DISCUSSION PAPER

July 2016 ■ RFF DP 16-27

The Environmental Turn in Natural Resource Economics

John Krutilla and "Conservation Reconsidered"

H. Spencer Banzhaf

1616 P St. NW
Washington, DC 20036
202-328-5000 www.rff.org

RESOURCES
FOR THE FUTURE

The Environmental Turn in Natural Resource Economics: John Krutilla and "Conservation Reconsidered"

H. Spencer Banzhaf

Abstract

Environmentalism in the United States historically has been divided into its utilitarian and preservationist impulses, represented by Gifford Pinchot and John Muir, respectively. Pinchot advocated conservation of natural resources to be used for human purposes; Muir advocated protection from humans, for nature's own sake. In the first half of the twentieth century, natural resource economics was firmly on Pinchot's side of that schism. That position began to change as the postwar environmental movement gained momentum. In particular, John Krutilla, an economist at Resources for the Future, pushed economics to the point where it could embrace Muir's vision as well as Pinchot's. Krutilla argued that if humans preferred a preserved state to a developed one, then such preferences were every bit as "economic"—either way, opportunity costs exist and economic choices must be made.

Key Words: Krutilla, conservation, preservation, existence value

JEL Classification Numbers: B21, B31, Q3, Q5

Contents

The Environmental Turn in Natural Resource Economics: John Krutilla and "Conservation Reconsidered"

H. Spencer Banzhaf *

1. Introduction

In popular discourse, one often hears about a trade-off between economics and the natural environment. Historically, defining their discipline in terms of the science of material wealth and welfare, economists have spoken in these terms as well, generally resisting economic analysis of the natural environment well into the 1950s. By the 1960s, however, as economists came to redefine their discipline in terms of opportunity costs and as environmentalism became wrapped up in a new aesthetic consumerism, the tension of economics versus the environment gave way to a new economics *of* the environment. More than any other economist, John Krutilla forged this intellectual development. In contrast to earlier work by natural resource economists, which focused on developing resources, Krutilla argued that preserving resources also had value. Because development came at the opportunity cost of those preservation values, a science weighing reciprocal opportunity costs had to consider both sides of the ledger.

This paper tells the story of these intellectual moves. Section 2 reviews the historical background of the conservation movement in the United States and discusses the prominent schism between Gifford Pinchot and John Muir, a background against which Krutilla would frame his new ideas. Section 3 briefly considers Aldo Leopold, an ecologist who wrestled with the inability of economics, as he saw it, to adequately justify the preservation of landscapes and ecosystems that he considered to have inherent value. In the face of the failure of economics to account for such values, Leopold advocated a new "land ethic" that would transcend economics. Section 4 then turns to Krutilla, who admired Leopold and wrestled with similar issues, but who came to a very different conclusion about the ability of economic science to defend preservation. Section 5 concludes.

* Professor, Department of Economics, Andrew Young School of Policy Studies, Georgia State University, PO Box 3992, Atlanta, GA 30302. hsbanzhaf@gsu.edu.

I thank Kerry Krutilla for very helpful discussions. I also thank Kerry Smith, Charlie Cicchetti, Polly Cleveland, Craufurd Goodwin, and participants in sessions at the 2015 History of Economics Society meetings and the 2016 ASSA meets for helpful discussion and comments. Finally, I thank Lynn Toscano at the SUNY Stony Brook University Libraries for assistance with the Environmental Defense Fund archives.

2. Gifford Pinchot and John Muir: Conservation versus Preservation

A crucial feature of the intellectual context in which Krutilla worked is the long divide between what are sometimes known as the *conservation* and the *preservation* sides of American environmental thought and politics, though these terms have been politically contested and fraught with confusion. Crudely speaking, the conservation side advocated that resources be managed for sustainable use; the preservation side advocated that they be sheltered from use and kept in their wild state (or "locked up," as the conservation side would put it).[1] These two sides came to be personified by Gifford Pinchot and John Muir, respectively.

The son and grandson of wealthy real estate magnates and lumbermen, Gifford Pinchot (1865–1946) graduated from Yale University in 1889 and received postgraduate training in forestry at the *École nationale des eaux et forêts*, making him one of America's first professional foresters. His career swiftly grew: by 1898 he was appointed as the second chief of the young US Division of Forestry (later to become the US Forest Service), and in 1900 he founded the Society of American Foresters. In the same year, he cofounded, with his father, the Yale School of Forestry. Eventually he would become governor of Pennsylvania.

Pinchot advocated "wise use" of natural resources, which he interpreted in utilitarian terms, extending Bentham's maxim to encompass sustainability. He defined conservation as "the greatest good to the greatest number for the longest time" (Pinchot 1910, 48). In identifying threats to such wise use, he emphasized Progressive Era concerns about waste and inefficiency, as well as monopoly control, which concentrated natural wealth so that it would not flow to the greatest number (Pinchot 1947, 506–7).

John Muir (1838–1914) had a very different background. Born in Scotland, Muir moved with his family to the Wisconsin frontier when he was eleven. He worked on the family farm with his father, then in a machine shop, where he was an expert on managing efficient work flows (Wolfe [1945] 2003). He always loved the wilderness but led a fairly conventional life until an accident in 1867 left him blind for one month. After recovering, he decided life was too short to do anything but live for his passion, so he went to the wilderness. He hiked 1,000 miles

[1] The division is by no means unique to the American intellectual landscape. Worster (1977) contrasts the "imperial" approach epitomized by Linnaeus with the "Arcadian" posture of Gilbert White. Smout (2000) discusses the two rival themes of "use" and "delight" in the history of Scottish and English conservation. Indeed, as Goodwin (1999) has pointed out, similar issues are at play in broader aesthetic discussions, including art.

from Indiana to the Gulf of Mexico, then famously hiked the Sierra Nevada. There, he was inspired to think and write and, soon, to work on the signature project of his life: the preservation as wilderness of the area that would become Yosemite National Park. That work yielded fruit in 1890 with the passage of the Yosemite Act, the first act of conservation explicitly tied to preserving land in its wild state.[2] Understanding the need to watch over this new asset, Muir founded the Sierra Club in 1892 as an advocacy group and nascent political force.

In contrast to Pinchot's utilitarianism, Muir was a transcendentalist, reworking his orthodox Christian upbringing into a spiritual faith in Nature (Nelson 2010). He hiked with a well-thumbed copy of Emerson's essays, and his hero would eventually seek him out in Yosemite.[3] To Muir, leaves, rocks, and bodies of water are "sparks of the Divine Soul." Landscapes are "blessed," "waters will wash away sins as well as dirt," and Nature shows material care ([1875] 1980 passim). Consequently, wilderness is the best avenue to divinity, for it best reflects God's creation, untarnished by human hands: "The clearest way into the Universe is through a forest wilderness" (quoted in Nash 1982, 125–26).

Consistent with this spiritual view of Nature, Muir was explicitly anti-anthropocentric. "No dogma taught by the present civilization," he wrote, "seems to form so insuperable an obstacle in the way of a right understanding of the relations which culture sustains to wildness as that which declares that the world was made especially for the uses of man" ([1875] 1980, 235–36). To the contrary, nature's value was intrinsic. For example, to a question about what rattlesnakes are good for, "[a]s if nothing that does not obviously make for the benefit of man had any right to exist; as if our ways were God's ways," he answered that "they are good for themselves, and we need not begrudge them their share of life" ([1901] 1980, 200).

Holding one another in mutual respect, Pinchot and Muir initially were allies against the status quo and laissez faire, which Muir referred to as the "gobble-gobble school of economics"

[2] In contrast, Yellowstone, established in 1872, had been preserved as a "pleasuring ground" for its "curiosities." Earlier, the Yosemite Grant of 1864 had deeded 10 square miles to the state of California for a state park at Yosemite, but that small area soon became the center of a thriving tourist business (Nash 1982, Ch. 7). In contrast, the Yosemite Act of 1890 added nearly 1,200 square miles.

[3] The encounter proved disappointing to Muir. He invited Emerson to join him "in a month's worship with Nature in the high temples of the great Sierra Crown beyond our holy Yosemite," but Emerson and his companions preferred the comfort of a nearby inn. Emerson later reciprocated, writing from Massachusetts to invite Muir to "bring to an early close your absolute contacts with any yet unvisited glaciers or volcanoes" and join him as a permanent guest, for wilderness "is a sublime mistress, but an intolerable wife." Muir declined (Nash 1982, 126).

(Wolfe [1945] 2003, 102). But that alliance began to unravel as the necessity of making specific land use decisions exposed their differences. For example, in 1891, the United States had established its first "forest reserves," creating some 13 million acres of federal forestland, but how those lands would be used was by no means clear. In 1896, Pinchot and Muir both were appointed to a committee of the National Academy of Sciences commissioned by the secretary of the interior to survey the newly created reserves and make recommendations about their disposition. Muir envisioned them being preserved as wild places, such as Yosemite; Pinchot favored managed development for wise use. The committee could not agree on a recommendation, and individual members soon turned to working against one another in a game of political chess. In the end, the wise-use side won, as Congress declared the purpose of the reserves as being "to furnish a continuous supply of timber" plus sustainable mining and grazing. When they met later that year, a comment by Pinchot supporting the grazing of sheep on federal lands so enraged Muir, who had long viewed sheep as "hoofed locusts" that denuded natural landscapes, that Muir declared, "I don't want anything more to do with you" (Nash 1982, 130–38). The fault line dividing the leading spokesmen for the romantic and the bureaucratic impulses in American environmentalism had widened to a cleft.

Setting a pattern for the future history of American environmentalism, the final, epic battle between Muir and Pinchot was fought over a dam. In 1906, shortly after its devastating fire, the city of San Francisco petitioned the federal government to allow the damming of the Hetch Hetchy valley (some 150 miles away in Yosemite) for municipal water supplies. In the end, the political forces in San Francisco carried the day and Hetch Hetchy was dammed, but not before a seven-year fight that further opened the divide between the conservation and preservation camps (Hays 1959; Nash 1982).

Muir and his allies launched a furious campaign to preserve their beloved Yosemite, emphasizing its spiritual significance. "Dam Hetch Hetchy!" exclaimed Muir, in the final words of his book, *The Yosemite*. "As well dam for water tanks the people's cathedrals and churches, for no holier temple has ever been consecrated by the heart of man" (Muir [1912] 1989, 218). Significantly, Muir and the "nature lovers" also appealed to Yosemite's value as a place for recreation. As Nash (1982) argues, this was a tactical error, for the proponents of the dam could just as well turn this argument to their advantage, with the resulting reservoir providing many more recreational opportunities for boating and fishing. Interestingly, outdoor recreation would continue to be a vexing question for the evaluation of dams and a major driver of the development of environmental economics (Banzhaf 2010).

For his part, Pinchot appealed to science and posed the problem in terms of the utilitarian calculus rather than spiritual values. In his testimony to Congress, he framed the question as centering on "whether the advantage of leaving this valley in a state of nature is greater than . . . using it for the benefit of the city of San Francisco. While he admitted the idea of preserving the valley was appealing when viewed in isolation, the city's need was "overwhelming" (Nash 1982, 170–71).

The clash between Pinchot and Muir extended to the very definition of the word "conservation" and related vocabulary. Pinchot claimed to have personally coined the term (1947, 326), though historians have considered that claim rather dubious (Hays 1959, 5–6). Using Pinchot's vocabulary, "conservation" inherently meant the wise use of resources. Muir and his allies would be said to advocate "preservation" in contrast to "conservation."[4] For their part, Muir and his allies were unwilling to concede the term "conservation" to Pinchot. In their rival vocabulary, the wise-use or utilitarian school and the preservationist school were two sides of the "conservation" coin.

It is tempting to reduce the differences between Pinchot and Muir to a simple difference in values: Pinchot valued timber, Muir preferred wilderness. But as Meyer (1997) argues, there are difficulties with that interpretation. Pinchot, in fact, first went into forestry as an act of propitiation, motivated by the sense of damage his family's lumbering business had done to the woods (Miller 1992). He frequently referred to the sublimity and beauty of nature. Describing his reaction on first seeing the Grand Canyon, he wrote, "Awe-struck and silent, I strove to grasp the vastness and the beauty" (1947, 42). Moreover, Muir was hardly the prototype of the misanthropic deep ecologist as some would paint him. He frequently conceded the necessity of forestry and development.

On Meyer's reading, the differences between Pinchot and Muir were as much about politics as values. Muir sought a space for wilderness sheltered from the pressures of political economy and built Tocquevillian mediating organizations such as the Sierra Club. Given his spiritual view of wilderness, a reasonable comparison for the place of preservation in Muir's politics would be to the space traditionally given to religion in American politics, and for preservationist organizations to institutions like churches. In contrast, Pinchot dismissed love of

[4] Just what the union of the two terms would be called is by no means clear. As Hays (1982) notes, importantly, the term "environmental" or "environmentalism" did not come into play until the postwar period.

wilderness as private feelings that had no place in his technocracy. In the debate over Hetch Hetchy, he conceded private feelings for the beauty of the wild valley but gave no role to them in public decisionmaking. "The fundamental principle of the whole conservation policy," he testified to Congress, "is that of use, to take every part of the land and its resources and put it to that use in which it will serve the most people" (quoted in Nash 1982, 170–71). Since love of wilderness was by definition omitted from his version of the utilitarian calculus, Pinchot's science of conservation management led inevitably to the recommendation to develop.[5]

Thus each side recognized the values espoused by the other but could make no room for them in its politics. According to Muir's poetic and spiritual approach, one must serve either Nature or mammon; no one can have two masters. According to Pinchot's scientific approach, spiritual values had no place in the utilitarian calculus.

As I shall argue, dissatisfaction with this dichotomy—and particularly the exclusion of real values from the utilitarian calculus—led Krutilla to introduce important reforms in natural resource economics. Krutilla was hardly the first to wrestle with this problem. Aldo Leopold, a more famous figure in the American environmental movement whom Krutilla greatly admired, grappled with similar issues. Despite holding a position in a department of agricultural economics, Leopold was quite skeptical of the promise of economics to value natural preservation. Indeed, Krutilla's moves can best be understood in contrast to Leopold's own.

3. "Do Economists Know about Lupines?" Aldo Leopold and the Environmental Turn in Conservation

Aldo Leopold (1887–1948) knew he wanted to be a forester from an early age. He went to a college preparatory school specifically for the purpose of going to Yale so that he could enroll in the School of Forestry, which had recently been founded by the Pinchot family. He arrived at Yale in 1904, first taking courses at the Sheffield Scientific School as preparation for the forestry school, where he did his graduate work. At Yale, Leopold obtained an interdisciplinary education in resource management, which included a great deal of economics, with a particular emphasis on Bentham's utilitarianism (Goodwin 2008). He began his professional career at the US Forest Service in 1909, during a period of time when it was headed

[5] Later in life, Pinchot seems to have reevaluated this position. As governor, he preserved the last large stand of virgin hardwoods (Miller 1992).

by Pinchot. In 1933, he took a position at the University of Wisconsin's Department of Agricultural Economics, as a professor of game management. In 1935, he cofounded the Wilderness Society with Benton MacKaye, Bob Marshall, and others.

Leopold began his career firmly in Pinchot's conservation camp. But during his time at the Forest Service into the 1920s, he increasingly came to feel that forests and other resources needed to be managed for multiple purposes and, moreover, that gaming and nonconsumptive recreational uses should be given more weight than they were relative to extractive activities such as lumbering (Nash 1982; Callicott 1994; Newton 2006). In this respect, Leopold was perfectly in step with trends in natural resource management. The Forest Service had recently commissioned a report from Frank Waugh, a landscape architect (and father of leading agricultural and resource economist Frederick Waugh), which recommended that recreation be given weight in management decisions.

While increasingly valuing these kinds of uses or purposes, Leopold still looked at the problem as a manager or economist would, as one of balance. He used marginal reasoning to think about the trade-offs between consumptive and nonconsumptive uses. Said Leopold, "[W]hile the reduction of the wilderness has been a good thing, its extermination would be a very bad one." Explaining by analogy, he continued:

> What I am trying to make clear is that if in a city we had six vacant lots available to the youngsters of a certain neighborhood for playing ball, it might be "development" to build houses on the first, and the second, and the third, and the fourth, and even on the fifth, but when we build houses on the last one, we forget what houses are for. The sixth house would not be development at all, but rather … stupidity. (quoted in Nash 1982, 187–88)

Eventually, however, Leopold became disillusioned with this way of thinking. In some sense, it could be said that he moved more to the preservation side of the spectrum from his start on the conservation side. He began as a forester, came to appreciate wilderness for its nonconsumptive uses, and increasingly came to value wilderness for its own sake. But Leopold did not just shift positions in an existing intellectual landscape; he molded new ones. To Leopold, the conservation approach did not give enough credit to the intrinsic value of wildlife. Yet the preservation approach of "locking up" wildlife did not give enough credit to human beings. A third way was needed.

Leopold turned to the growing field of ecology as that third way. Humans could live with wildlife as part of a complex web of interactions. This would require a new "ethic," a "universal symbiosis with land, economic and aesthetic, public and private" (Leopold 1933, 639). At the

end of his life, Leopold proposed a new interdisciplinary research and teaching project in "ecological economics," based on the premise that "industrialization is now bringing on a worldwide conflict between economics and conservation (ecology)," and that people from both sides of that conflict needed to be brought together to overcome the impasse (Lin 2014, 110; see also Newton 2006).

That Leopold, trained in conservation management and with a position in a department of agricultural economics, would frame the problem in terms of a conflict between economics and ecology is telling. To Leopold, economics—like Pinchot's calculus—inevitably discounted the intrinsic values of wildlife (Goodwin 2008). As he wrote in *A Sand County Almanac*:

> Sometimes in June, when I see unearned dividends of dew hung on every lupine, I have doubts about the real poverty of the sands. On solvent farmlands lupines do not even grow, much less collect a daily rainbow of jewels. If they did, the weed control officer, who seldom sees a dewy dawn, would doubtless insist they be cut. Do economists know about lupines? (Leopold [1949] 1987, 102)

As Muir defended the rattlesnake, Leopold defended the mere existence of creatures lacking narrowly construed utilitarian value (Callicott 1994; Goodwin 2008). He understood that there were economic arguments for preserving nature, but he found them inadequate:

> The emergence of ecology has put the economic biologist in a peculiar dilemma: with one hand he points out the accumulated findings of his search for utility in this or that species; with the other he lifts the veil from a biota so complex, so conditioned by the interwoven cooperation and competitions that no man can say where utility begins or ends. (Leopold 1939, 727)

Leopold had no doubts about the real choice in this dilemma. The search for arguments based in utility, while sometimes valid, were too often futile—ridiculous, even—to be the intellectual basis for conservation. Expanding on this point, Leopold wrote:

> One basic weakness in a conservation system based wholly on economic motives is that most members of the land community have no economic value. Wildflowers and songbirds are examples. Of the 22,000 higher plants and animals native to Wisconsin, it is doubtful whether more than 5 per cent can be sold, fed, eaten or otherwise put to economic use. Yet these creatures are members of the biotic community, and if (as I believe) its stability depends on its integrity, they are entitled to continuance.
>
> When one of these non-economic categories is threatened, and if we happen to love it, we invent subterfuges to give it economic importance. At the beginning of the century songbirds were supposed to be disappearing. Ornithologists jumped to the rescue with some distinctly shaky evidence to the effect that insects would eat

> us up if birds failed to control them. The evidence had to be economic in order to be valid. (Leopold [1949] 1987, 210)

For Leopold, something beyond economics was clearly necessary.

4. John Krutilla and the Environmental Turn in Economics

If Leopold's distinctive move was to wed the romanticism of Emerson and Muir to the still ascending science of ecology, it was John Krutilla (1922–2003) who—improbably—wed it to economics. Krutilla was a wilderness advocate, an avid outdoorsman who read Muir and Leopold, and a friend of such figures as Margaret and Olaus Murie, leading American naturalists.[6] Eventually he served as trustee of Environmental Defense (1971–74) and as an officer of Leopold's Wilderness Society (1973–76). Like Leopold, he forged a new synergy of economics and environmental preservation, but in contrast to Leopold's ecological economics, Krutilla's environmental economics put economics at the center.

Krutilla grew up on a Washington farm and earned a BA in economics from Reed College. He earned a PhD from Harvard in 1952, working under Walter Isard (regional economics) and Alexander Gerschenkrom (comparative economic systems and development), with a dissertation titled "The Structure of Costs and Regional Advantage in Primary Aluminum Production." He began his career working with a natural resources development team at the Tennessee Valley Authority (TVA) but went to Resources for the Future (RFF) in 1955, where he remained until his retirement in 1988.

Krutilla's Early Work

With his background in regional and development economics, Krutilla's early body of work represented a fairly conventional, albeit successful, application of economic theory to benefit–cost analysis, construed in narrowly materialistic terms. It included numerous pieces in applied journals and one in the *Journal of Political Economy* (1962). In one piece that would have important echoes later, Krutilla (1955) argued that regional development programs are better evaluated using benefit–cost analysis than by attempting to empirically estimate changes in regional output or income. He also suggested it would be useful to understand a program's effect on the supply functions of factors (such as power and water) that are inputs into the

[6] Personal communication with Kerry Krutilla, October 20, 2015.

production of goods for which demand is likely to increase as income increases. He called these "strategic factors."

Most notably among his early body of work, Krutilla co-authored the book *Multiple Purpose River Development: Studies in Applied Economic Analysis* with Otto Eckstein in 1958. The book was a cutting-edge application of benefit–cost analysis to water projects, which for a quarter century had been *the* setting in which to apply benefit–cost analysis in the United States (Banzhaf 2009, 2010; Porter 1995). To detailed institutional considerations of water projects, it united a more sophisticated understanding of microeconomic theory than previous practitioners had brought to the topic, including discussions of capital markets, the cost of public funds, external economies, indivisibilities, and so forth. It then applied their analytical framework to four case studies, including the Snake River in the Columbia River tributary system (Krutilla and Eckstein 1958, Ch. 5).

Hells Canyon was notable as a battleground between two rival philosophies of development: a progressive version of government investment spearheaded by the US Army Corps of Engineers and the Bureau of Reclamation, championed by New Deal Democrats, and a pro-business version led by Idaho Power and championed by Republicans (Brooks 2006). The Corps of Engineers proposed one massive dam, while Idaho Power proposed a series of three smaller dams. Eventually, Idaho Power's plan prevailed, and the last of the three dams was completed in 1967.

In *Multiple Purpose River Development*, Krutilla and Eckstein evaluated the relative merits of the two rival projects. Considering the standard purposes of water development—hydroelectric power, flood control, and navigation—they found the Corps of Engineers' plan to be more efficient, but they determined that a convex combination of the two, a hypothetical two-dam project, would be more efficient than either. Though the book, in general, and the application to Hells Canyon, specifically, represented the frontier of benefit–cost analysis at the time, the times were rapidly changing. As Krutilla later conceded with a note of regret (Fisher et al. 1972), the book limited its consideration of economic factors to physical production. In particular, it treated the "preservation" of wilderness for its "aesthetic appeal" as an extra-economic consideration, a value "in addition to economic efficiency" rather than one factor in the economic efficiency calculation (Krutilla and Eckstein 1958, 265).

"Conservation Reconsidered"

Sometime in the mid-1960s, Krutilla appears to have made a deliberate pivot to address that deficiency and to combine his outdoor avocation with his economics profession, an intellectual move that would characterize the rest of his career. With his wife, Shirley Krutilla, he began to take a series of courses offered by the US Department of Agriculture and the Audubon Society, including ecology, meteorology, geology, and soil science.[7]

The intellectual fruits of this pivot first appeared in 1967, when Krutilla published the article "Conservation Reconsidered" in the *American Economic Review* (1967a) plus a more discursive version in *Daedalus* (1967b). In these articles, he borrowed the language of "conservation" and "preservation," which still carried the historical echoes of the dispute between Pinchot and Muir and their respective intellectual heirs. Specifically, he argued that economists, by ignoring the concerns of the preservationists, implicitly had biased benefit–cost calculations in favor of wise-use conservationists.

Krutilla's most fundamental point in making this case was that there was a trade-off between developing a resource and preserving it. In other words, developing a resource came at the opportunity cost of preservation, potentially meaning the loss of a unique or special landscape.[8] And these costs were very real. Said Krutilla, "When the existence of a grand scenic wonder or a unique and fragile ecosystem is involved, its *preservation* and continued availability are a significant part of the real income of many individuals" (1967a, 779, emphasis added). By these "individuals," he clarified that he meant "the spiritual descendants of John Muir, the present members of the Sierra Club, the Wilderness Society, … and others to whom the loss of a species or the disfigurement of a scenic area causes acute distress and a sense of genuine relative impoverishment" (779n7).[9] They valued the "mere existence of biological and/or geomorphological variety and its widespread distribution" (781). Such values would come to be known as "existence values" in the environmental economics literature.

[7] Personal communication with Kerry Krutilla, October 4, 2015. Further evidence in Krutilla ([1970?]).

[8] Smith (2004) comments that the historical use of the term "undeveloped" for natural environments seemed to give the impression that there were no opportunity costs of development, whereas labeling them as "preserved" conveyed a very different impression.

[9] Muir and Leopold, as well as their respective followers in the Sierra Club and the Wilderness Society, appear often as figures in Krutilla's writings from this point on. Additional instances include Krutilla and Cicchetti (1972), Fisher and Krutilla (1975), Fisher et al. (1974), and many others.

To this overarching point, Krutilla added two specific reasons why analysts should consider weighting the benefit–cost scales more in favor of preservation. The first centered on uncertainty about the future. Krutilla noted that whereas a decision to preserve always left open the possibility of developing later, in contrast, a decision to develop had irreversible adverse consequences for preservation, since the landscape would be irretrievably lost, a point that would be further developed by Fisher et al. (1972) and taken up by Kenneth Arrow (Arrow and Fisher 1974). Furthermore, drawing on Weisbrod (1964), Krutilla suggested that even if preservationists had no value for the resource at present, the possibility that they might would generate an "option value" in the presence of such irreversibility. All this not only implied that benefit–cost analyses of development projects were biased in favor of development whenever they ignored these opportunity costs, but also suggested that many market transactions involved the problem of free-riding on the preservation side of the ledger.

Second, Krutilla argued that private markets were quite adept at providing substitutes for those scarce resources that served as material or energy inputs in private production. Consequently, the value of developing natural resources was decreasing over time. In contrast, markets underprovided environmental quality because of its public good nature. Moreover, demands for outdoor recreation and for the existence values of environmental quality appeared to be increasing over time. This logic reversed the traditional emphasis in natural resource economics on conservation. Said Krutilla:

> [T]he traditional concerns of *conservation* economics—the husbanding of natural resource stocks for the use of future generations—may now be outmoded by advances in technology. On the other hand, the central issue seems to be the problem of providing for the present and future the amenities associated with unspoiled natural environments. (Krutilla 1967a, 778, emphasis added)

Here Krutilla seems to have been harking back to his earlier notion of "strategic factors," in which he had suggested that public investments in development should target resources that were inputs into the production of outputs with growing demand (Krutilla 1955). Only now those inputs were reinterpreted more broadly to include preserved environmental amenities.

This reinterpretation seems to have been in part a response to *Scarcity and Growth* (1963), a recent book by Harold Barnett (a colleague of Krutilla's at RFF) and Chandler Morse

that was a milestone in the history of natural resource economics.[10] After documenting in the greater part of their book that the costs of food and natural resources had not increased over time, Barnett and Morse reflected that natural resource scarcity could be overcome by self-generating technological change. As new resources and techniques substitute for old, they said, "the resource spectrum undergoes kaleidoscopic change through time" (244). But in closing, they suggested that issues related to quality of life, to the distribution of income and "the intangible satisfactions derived from the appearance of the environment" (252), may prove to elude substitution. What was needed, they suggested, was a more objective approach to our "value problem," a way to incorporate the trade-offs among distribution, intangible benefits, and material wealth into the economic calculus. This was precisely the project Krutilla took up.

As Smith (2011) has noted, in "Conservation Reconsidered" we see Krutilla coming to grips with the same problems that so vexed Leopold. As Leopold had argued, "One basic weakness in a conservation system based wholly on economic motives is that most members of the land community have no economic value. … When one of these non-economic categories is threatened, and if we happen to love it, we invent subterfuges to give it economic importance" ([1949] 1987, 210). These concerns led Leopold to forge compromises among economics, ecology, and other disciplines into a new land ethic. In contrast, Krutilla argued that if indeed we do love one of these categories in the land community, then that constitutes economic value. Their "mere existence" is a type of value. For Krutilla, development brings benefits but comes at the opportunity cost of forgoing preservation values (and vice versa); thus the choice between development and preservation was itself an economic question. That is, the question was no longer one of economics *versus* the environment, but one of the economics *of* the environment.

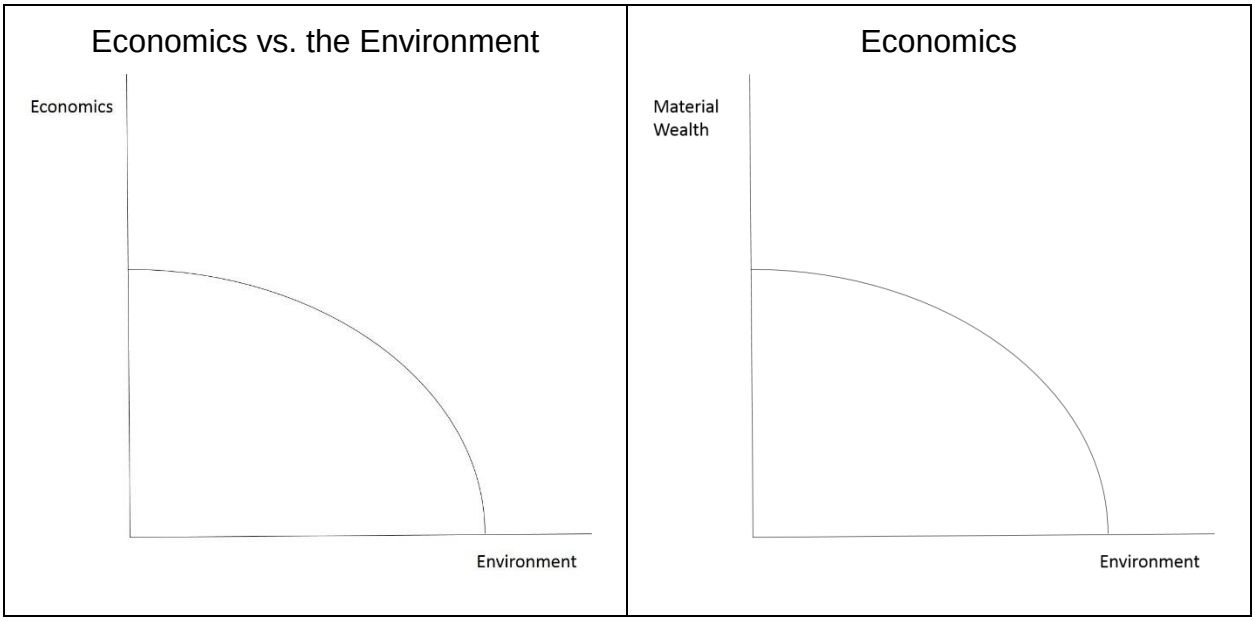
A Shifting Landscape of Economic and Environmental Thought

These changes in Krutilla's thinking occurred within the context of larger intellectual developments in economics and the environmental movement. In economics, Lionel Robbins's (1935) definition of the field in terms of opportunity costs was rapidly displacing rival "classificatory" definitions. Those classificatory definitions had demarked the territory of

[10] Krutilla's young protégés at RFF, Charles Cicchetti, Anthony Fisher, and Kerry Smith, all recall that Krutilla was deeply affected by *Scarcity and Growth*. See Smith (2015) for additional discussion of its influence on Krutilla's thinking.

economics as limited to the business or material realms of life.[11] When viewed in these terms, "spiritual" considerations such as the love of wilderness were decidedly noneconomic (Banzhaf 2010). But when viewed through the lens of Robbins's definition, natural resources are inherently scarce, so the choice to develop or preserve them entails opportunity costs, making it an economic choice. The distinction is illustrated in Figure 1. In the economics-as-material-welfare view, the choice is about the trade-off between economics and wilderness. In the economics-as-opportunity-cost view, economics is elevated to govern the trade-off between material welfare and wilderness. As Backhouse and Medema (2009) have shown, economists

Figure 1. Economics vs. the Environment contrasted with Economics of the Environment



on both sides of the Atlantic were coming to embrace the new definition in the late 1950s and 1960s. Thus it is no coincidence that Krutilla's intellectual journey from *Multiple Purpose River Development* to "Conservation Reconsidered" occurred at the same time that Gary Becker was pushing labor economics to consider the allocation of time, crime, and so forth. Both

[11] For example, Marshall ([1920] 1946) defined economics as "a study of men as they live and move and think in the ordinary business of life. But it concerns itself chiefly with those motives which affect … man's conduct in the business part of his life. … [And] the steadiest motive to ordinary business work is the desire … for the material reward of work" (14). Cannan (1922) similarly equated economics with wealth, which has to do with "material welfare" (1–3).

developments were an expansion of economics to new ranges of topics: opportunity costs were everywhere.[12]

These changes in economics coincided with important historical developments in environmentalism. Indeed, properly speaking, one can hardly even talk of "environmentalism" before this period. Until World War II, the schism in American conservationism, represented by the rift between Pinchot and Muir, pitted natural resource managers pursuing efficiency against lovers of nature who approached nature on spiritual, rather than rational, terms. While those tensions remain with us today, the two categories of conservation and preservation rearranged and reconfigured themselves in important respects. On one side, elements from the "preservationist" camp dropped Muir's spiritual focus and embraced the new science of ecology to bolster the case for preservation. For example, when Leopold transitioned from being a disciple of Pinchot's to a lover of wilderness, he hardly dropped science in favor of spiritual transcendence. Rather, he fused a love of wilderness with new arguments for its importance drawn from ecology, while simultaneously urging people to abandon the zero-sum fight between development and preservation in favor of a new harmony between man and nature (Calicott 1994). At the same time, popular politics was giving stronger voice to conservation than ever before. The "conservationist" camp, which had previously defined scientific management of resources only in terms of material uses, soon adapted to these political pressures (Banzhaf 2009, 2010; Hays 1982). As one small but revealing example, during this period many state agencies simply swapped out their shingles reading "game managers" for ones reading "wildlife managers" (Hays 1982).

As Hays (1982) notes, the new "environmentalism" that emerged during this period was thus a fusion of ecology and the political economy of aesthetic consumption, rather than production. The changes in the applied economics of benefit–cost analysis reflected these broader trends. As I have shown elsewhere (Banzhaf 2010), starting from a focus on material development in the spirit of Pinchot, the political pressures to nudge benefit–cost ratios in favor

[12] As Backhouse and Medema (2009) note, Robbins's definition was simultaneously liberating and restricting. It liberated economists to consider new topics but restricted them to using the tools of constrained optimization. In evaluating economics, Leopold had seen a discipline that could not yet conceive of addressing the environment in the way Krutilla would later do. But at the same time, to forge a new ecological economics, Leopold had been able to draw on a profession willing to embrace a wider set of human motives and a greater appreciation for institutions and history. Interestingly, at the end of his career, Krutilla (1981) would place his work in the context of helping meet Robbins's critique of applied welfare economics based on the impossibility of interpersonal comparisons of utility.

of development ironically forced economists to consider the recreation values of reservoirs in the 1940s and 1950s, against their better judgment that economics should be limited to material considerations and avoid such spiritual intangibles. Once that threshold was crossed, however, it was no great leap to apply recreation benefits and related values to the preservation side of the ledger.

Shortly after "Conservation Reconsidered," Krutilla and Cicchetti (1972) made this point quite explicitly and succinctly, arguing that the "nub of the analytical problem" for many conservation questions was a trade-off between two alternative purposes:

> One purpose, associated with extractive activities, would convert the natural environment into intermediate products to satisfy the requirements of industrial raw materials used in production of final consumption goods. The other purpose involves the retention of the natural environment for the provision of a flow of services which enter directly into the utility function of final consumers. (2)

Economics could handle "spiritual" values for nature by reinterpreting nature as something that provided services directly to consumers, as well as to producers of material goods.

Hells Canyon Revisited

These broader intellectual currents rippled through the Snake River. In 1957, just about the time *Multiple Purpose River Development* appeared in print, Pacific Northwest Power, a consortium of four private utilities, proposed yet another project in Hells Canyon, downstream from the earlier three, at what was known as the High Mountain Sheep site. The Washington Public Power Supply System soon proposed a rival project nearby; then in 1962, the Department of the Interior proposed an alternative federal project at the High Mountain Sheep site. Thus three parties were rivals to develop the same area. In 1962, the Federal Power Commission (FPC) ruled in favor of Pacific Northwest Power. The Interior Department, headed by Secretary Stewart Udall, sued the FPC over this decision, in part on the grounds that Interior's plan would better protect anadromous fish, as required by law. The initial decision was upheld in an appeal to the FPC and a trial, but the case eventually went to the US Supreme Court. In 1967, in *Udall v. FPC*, the court by a 6–2 decision remanded the case to the FPC, ordering it to reconsider not only *which* development proposal was in the public interest in light of further evidence about fish protection, but also whether *any* development was in the public interest in light of such concerns. The majority opinion stated:

> The issues of whether deferral of construction would be more in the public interest than immediate construction and whether preservation of the reaches of

> the river affected would be more desirable and in the public interest than the proposed development are largely unexplored in this record. We cannot assume that the [Federal Water Power] Act commands the immediate construction of as many projects as possible. … The grant of authority to the Commission to alienate federal water resources does not, of course, turn simply on whether the project will be beneficial to the licensee. Nor is the test solely whether the region will be able to use the additional power. The test is whether the project will be in the public interest. And that determination can be made only after an exploration of all issues relevant to the "public interest," including future power demand and supply, alternate sources of power, the public interest in preserving reaches of wild rivers and wilderness areas, the preservation of anadromous fish for commercial and recreational purposes, and the protection of wildlife. (*Udall v. Federal Power Commission* 387 U.S. 428 1967, 449)

For the first time in the bureaucratic turf wars over river development, preservationists now had a seat at the table. In a very real sense, the modern era of environmental politics in America was born.[13]

When the case was remanded to the FPC, Krutilla entered as an expert "Friend of the Commission" in 1969 (Krutilla [1970?]).[14] In contrast to his earlier work on Hells Canyon in *Multiple Purpose River Development* (Krutilla and Eckstein 1958), Krutilla now applied the arguments of "Conservation Reconsidered" to the problem. Working with a team of young economists whom he assembled at RFF, including Charles Cicchetti, Anthony Fisher, and Kerry Smith, Krutilla would continue to develop the ideas in "Conservation Reconsidered," and their application to the Hells Canyon case in particular, in a series of publications in the early to mid-1970s, including Fisher et al. (1972), Krutilla and Cicchetti (1972), and Krutilla and Fisher (1975).

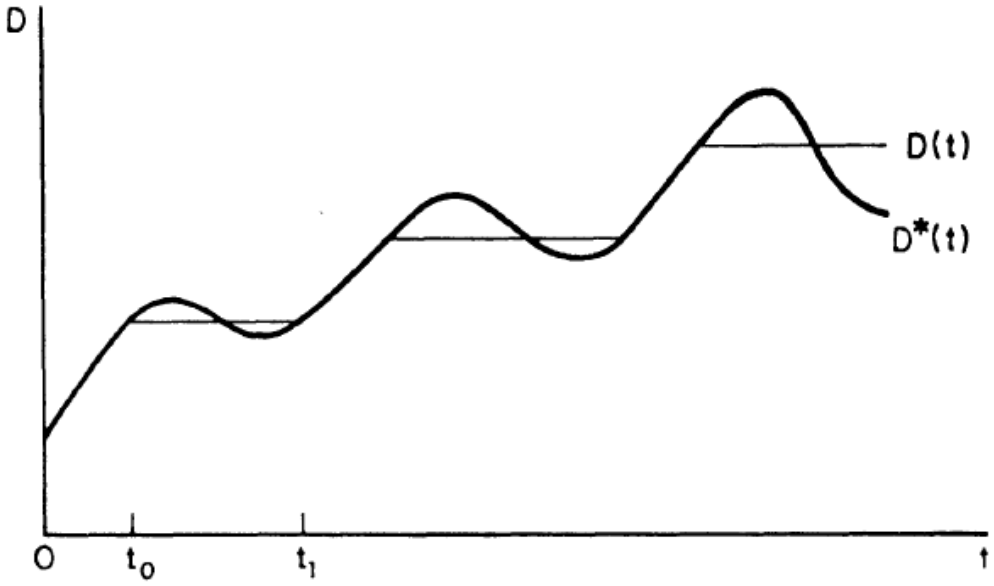
The basic argument outlined in Fisher et al. (1972) is illustrated in Figure 2. The curve $D^*(t)$ is a hypothetical path of what the optimal development over time would be *if*, theoretically, it were possible to reverse development. The path shows periods of increasing development followed by periods of decreasing development. But since development is irreversible, the downward-sloping portions of this myopic path are impossible. Ruling those out, the optimal

[13] Hays (1982) considers the Hells Canyon episode the most dramatic example of the transition from the old politics of conservation to the postwar politics of environmentalism. For more on the history of the Hells Canyon episode, see Brooks (2006) and Ewert (2001).

[14] See also Cicchetti, Charles, testifying before the same commission.

path becomes $D(t)$. To maximize the present value of net benefits, the constraint imposed by irreversibility leads to a smoothed path, which, relative to the myopic one, undershoots development for a time where the myopic path would be at its peaks, but then overshoots it where the myopic path would be at its troughs. Fisher et al. (1972) then assert that the gross benefits of preservation are growing over time, while the gross benefits of development are shrinking, as technological change reduces the costs of substitutes, a point made in Krutilla (1967a). Consequently, $D^*(t)$ would decline monotonically. Since that is impossible, the optimal $D(t)$ entails a bang-bang solution with development in the present period and no further development in the future.

Figure 2. Irreversible Development



Source: Fisher et al. (1972, 609). Reproduced with permission.

Fisher et al. (1972) employ a fairly complicated simulation model to apply this analysis to Hells Canyon. The model involves parameters representing a rate of technological change in private substitutes, growth rates (and deceleration in growth) in intercept and slope terms of a demand function for preservation, population growth rates, plus the by-then-conventional benefit–cost parameters related to development benefits and costs and interest rates.[15] Fisher et

[15] For the most detailed account of the model, see Krutilla and Fisher (1975), Chs. 5 and 6. The basics are also present in Krutilla ([1970?]).

al. (1972) find that given the simulated rates of change, a base-period annual preservation value of $52,000 to $147,000 annually would be enough to tip the balance toward preservation and away from further developing the Hells Canyon dam. Since this was a fraction of the best estimates of recreation values, they concluded that the economics supported preservation.[16] The road from Pinchot to Muir had come full circle: Rational utilitarian management of natural resources no longer presupposed development, as Pinchot had viewed it; it could also come out on the side of preservation.

5. Conclusions

Early debates over conservation policy in the United States left a landscape in which rational calculation about material well-being was opposed to spiritual values for nature that defied quantification. In the postwar period, however, that dichotomy was becoming increasingly untenable. Initially all too happy to concede the impossibility of measuring such spiritual values, economists in government were being dragged by political pressures into including recreation values in their benefit–cost analyses (Banzhaf 2010). Economists more broadly were reinterpreting their field as the study of opportunity costs, rather than as one based on concerns with material wealth (Backhouse and Medema 2009). Preservationists following Aldo Leopold tried to build bridges between conservation and social sciences. Popular movements celebrated the natural environment with a new consumer spirit (Hays 1982). At the crossroads of all these movements stood John Krutilla. Taking a little bit from all of them, he helped reorganize earlier debates framed in terms of economics versus the environment into a new field studying the economics of the environment.

[16] Krutilla had reached a similar conclusion in his testimony ([1970?]).

References

Arrow, Kenneth J., and Anthony C. Fisher. 1974. "Environmental Preservation, Uncertainty, and Irreversibility." *Quarterly Journal of Economics* 88 (2): 312–19.

Backhouse, Roger E., and Steve G. Medema. 2009. "Defining Economics: The Long Road to Acceptance of the Robbins Definition." *Economica* 76: 805–20.

Banzhaf, H. Spencer. 2009. "Objective or Multi-objective? Two Historically Competing Visions for Benefit–cost Analysis." *Land Economics* 85 (1): 3–23.

———. 2010. "Consumer Surplus with Apology: A Historical Perspective on Non-market Valuation and Recreation Demand." *Annual Review of Resource Economics* 2: 183–207.

Barnett, Harold J., and Chandler Morse. 1963. *Scarcity and Growth: The Economics of Natural Resource Availability*. Baltimore: Johns Hopkins University Press for Resources for the Future.

Brooks, Karl Boyd. 2006. *Public Power, Private Dams: The Hells Canyon High Dam Controversy*. Seattle: University of Washington Press.

Callicott, J. Baird. 1994. "A Brief History of American Conservation Philosophy." In *Sustainable Ecological Systems*, edited by W. Wallace Covington and Leonard F. Debano, 10–14. Fort Collins, CO: Rocky Mountain Forest & Range Experiment Station.

Cannan, Edwin. 1922. *Wealth: A Brief Explanation of the Causes of Economic Welfare*. 2nd ed. London: P. S. King & Son.

Ewert, Sara E. Dant. 2001. "Evolution of an Environmentalist: Senator Frank Church and the Hells Canyon Controversy." *Montana: The Magazine of Western History* (Spring): 36–51.

Fisher, Anthony C., John V. Krutilla, and Charles J. Cicchetti. 1972. "The Economics of Environmental Preservation: A Theoretical and Empirical Analysis." *American Economic Review* 62 (4): 605–19.

———. 1974. "The Economics of Environmental Preservation: Further Discussion." *American Economic Review* 64 (6): 1030–39.

Goodwin, Craufurd D.W. 1999. "The Economics of Art through Art Critics' Eyes." In *Economic Engagement with Art*, edited by Neil De Marchi and Craufurd D.W. Goodwin, 157–84. Durham, NC: Duke University Press.

———. 2008. “Ecologist Meets Economics: Aldo Leopold, 1887–1948.” *Journal of the History of Economic Thought* 30 (4): 429–52.

Hays, Samuel P. 1959. *Conservation and the Gospel of Efficiency: The Progressive Conservation Movement, 1890–1920*. Cambridge, MA: Harvard University Press.

———. 1982. “From Conservation to Environment: Environmental Politics in the United States since World War Two.” *Environmental Review* 6 (2): 14–41.

Krutilla, John V. 1955. “Criteria for Evaluating Regional Development Programs.” *American Economic Review Papers & Proceedings* 45 (2): 120–32.

———. 1962. “Welfare Aspects of Benefit–cost Analysis.” *Journal of Political Economy* 69 (3): 226–35.

———. 1967a. “Conservation Reconsidered.” *American Economic Review* 57 (4): 777–86.

———. 1967b. “Some Environmental Effects of Economic Development.” *Daedalus* 96 (4): 1058–70.

———. [1970?]. Testimony before the Federal Power Commission in the matter of Pacific Northwest Power Company and Washington Public Power Supply System, project no. 2243/2273, Environmental Defense Fund Collection, Special Collections, Stony Brook University Libraries, RG 1, SG V, Ser. 1, Litigation Files G-I, Box 2.

———. 1981. “Reflections of an Applied Welfare Economist.” *Journal of Environmental Economics and Management* 8: 1–10.

Krutilla, John V., and Charles J. Cicchetti. 1972. “Evaluating Benefits of Environmental Resources with Special Application to the Hells Canyon.” *Natural Resource Journal* 12: 1–28.

Krutilla, John V., and Otto Eckstein. 1958. *Multiple Purpose River Development: Studies in Applied Economic Analysis.* Baltimore: Johns Hopkins University Press for Resources for the Future.

Krutilla, John V., and Anthony C. Fisher. 1975. *The Economics of Natural Environments: Studies in the Valuation of Commodity and Amenity Resources*. Baltimore: Johns Hopkins University Press for Resources for the Future.

Leopold, Aldo. 1933. “The Conservation Ethic.” *Journal of Forestry* 31: 634–43.

———. 1939. “A Biotic View of Land.” *Journal of Forestry* 37: 727–30.

———. (1949) 1987. *A Sand County Almanac*. New York: Oxford University Press.

Lin, Qi Feng. 2014. "Aldo Leopold's Unrealized Proposals to Rethink Economics." *Ecological Economics* 108: 104–14.

Marshall, Alfred. (1920) 1946. *The Principles of Economics*. 8th ed. New York: Macmillan.

Meyer, John M. 1997. "Gifford Pinchot, John Muir, and the Boundaries of Politics in American Thought." *Polity* 30 (2): 267–84.

Miller, Char. 1992. "The Greening of Gifford Pinchot." *Environmental History Review* 16 (3): 1–20.

Muir, John. (1875) 1980. "Wild Wool." In *Wilderness Essays*, edited by Frank Buske, 227–42. Salt Lake City: Peregrine Smith.

———. (1901) 1980. "The Yellowstone National Park." In *Wilderness Essays*, edited by Frank Buske, 178–219. Salt Lake City: Peregrine Smith.

———. (1912) 1989. *The Yosemite.* San Francisco: Sierra Club Books.

Nash, Roderick. 1982. *Wilderness and the American Mind*. 3rd ed. New Haven, CT: Yale University Press.

Nelson, Robert H. 2010. *The New Holy Wars: Economic Religion vs. Environmental Religion in Contemporary America*. University Park: Pennsylvania State University Press.

Newton, Julianne Lutz. 2006. *Aldo Leopold's Odyssey*. Washington, DC: Island Press.

Pinchot, Gifford. 1910. *The Fight for Conservation*. New York: Doubleday, Page, & Co.

———. 1947. *Breaking New Ground*. New York: Harcourt, Brace, & Co.

Porter, Theodore M. 1995. *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*. Princeton, NJ: Princeton University Press.

Robbins, Lionel. 1935. *An Essay on the Nature and Significance of Economic Science*. 2nd ed. New York: St. Martin's Press.

Smith, V. Kerry. 2004. "Krutilla's Legacy: Twenty-First-Century Challenges for Environmental Economics." *American Journal of Agricultural Economics* 86 (5): 1167–78.

———. 2011. "Inventing Price Systems and Substitutes for Them." *History of Political Economy* 43 (2): 347–52.

———. 2015. "Krutilla's Conservation Reconsidered." Unpublished manuscript.

Smout, T. C. 2000. *Nature Contested: Environmental History in Scotland and Northern England since 1600*. Edinburgh: University of Edinburgh Press.

Weisbrod, Burton A. 1964. "Collective-Consumption Services of Individual-Consumption Goods." *Quarterly Journal of Economics* 78 (3): 471–77.

Wolfe, Linnie Marsh. (1945) 2003. *Son of the Wilderness: The Life of John Muir*. Madison: University of Wisconsin Press.

Worster, Donald. 1977. *Nature's Economy: The Roots of Ecology.* San Francisco: Sierra Club Books.