative and unproven, a simple correlation between the erosion cycle of the late nineteenth and early twentieth century and the increase in livestock cannot stand. In some areas erosion began before livestock was introduced; in other areas prehistoric gullying was far worse than that which followed the introduction of livestock \ldots . This does not mean that the range was not being overgrazed, only that severe gullying would have occurred with or without sheep. Overgrazing hurt the land, hurt the sheep, and hurt the Navajos, but it was only a secondary cause of gullying and erosion.

Whether the Navajo were the primary cause of the erosion or not became, from one perspective, irrelevant. This perspective was that of the Federal government. In 1928, the Federal government authorized the construction of a dam, later named for President Herbert Hoover, on the Colorado River. This dam served several important functions. It supplied the entire southwestern United States with electricity; it protected a major agricultural area in southern California from flooding; and it provided water to Los Angeles. Even before the dam was constructed, however, concern arose over the reservoir filling with silt. According to a U.S. Army Corps of Engineers report in the early 1930s, two tributaries of the Colorado River, the San Juan and the Little Colorado, contributed small amounts of water, but large amounts of silt. The U.S. Soil Conservation Service considered the silt coming from the Navajo Reservation to be a threat to the new dam (White, 1983, p. 251). The dam was a major component of the regional economy. The Federal government concluded that something had to be done to stop land erosion on the reservation. Since the perception was that erosion was the result of overgrazing, for overgrazing was evident to even the most casual observer, a solution had to be found.

Expanding the reservation had been discussed repeatedly over the previous 40 years as a solution to overgrazing. The non-Native ranchers who had moved into the public domain around the reservation opposed any expansion, however. The other possible solution existed only because the Federal government was the trustee for all Native Americans: force the Navajo to reduce the number of sheep and goats.

In its first attempts at reduction, the government made several mistakes. It lumped all animals together according to the amount of range that they used. It paid little attention to the differences between the regions in their ability to support horticulture or livestock. Finally, it was believed that the Navajo could give up stock raising for full-time horticulture. All these beliefs ignored the environmental realities of the reservation. The government also believed that it was possible to achieve the same level of wool and meat production with fewer animals. This claim was true, at least for most Navajo herds. It ignored, however, the need for a diversified economy and the competing claims upon the Navajo's time and resources from the other components of their economic system.

Because of these assumptions, the government encountered considerable trouble during its initial efforts at reduction. In its first attempt in 1933, it simply purchased 100,000 sheep. The prices paid were too low, so the Navajos sold their culls, which the next lamb crop immediately replaced. In 1934, the Bureau of Indian Affairs (BIA) administrators designed what they thought was a better program. They targeted goats in particular. Range managers perceived goats as far more destructive and less economically valuable than sheep. Coercion was used to enforce an equal reduction in all herds. This affected the poor most of all because their herds were smaller and they were more dependent upon goats. The government also required that 80% of the lamb crop be sold. The Navajos complied, but under considerable protest. A third reduction in 1935, which was supposed to bring in 250,000 sheep and goats through voluntary sales, brought in only 27,000 head (White, 1983, p. 271).

A new estimate, made in 1935, showed that even though the number of sheep had declined from 1.3 to slightly more than .94 million head, the total number of all grazing animals was still equal to about 1.3 million "sheep equivalents." According to government advisors, the reservation could only maintain about 560,000 sheep units. Thus, after three attempts at reduction, the Soil Conservation Service said that the number of animals still had to be reduced by 56% (U.S. Soil Conservation Service, 1936; Parman, 1976, pp. 92–93) The government, after 3 years of insisting that each year's reductions would improve the range, found itself demanding even greater reductions. What was worse, in the off-reservation areas, where Navajos competed with non-Navajos for range, the non-Navajos simply moved into the range opened by the Navajo reductions (White, 1983, p. 266).

The government did attempt at this point to become more sensitive. It divided the reservation up into grazing units. The carrying capacity for each unit was determined and the reductions based upon these figures. The Navajo Service developed a sliding scale on which those whose herds were already under the carrying capacity were exempted from further reductions. Simultaneously, the rules allowed for a firmer government hand.

The superintendent of a grazing district could issue permits up to the carrying capacity and remove any animals that exceeded the limit. When in 1938 the government felt that large-scale owners were blocking the program, they took those owners to court. The courts upheld the government's right to remove the stock, by force if necessary (White, 1983, p. 298) The government also initiated roundups to reduce the number of horses. By 1945, the reservation as a whole was below carrying capacity, though individual grazing districts remained in poor condition. In 1946, the reservation contained just 449,000 sheep units. Reduction had been achieved.

The Navajo did receive compensation for the animals taken. The compensation may or may not have been at "fair market value." In any case, the people were left with cash that, unlike sheep and goats, did not regenerate itself. Once consumed, it was gone. While the government had planned agricultural projects to increase alternative food sources, the projects proved defective. Opportunities for wage work continued to come solely from the government. On-reservation employment remained around 25% of total Navajo income over the period from 1940 to 1958 (Kluckhohn and Leighton, 1962, p. 60). People had to leave the reservation to find work. In White's (1983, p. 310) words, "Stock reduction ultimately neither restored the lands of the reservation, revitalized the Navajo livestock economy, nor made the Navajos a predominantly farming people-all developments promised at one time or the other by the government. Instead, it made them wage earners and welfare recipients" Most ironic was that John Collier did what he had criticized the previous administration for doing: forced the Navaios to change their way of life. His principles of Indian reform had conflicted with his concern for conservation. Conservation won

In the 1930s, the earlier gullying slowed. By the 1970s, government scientists found that Lake Mead, the reservoir behind the Hoover Dam, was not in danger of filling with silt. All of which would appear to have supported the government's contention that reduction was necessary. Sheep herds, however, began to increase again in the 1950s, and overgrazing again became a problem. Scientists began to doubt that overgrazing was the sole reason for siltation, nor did all of them accept that the siltation had come from the Navajo Reservation. In effect, the original cause for concern may not have been a concern at all. Had the land been in fee simple ownership, the government would have passed legislation describing the public purpose for reducing the number of head; would have paid fair market value for the sheep and goats; would have dealt with the herders individually; and its evidence for the causes of silting would have been more closely scrutinized. The relationship of the government to the Navajo was different. The government, through its trust responsibility could bring pressure to bear, including the outright seizure of livestock. It had to provide compensation, but not necessarily equal to the full value of the livestock. Even had the silt come from other sources, it would have been easier to deal with the herders on the Navajo reservation.

CARIBOU IN NORTHWEST ALASKA

In the 1930s, the Western arctic caribou herd (WAH) began to reappear in northwestern Alaska, an area of predominantly Iñupiat villages. Though small groups of caribou were always present, large numbers had been absent since the 1880s (Hall *et al.*, 1985). From the 1930s on, caribou herds became intensely managed, heavily hunted, and the center of a political controversy over harvest rights.

The origins of the caribou hunting controversy may be found in the early 1960s, when the U.S. Atomic Energy Commission (AEC) revealed a plan to create a harbor between Point Hope and Kivalina by exploding atomic bombs (O'Neill, 1994). Scientists and local residents feared that the radiation released would be absorbed by the lichen, then move up through caribou into humans. The explosion did not take place, but a Native land claims movement started in reaction. The initial purpose of this movement was to protect what is commonly referred to in Alaska as "subsistence," the traditional resources used for food, clothes, and shelter (Fienup-Riordan, 1984). The discovery of oil on the North Slope and the need to clear land title to the Trans-Alaska Pipeline right-of-way, created pressure for a settlement. The oil companies, in fact, provided support to the Alaska Natives pushing their claim. The movement succeeded in 1971, when the U.S. Congress passed the Alaska Native Claims Settlement Act (Public Law 93-203 or ANCSA).

The Act turned out, however, to have a different purpose than the protection of subsistence resources. The 44 million acres (18 million ha) awarded under the Act were turned over to corporations of which Alaska Natives would be shareholders (Arnold *et al.*, 1978). The corporations were for-profit. The shares in these corporations could be sold to anyone after 1991. Most remarkably, the Act explicitly removed any special hunting and fishing rights for Alaska Natives (Case, 1984, p. 295). It did this for two reasons, first to prevent the use of such rights to make further claims on land, as had happened with other Native American groups, and, second, because the state of Alaska convinced the Federal government that it could adequately protect Native hunting and fishing.

For the state, controlling the natural resources within its borders was a central issue (Naske, 1971). Before statehood, the revenue from com-

mercial fishing had left the territory along with the fish. Until oil was discovered, fishing was the primary economic activity in Alaska. The Federal government managed the fisheries poorly because policies were set in Washington, D.C. where the packing companies exercised political influence (Naske, 1971). The packing companies were the primary opponents of Alaska statehood. The authors of the state constitution wrote in two unusual provisions: first, the state had to manage its natural resources for the benefit of all, and, second, it had to manage them according to the principle of sustained yield. The belief was that Alaska was a place of great wealth, if only Alaskans controlled the resources.

The promise of the state to protect subsistence was put to the test in 1975. The State Department of Fish and Game had made several surveys of the WAH. Its 1975 aerial survey showed a drastic decline in the herd to 75,000 animals. Estimating annual harvests to be between 25–30,000, game managers felt drastic action was called for. The State Board of Game decided to limit the harvest to 3000 males under a permit system. The biologists preferred no harvest, but recognized the need for a village hunt. To fulfill its promise to Congress, the state allocated permits to each Native village council in the region, allowing the council to decide who should get them. Giving permits to villages angered sport hunters and professional hunting guides. They took the matter to the state court, which found in their favor. The state court pointed to the constitutional provision requiring that resources be managed for the benefit of all. Hunters in urban areas had to be given equal access to the herd. The battle over subsistence had begun.

Consequently, the Alaska Native Federation lobbied Congress to protect subsistence. To forestall reassertion of Federal control, the state legislature passed a subsistence law of its own, which gave preference to the subsistence use of resources when the resource was in limited supply. Congress, however, included subsistence protection provisions in the Alaska National Interest Lands Conservation Act (Public Law 96-487 or ANILCA) of 1980. Congress allowed the state to retain management over fish and wildlife on Federal land if it had a subsistence law, such as the 1978 one, that met certain minimum requirements (ANILCA, Section 801). Also, at the request of the Alaskan Congressional delegation, it gave the subsistence rights to "rural residents" rather than Alaska Natives.

The state law proved controversial, however. Non-Natives living in urban areas, pushed on by big-game hunting guides, claimed that the Natives did not really need the food, that they were really sports hunters, that the preference violated the United States constitutional principle of equal protection, and that they wasted the resource, killing more than they could ever possibly eat. The latter was a particularly significant claim because it suggested that the Natives were irresponsible in their use of game.

In 1982, a proposition to repeal the 1978 law failed.⁴ The Alaska Boards of Fish and Game, which actually decides on hunting and fishing regulations, was then left with defining who qualified as a subsistence user. In an effort to find a race-blind definition, they used place of residence as the criterion. Urban Natives objected in state court, where the provisions were repeatedly struck down. The legislature tried writing new legislation. In 1989, the state supreme court made it clear that no state subsistence law could be constitutionally acceptable and meet Federal guidelines. The equal access to resources provision of the state constitution prevented it. In the summer of 1990, the state legislature went into special session to consider amending the constitution. It did not reach a conclusion, and the Federal government took over management.

The current situation may be summarized as follows: the Federal government now manages fish and game on the land that it owns, roughly 50% of the state, and the state government manages fish and game everywhere else. State management would include the Native corporation land. which is private. However, under the modifications to ANCSA made in 1987, undeveloped Native corporation land must be managed in a "manner consistent with" management on the surrounding state and Federal lands. Thus, Native corporation land may be subject to some, as yet unspecified. restrictions (Flanders, 1989). In essence, the Federal government has taken over control of a resource that the state had previously managed. It has done so in the nominal interest of the Alaska Natives. In Title VIII of ANILCA. Congress justified its decision to provide for a subsistence use preference through its constitutional power over Native affairs (ANILCA. Sec. 801). All the same, several legal commentators have suggested that ANILCA has given back rights to fish and game that ANCSA took away (Conn and Garber, 1990).

Whether these rights benefit Alaska Natives remains to be seen. The Federal agencies with land in Alaska at first adopted the state regulations that had existed before July 1990. A Native group sued, pointing out that ANILCA required the Federal agencies to consult with the local advisory groups set up under the Act before promulgating regulations. The Federal government has now stepped back and contracted for research on Native subsistence practices to inform its regulatory decisions. This preliminary action has, however, raised the issue of Native influence over fish and game management decisions and increased the calls for Native management of the resources through tribal governments. Tribal governments, e.g., the

⁴In Alaska, propositions can be placed on general election ballots and, if passed, become law.

Kotzebue Indian Reorganization Act (IRA) government, have begun conducting their own research.

While the battle over subsistence was being fought, concerns over other aspects of ANCSA began to mount (Berger, 1985). Because village and regional for-profit corporations held the land granted under the act, the management and financial health of the corporations indirectly threatened the land. The corporations could develop or sell their land or lose through court judgments. Any one of these dispositions would threaten subsistence activities. These things did not happen, but economic necessity, bad business decisions, or the corporations going public in 1991 could have forced a change in management (Flanders, 1989). Thus concern mounted for the future of the corporations and the land that they owned.

Out of this grew two movements. The first group, largely made up of those most closely associated with the corporations, sought to modify the original law, but keep the corporate structure. The other group sought to reinvigorate the tribal governments that predated ANCSA and had not been extinguished by the 1971 Act. This latter group believed that the corporations could not protect Native interests because of their limited time. their focus on making profits, and their control over a limited amount of land rather than significant subsistence resources. A split had also developed between the older Native leaders who had ridden corporations to positions of prominence and a generally younger group who were concerned about the future of their communities. The tribal government supporters sought to turn corporation land over to the village tribal governmental and to obtain control over all resources, particularly fish and game, within tribal boundaries (Berger, 1985). Unlike tribal governments in the 48 contiguous states, the ones in Alaska are based on villages. In the other states, a tribal government is based on a reservation, a well-defined territorial area. Few formal reservations existed in Alaska before ANCSA and only one after. Thus, the extent of territorial control exercised by Alaska tribal governments has been an issue. A recent decision by the U.S. Supreme Court denied that Native villages constitute "Indian country," but allowed that congress could designate them such.

In 1987, Congress modified ANCSA to take care of the problems with the corporation structure. Congress, however, left the issue of tribal sovereignty up to the courts. National sports hunting groups were concerned that tribal management of fish and game in Alaska would prevent non-Natives, particularly non-Alaskans, from hunting in Alaska. Thus, the issue of access to fish and game stymied the effort to reinvigorate the tribal governments. Furthermore, the historical position of the courts and Congress were reversed. In the past, the Federal courts, because of the plenary power of Congress over Native affairs, had always deferred to the actions of Congress. In this instance, Congress left the issue up to the courts. Congress in effect said that if Alaska Natives have tribal sovereignty then it is inherent and it already exists apart from the actions of Federal or state governments: it is up to the courts to decide.

Until the issue of tribal governments is resolved, fish and game management is in the hands of Federal agencies. Conflicts have already arisen over Native hunting in national park units, which manage the land around several important caribou river crossings. The National Park Service has emphasized enforcement. Those who object to this approach have suggested that the management of game, caribou in particular, would benefit from a co-management agreement similar to that employed in Canada and other parts of Alaska (Berkes et al., 1991; Borrini-Feverabend, 1996; Huntington, 1992; Osherenko, 1988). Such an arrangement is currently under consideration following a conference in Alaska that pointed out the need for managers to work more closely with communities (Trent et al., 1996). The agreement would be among three entities: the tribal governments in the herd's range, the state, and the Federal government. Tribal governments have come back into the fore, in part because they are in the best position to represent villages (cf. Noble, 1987). Not all villages have an ANCSA village corporation (most of those in the region around Kotzebue were merged with the regional corporation) or state-chartered village governments. Even where corporations and city government are present, it is questionable whether they would have the formal ability to take on fish and game management. Tribal governments generally do. The state has become more willing to recognize tribal governments as something more than private organizations.

The central difficulty is that Federal agencies have differing approaches to management, with the Park Service following the implicit strategy that the best management is no management (Chase, 1987). The Park Service has also been most reluctant to move into a co-management agreement because of its tradition of protection rather than conservation. A comanagement agreement may require some fundamental changes in agency perspectives.

As with erosion on the Navajo reservation, one may retrospectively question the science on which the WAH crisis began: a master's thesis based on the WAH research observed that the numbers used were minimum estimates of herd size (Doerr, 1979, p. 155). The researchers could not come up with a maximum confidence interval estimate (p. 172). At the time, villagers questioned whether the aerial surveys had actually located all of the animals that they were seeing on the ground. The biologists' reports between 1970, when the last survey had estimated a population of 243,000, and 1975 stated that the herd was in good condition and that no

restrictions were necessary (e.g., Pegau, 1973). A 1974 survey did note that animals were missing from parts of their usual range, but since "caribou migrate and disperse in an inherently unpredictable manner, the pattern exhibited during 1974 can be expected" (Grauvogel and Pegau, 1974). The state biologists simply didn't believe that the herd's population could change so rapidly (Hinman in Fairbanks Environmental Center, 1976).

The more questionable scientific issue concerned the cause of the believed decline. The state biologists employed emotive language of questionable scientific relevance, "heavy harvest by rural subsistence hunters (including waste), and substantial predation by wolves were the primary causes of caribou mortality during the post-1970 decline" (Davis et al., 1980). Human harvest can be a cause of herd decline when numbers are low. The 1970 level was arguably sufficient to allow the usual subsistence take. In 1986, the herd was estimated to have again reached the 1970 level. It has since grown to an estimated 450,000 (Medred, 1992) despite essentially unrestricted harvesting from the early 1980s on. The uses to which the harvest is put, be it subsistence or waste, are not a cause of decline. Waste may be a factor in obtaining accurate harvest data and may be a legitimate policy question if one is trying to reduce harvest while maintaining the same level of available food. The use of the words "subsistence" in quotation marks and "waste," whether accurate or not, went beyond reporting scientific results.

Even given that the herd had declined precipitously, the causes were likely to have included factors other than human hunting. Subsequent research on caribou and reindeer suggests that abiotic factors, such as icing events, and insects may be more important than human hunting or predation (for example, see Russell *et al.*, 1993). The researchers at the time did consider these alternatives, but rejected them because there was "no evidence." They did not actively test for these factors as competing hypotheses. One argument for human harvest as a factor came from modeling, which estimated backwards to the level of human harvests that would have been necessary to achieve the estimated decline in the herd (Davis *et al.*, 1980; Doerr, 1979). No hard data existed. Government research, research carried out within agencies, is typically different from nongovernment research, particularly its lack of merit review (see for example Busch, 1991). To this author's knowledge, the Department of Fish and Game's research was never subjected to such a review.

Their argument, thus, seemed more ideological than scientific. The biologists argued against any subsistence hunting at all, implying that it was irresponsible, and thus tried to limit the activities of the one element in the system that seemed the easiest to change: Iñupiat villagers. In the end, the Department of Fish and Game admitted internally that the restrictions may have been too great and that they did not know whether people in the village actually followed them (Pegau, 1980). The result was a much larger conflict over subsistence resources.

DISCUSSION

The current debate over subsistence was foreseen. In 1963, when the Native land claims movement was just beginning. Don Foote, a human geographer, predicted that something like these events would happen. At that time, the Iñupiat had enlisted the aid of a Euro-American group interested in Native American affairs. The advisors to this group pushed for clear titles over land. Their reasoning was that titles would allow the Iñupiat to obtain loans and participate in the industrial development of the North. Foote disagreed with this point of view. He argued that no industrial development in the North could replace hunting and fishing as the basic component of the village economies (Foote, unpublished). Owning land could not secure access to the land and sea resources upon which the villages depended for food. Foote suggested that the Iñupiat and other Alaska Natives should receive rights in the ecosystem, not land (cf. Usher and Banks, 1986). In retrospect, he was prescient about the failure of ANCSA to provide for the well-being of the villages and to protect the resources upon which they depend.

Foote had suggested an ecosystem management regime in which scientists would study the population dynamics of the food species and would help the "owners" of the ecosystem to develop guidelines for harvesting. He suggested that through a program of on-the-job training, the local people would eventually take over the scientists' role. What has evolved in Alaska has been something similar to this plan, in the sense of ecosystem management, but with the locus of control currently in state and Federal agencies.

The resource regime⁵ that is taking shape under Federal control may become like the technocratic management that Worster (1985) describes for the irrigation works of the Imperial Valley, California. Worster has taken the theory of "oriental despotism," originally developed by Wittfogel (1957) for Imperial China, and applied it to modern water management. The irrigation system in the Imperial Valley was a result of the Hoover Dam construction. The re-routing of water across watersheds, and the need to control large areas of land was, of course, the reason for a Federal role in water management. Worster argues that the resulting bureaucracy is

⁵For a definition of resource regimes, see Young (1982).

strikingly similar to that described by Wittfogel, and for the same reasons. Rearranging watersheds requires highly centralized control whether in China or California. The bureaucracy concentrates on the technical and scientific problems of delivering large amounts of water. Its power base becomes those who benefit from that water. It ignores the prior ecology and geography, and the people who have depended upon them.

The Navajo sheep reductions are an example of how such a bureaucracy can create dire consequences for local populations without considering whether its actions truly address a problem. The fear of siltation behind the Hoover Dam drove the reductions. At the same time, however, Navajo land erosion justified the use of Federal authority over Native Americans to enforce policies. Under less pressure and with greater attention to the needs and perceptions of the Navajo, the issues and results might have been very different. The reductions were devastating because a centralized administrative structure made the decisions based upon scientific evidence that might or might not have been correct. Central decision-makers are rarely the ones to pay for the incorrect use of scientific information.

In Alaska, the driving forces may be different, but the potential for a technocratic management of wildlife resources remains. Caribou are in some respects like water. The major herds cover large areas, cross jurisdictions, but also provide some opportunities for management. In short, knowing the "larger picture" is important to the health of the herds. State management of the herd is like Western water management when it seeks to provide a steady flow (of caribou) to a group of users (hunters, primarily sport). Caribou could become, like water in the Imperial Valley, a number instead of a vital gift of life to local villages.

Federal management in Alaska is now at a decisive point. It is guaranteeing a flow of caribou to village users, but with a centralized structure. This regime is currently beneficial to village users. The centralized control, however, also contains the potential for other objectives to appear that would not fulfill the needs of Alaska Natives. As the concept of the herd becomes more of a number, it can also be more easily allocated to other uses. Alternate objectives could be anything from industrial development to environmental protection.

The use of scientific research, the *modus operandi* of technological management (Friedmann, 1987), in this situation is particularly worrisome: Federal agencies can use it not just for the knowledge that it imparts, but as a way to exclude local participation in decision-making. Federal managers can override Congressionally-mandated, locally developed wildlife management programs if they violate "recognized principles of wildlife conservation, or threaten(s) the conservation of natural or healthy populations of wildlife" Thus, the managers can use research as a means to

preempt local proposals. While Federal responsibility in rural Alaska may in theory protect Native interests, decision-makers may act on poor research and do those interests harm. Even bad data obtained through scientific research can cast a spell that is hard to break.

Native sovereignty can be used to solve the problems of common property resources. This application we have seen in two prominent cases. But it contains an equal potential for misuse. The development of a co-management regime, one that incorporates the knowledge of local users, suggests an alternative future in which management is decentralized. Such a structure could come closest to Foote's suggested ownership over resources. Here the distinction between patterns of social practice—institutions—and entities possessing legal identities and physical presences—organizations is significant (Young, 1989, pp. 32–37). A co-management institution need not have a large organization to go with it; it can provide diffuse management of resources (cf. Osherenko, 1988). At the end of the European Westward expansion and the twentieth century, perhaps the history of Native–White interactions will change. Perhaps these interactions can be the basis for a new, more effective resource management institution.

ACKNOWLEDGMENTS

The research upon which this paper is based was funded under a U.S. Man and the Biosphere Program Northern Science Network fellowship and a grant from the National Science Foundation (OPP 9318926). An earlier version of the paper was presented at the 1991 Nordic MAB meeting in Alta, Norway. The Arctic Centre of the University of Lapland and the Chukchi Campus of the University of Alaska Fairbanks at various times provided physical facilities necessary to the work.

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