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Instituting water research: the Water Resources Research Act (1964) and the Idaho Water Resources Research Institute

Adam M. Sowards[1] · **Brynn M. Lacabanne**[2]

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Abstract In 1964, Congress passed the Water Resources Research Act (WRRA) and created state research institutes to pursue practical research for the nation's growing water problems. The Idaho Water Resources Research Institute (IWRRI), initiated as part of WRRA, implemented its research program with multidisciplinary specialists across Idaho. Collaborating with public and private partners, IWRRI advanced research that reflected distinct political, economic, and environmental needs at a time when the state required more rigorous water planning. Case studies presented here include research on understanding and valuing wild and scenic rivers, tracing and mitigating water pollution from industrial mining, and improving efficiency and promoting maximization in irrigation among rural landscapes. Scientists developed new methods and advised on ways to improve water quality. Tracing IWRRI's research demonstrates how concerns about wilderness, pollution, and efficiency developed within a research regime determined to improve water resources management. Each element reflected historical forces and social values, something only occasionally acknowledged by the researchers but nonetheless central to their efforts. In this way, IWRRI shines analytical light on state water use and the policy and scientific methods used to comprehend, mitigate, and manage water resources. The history of institutes like IWRRI provide a neglected, but useful, avenue to explore the powerful ways contemporary legal, political, and economic concerns shaped scientific research agendas, reminding us of the larger social context in which scientific research occurs.

Keywords Idaho Water Resources Research Institute · Water Resources Research Act (1964) · Water resources research · Water resources management · History

✉ Adam M. Sowards
asowards@uidaho.edu

[1] University of Idaho, 875 Perimeter Dr. MS3175, Moscow, ID 83844-3175, USA

[2] Idaho Department of Environmental Quality, 1410 N Hilton St., Boise, ID 83706, USA

Introduction

In mid-summer 1964, President Lyndon B. Johnson signed the Water Resources Research Act (WRRA) and noted the myriad needs the law addressed. Water was significant to American life, he explained: "Abundant, good water is essential to continued economic growth and progress. The Congress has found that we have entered a period in which acute water shortages are hampering our industries, our agriculture, our recreation, and our individual health and happiness" (Cong. Rec 1964c, p. 110, pt. 13:16,655). By century's end, the president relayed, experts predicted half the American states would not meet their water needs if current practices continued. So, WRRA promised to "enlist the intellectual power of universities and research institutes in a nationwide effort to conserve and utilize our water resources for the common benefit" (Cong. Rec. 1964c, p. 110, pt. 13:16,655). When implemented, WRRA would support more coordinated, widespread, and sophisticated water research for the public interest. The law targeted a national problem and developed solutions in individual states. It has been a critical research program for water resources for more than half a century. In important ways, central concerns from the 1960s remain high priorities in water research—not because research has failed but because the issues are inherent in modern societies (e.g., National Research Council, Committee on Assessment of Water Resources Research 2004, pp. 16–23).

Surprisingly, historians have neglected WRRA and the state research institutes the legislation created. In fact, water research has been almost wholly neglected by historians of science and environment (Kingsland 2005; Worster 1994). A single short history in a water resources bulletin provides historical context to this long-lasting successful program (Burton 1986). Millions of dollars have been spent and thousands of studies have been launched and coordinated from WRRA's impetus, deepening local resource knowledge and improving water management. For historians of water—as well as historians of science, technology, and environment—the basic and applied problems these state institutes researched offer diverse sources that reveal important contours of the last half-century. No doubt each state would offer distinct and compelling histories, but Idaho's is especially interesting as the Idaho Water Resources Research Institute (IWRRI, pronounced "eye weary") delved into wild, rural, and industrial waterscapes.

This article aims to explain how water resources research became institutionalized through WRRA generally and IWRRI specifically. First, we explain WRRA's aims, its underlying values, and the mechanisms by which it functioned. Next, we contextualize the research and political infrastructure in Idaho at the time WRRA passed and IWRRI started. Then, we turn to three case studies highlighting critical water issues in Idaho: wild rivers, industrial pollution from mining, and agricultural efficiency. These examples reveal a representative array and each speak to different historical trajectories and highlight distinct social, economic, and environmental challenges. Other case studies are possible, of course, so this article does not pretend to be a comprehensive accounting of Idaho's water resources research or IWRRI. Nevertheless, it does explain how from a congressional act in 1964 has come a series of understandings that has helped Idaho confront and manage its water resources with greater knowledge. Tracing the research shows how concerns about wilderness, pollution, and efficiency developed within a research regime determined to improve water resources management. Each element reflected broader historical forces and social values, something only occasionally acknowledged by researchers but nonetheless permeating this history. In this way, IWRRI shines analytical light on state water use and the policy and scientific methods used to comprehend, mitigate, and manage water resources, exemplifying efforts throughout the United States and the industrialized world in the post-World War II era (McNeill 2000).

Contexts

At the time the WRRA passed, both Congress and the State of Idaho recognized significant challenges to the understanding and use of the nation's water resources. These were local manifestations of emerging global patterns—from Germany to India (Blackbourn 2006; Cioc 2009; Gilmartin 2015)—of places coming to grips to polluted and engineered waterways, especially through new legislative programs. The American West in particular faced enormous concerns over water shortages, concerns that led to several schemes to transfer water over long distances and across river basin boundaries (Reisner 1993). In Idaho, legacy effects from mining (Aiken 2005), irrigation (Fiege 1999), hydropower (Brooks 2006; Hirt 2012), and municipal waste (Neil 2005) taxed the state's water resources and prompted constitutional changes to integrate water planning centrally in state government. No shortage of national and local priorities over quality and quantity of water set the stage for WRRA and the founding of IWRRI. Besides enthusiasm and need, support and experience remained critical prerequisites to enact legislation and create institutions.

Congress

As Congress debated WRRA in 1964, Hawaii Representative Thomas Gill spoke and encapsulated many of the issues confronting the nation's water use. He stated, "Our rapidly rising population, falling water tables, increased pollution of existing supplies, and tremendous new uses for water all combine to make knowledge of this life source more critical each day. Strangely, we have long taken water for granted; our scientific effort and our fund of knowledge in this commonplace subject has been minimal, compared to advances in more spectacular areas" (Cong. Rec. 1964a, p. 110, pt. 9:12,461). Such a troubling scenario demanded action, and WRRA would rectify the meager sense of knowledge by funding research institutes at state land-grant colleges.

Much of WRRA's text concerned funding mechanisms and priorities (Burton 1986). The Secretary of the Interior would distribute funds, beginning with $75,000 in the first year, $87,500 the second, and $100,000 thereafter to establish and maintain those state research institutes (Water Resources Research Act of 1964, p. 329). Another $15 million over the next 5 years would be available for matching funds to support water resource research (Water Resources Research Act of 1964, p. 330). The law charged the institutes, working independently or collaboratively, "to conduct competent research, investigations, and experiments of either a basic or practical nature, or both, in relation to water resources and to provide for the training of scientists through such research, investigations, and experiments" (Water Resources Research Act of 1964, p. 329; also, Burton 1986). Appropriate, specified issues ranged widely from engineering to law, supply and demand to recreation, the hydrologic cycle to conservation and more (Water Resources Research Act of 1964, p. 329). Congress directed the Interior Department with coordinating these efforts to assure minimal duplication among the state institutes' research efforts and between research activities supported by other federal agencies (Water Resources Research Act of 1964, p. 331). The law in action would promote practical problem solving in myriad ways.

Given this practicality, WRRA passed with relative ease. Senator Clinton P. Anderson, a savvy politician, launched the idea and shepherded the WRRA through several congresses before both chambers passed the law in 1964. The New Mexico Democrat was a longtime leader in western water legislation and a Senate powerhouse especially when chairing the Interior Committee in the early 1960s, a time when several other important conservation bills wound their way through Congress (Baker 1985). To build support, Anderson modeled the act on the Hatch Act of 1887 that provided federal funding for agricultural experiment stations also at state land-grant institutions. The practical results for agriculture from this federally sponsored and subsidized research made the Hatch Act popular, even with traditionally conservative rural legislators.[1] Anderson recognized the winning formula and saw how a water resources research bill could tap into established constituencies who favored the land-grant mission and practical-oriented research. Consequently, Anderson fashioned WRRA to leverage federal money into partnerships between federal and state entities to produce results for pressing water resource issues (Danver 2011c; Baker 1985).

Anderson was WRRA's leading champion and most articulate promoter. During his campaign to enact WRRA, Anderson articulated the legislation's aims well in a 1964 speech, the text of which appeared in the *Congressional Record* (Anderson 1964). To the audience at the annual New Mexico Water Conference being held at his home state's land-grant institution, New Mexico State University, the senator argued water resources research was underfunded while the needs for answers only multiplied with time's passage. Population increases, underway and projected into the future, demanded both water conservation and development to increase supply. Such work, though, required research, which the federal government, as well as state and local entities, ignored. While agencies providing water to the nation's citizens and economic groups spent only 0.7% on research, the oil and gas industry dedicated 3% of their budgets to research and development, the chemical industry 6%, and the auto industry 12.5% (Anderson 1964, p. 5779). Although the pending request in Congress for $73 million might seem extravagant to critics, Anderson contextualized these disproportionate budgets, emphasized pressing needs, and claimed the nation stood unprepared for the anticipated doubling of population and concomitant water needs. Anderson bolstered his claims by citing recommendations from the recent Senate Select Committee on National Water Resources, an influential committee that recommended to President John F. Kennedy in 1961 that the federal government lead efforts for basinwide river planning and support wider research in water conservation and development to meet national needs by 1980 (Anderson 1964, p. 5779; Baker 1985; Burton 1986; Danver 2011a). Anderson made a strong case.

Anderson's support and experience lent the bill credibility, but he led a widespread and bipartisan coalition supporting the bill. Although some critics worried about costs, Representatives Clarence J. Brown, an Ohio Republican; Wayne N. Aspinall, a Colorado Democrat; and John P. Saylor, a Pennsylvania Republican all expected that WRRA would coordinate federal water research activities to prevent duplicate projects, thereby saving money (Cong. Rec. 1964a, p. 110, pt. 9; Cong. Rec. 1964b, p. 110, pt. 12). Such coordination impressed Saylor, a representative with a strong conservation record (Smith 2006), as the legislation's most significant provision. As Saylor once put it, "We want results and we need results from water research but we do not want a continuous scramble among the agencies… to outdo each other" (Cong. Rec. 1964bb, p. 110, pt. 12:15,908). The conservative Democrat Aspinall, one of the most powerful representatives (Schulte 2002; Sturgeon 2002), assured the House that the research centers would "not… be a boondoggle" (Cong. Rec. 1964a, p. 110, pt. 9:12,453).[2] Meanwhile, Olin E. Teague, a

[1] Several times in the Congressional debate (*Cong. Rec.* 1964a, p. 110, pt.9: 12,458, 12,464, 12,465; *Cong. Rec*. 1964b, p. 110, pt. 12: 15,909), politicians referenced the Hatch Act and agricultural experiment stations as an effective precedent.

[2] Not all accepted such reassurances. Representative Fred Schwengel of Iowa noted current duplications and delineated then-current expenditures of more than $70 million across more than two dozen federal agencies (Cong. Rec. 1964a, p. 110, pt. 9:12,464).

Representative from Texas, argued that coordinating research would simultaneously help prioritize the needed work: "It seems to me, and to almost every other reasonably well-informed person with whom I have spoken, that we cannot any longer depend upon independent, sporadic, and uncoordinated research programs if we are going to lick this problem. And lick it we must, or we shall be in dire trouble as a nation and a civilization" (Cong. Rec. 1964a, p. 110, pt. 9:12,464). Central to the Congressional discussion, then, were matters of efficiency in both applied research and expenditure. The tone in the *Congressional Record* overwhelmingly expressed support for this legislation, but still members of Congress sought assurances that embarking on this federal sponsorship would wisely marshal financial and intellectual resources for as effective a program as possible.[3]

Exemplifying this tendency and germane to this article was Idaho's Representative, Compton I. White, Jr., a Democrat from Clark Fork in the northern panhandle (Biographical Directory of the United States Congress n.d.). Rising in the House of Representatives, White expressed great support for WRRA. Passing WRRA was "imperative," he claimed; the legislation would fund research that up until then had been "minimal and quite unrelated" (Cong. Rec. 1964a, p. 110, pt. 9:12,461). More revealing, White encapsulated a common, if regrettable, Idaho experience. "In my own State of Idaho," White announced, "there is a great deal of interest in water resources but the lack of funds for geological, physical, legal, and hydrological studies have kept activity at quite a low level" (Cong. Rec. 1964a, p. 110, pt. 9:12,461). This law might be the tool needed to accomplish Idaho's goals. In particular, White cited strong interest in inventorying groundwater resources. "Our university has devoted much time, money and energy to this and other water questions but the lack of adequate funds has limited the scope of this work," he complained (Cong. Rec. 1964a, p. 110, pt. 9:12,462).[4] True to the conservative state White represented, he lauded WRRA's provisions that emphasized local control over research problems and the initial 10-year limit to the legislation to prevent an unchecked government program from continuing indefinitely without revision (Cong. Rec. 1964a, p. 110, pt. 9:12,462). In short, White exemplified Idaho's long-standing concerns about local control, intrusive government bureaucracy, and chronic underfunding (Aiken 2014), but despite all those reservations, he recognized the potential practical results WRRA would likely gain to enhance Idaho's understanding and management of water resources. When implemented, WRRA would improve water research for the common benefit; Representative White stood ready for Idaho to receive its due.

Idaho

IWRRI provided one vehicle for sustained engagement with these issues within a state that seemed ready to face some intractable water resources problems at both the university and state level where recent trends dovetailed with federal interests.

[3] Opposition existed for various reasons including equitable and excessive funding (Cong. Rec. 1964a, p. 110, pt. 9:12,455, 12,451–52), concerns over patents (Cong Rec. 1964a, p. 110, pt. 9:12,467–68; Cong. Rec. 1964b, p. 110, pt. 12:15,908–09), and the automatic appointment of land-grant universities (Cong. Rec. 1964a, p. 110, pt. 9: 12,462–64 passim).

[4] Calvin C. Warnick who became IWRRI's founding director made much the same case before the Subcommittee on Irrigation and Reclamation of the Interior and Insular Affairs Committee (Warnick 1963).

University of Idaho

During the WRRA campaign, Senator Anderson (1964) hailed universities. Federal agencies possessed narrow expertise, while universities' very nature was broad. Since experts now recognized water resource problems as multifold, universities with their diverse expertise furnished "an ideal setting for water resources research", Anderson maintained (Anderson 1964, p. 5780). Furthermore, "At a number of universities there is encouraging evidence that cross-discipline seminars and research teams already are coming to grips with water resources matters" (Anderson 1964, p. 5780). Just as significant as their interdisciplinarity (*Cong. Rec.* 1964b, p. 110, pt. 12:15,857-58), these centers would work in local areas, providing geographically specific and relevant research programs sensitive to the local problems and needs. "I am confident," Senator Anderson declared, "that university research, both basic and applied, will make important contributions to solving water resources problems" (Anderson 1964, p. 5780). Proponents also saw this law as helping to prepare and train new researchers (*Cong. Rec.* 1964a, p. 110, pt. 9:12,453, 12,456; *Cong. Rec.* 1964b, p. 110, pt. 12:15,909, 16,655, 16,656). The University of Idaho (UI) represented an ideal example of what Anderson pitched; it would establish IWRRI and coordinate multidisciplinary water resources research in a concerted effort to solve local practical issues, mirroring the basic premise and purpose of Senator Anderson's vision.

As the congressional discussion surrounding WRRA assumed, the land-grant university had already established research activities and expertise in water resources (Water resources research institute records, 1961–1981). A Policy and Coordinating Committee on Water Resources [known more simply as the Water Resources Committee (WRC)] existed with a stated purpose to coordinate research and planning of the state's water resources (Water Resources Committee 1963). Consistent with the university's land-grant mission, the committee resolved to disseminate their findings about conserving and developing the state's water resources to "give all the people of Idaho an opportunity to make informed decisions and establish goals… within the framework of our democratic processes" (Water Resources Committee 1963, p. 3). Furthermore, the WRC sought an approach "to help achieve a program of water use and development that will contribute the most good for the most people in the State of Idaho in the long run" (Water Resources Committee 1963, p. 4). Such language mimicked the utilitarian ideas long central to the American conservation movement (Hays 1959) and especially the first U.S. Chief Forester Gifford Pinchot who famously said conservation's goal was to create "the greatest good, for the greatest number in the long run" (quoted in Miller 2012, p. 61). The University of Idaho's WRC, then, represented a group of water researchers steeped in the land-grant tradition of service guided by the conservation movement's utilitarianism. Such an ethos suited the purposes of the state, the issues, and the pending WRRA legislation.

On the cusp of WRRA's passage, the WRC issued a report useful for understanding the state of water resources research at the time. WRC's "Research in Water Resources for Idaho" (1963) summarized university research activities and identified priorities by sharing short research briefs from across the state. It highlighted both basic and applied research across a variety of disciplines (including hydrology, engineering, and economics) and water resources problems (including irrigation efficiency, fish predation, and water content in snow). The robust research program at UI spanned the state and focused from high up in watersheds all the way to plants in farmers' fields. The report prioritized future research into three categories. The top priority concerned understanding groundwater and the economics and law surrounding water transfers. The next priority focused on abating pollution and propagating fish. Finally, researchers planned to study land use to help forecast quantity and timing of flows, basic relationships between soil and water under irrigation, and history of water use in irrigation. Also revealed in the report and anticipating WRRA were partnerships. University researchers—many of whom worked out of the extension offices and experiment stations consistent with the land-grant mission and Hatch Act funding—linked with federal agencies (e.g., Bureau of Reclamation, Department of Agriculture, U.S. Army Corps of Engineers, Soil Conservation Service, Forest Service, Bureau of Land Management, Weather Bureau, Fish and Wildlife Service, Public Health Service), state organizations (e.g., Cooperative Wildlife Research Unit, Board of Land Commissioners, Bureau of Mines and Geology, and Department of Fish and Game), and private entities (e.g., power companies and timber corporations). All of these characteristics—the practical problems, the spatial diversity, the interdisciplinarity, the partnerships—that were present at the outset remained consistent ever since.

State of Idaho

If UI seemed poised to continue and augment its existing programs at the time of WRRA, the State of Idaho was also set to transition its approach. This shift was best symbolized by a constitutional change to mandate better water planning from a position of greater knowledge—knowledge won, in part, through partnerships with the university. Seen together, these statewide reforms indicated a common set of issues facing the state's water governance and intellectual infrastructure.

In 1964, Idaho voters approved a state constitutional amendment creating the Idaho Water Resource Board (IWRB) to conduct state water planning (Idaho Department of Water Resources n.d.).[5] The constitutional amendment—Sect. 7 of Article XV on water rights—included several components, but it essentially empowered the state resource agency to create a plan "for optimum development of water resources in the public interest" (State of Idaho Legislature n.d.). Developed by the board with public input, a State Water Plan would include data relevant to policy goals to be periodically updated as new research or public needs changed.[6] The legislature the next year explained the larger rationale for the IWRB: "The welfare of the people of this state is dependent on conservation, development and optimum use of our water resources. To achieve this objective and protect the waters of Idaho from diversion out of state, it is essential that a coordinated, integrated, multi-use water resource policy be formulated and a plan developed to activate this policy as rapidly as possible" (Idaho Water Resource Board 1974, p. 1). These actions show how Idaho voters and legislators saw a need to address how water would aid future economic and political development and to protect it from wasteful or predatory practices. At the same time, water planning commenced at the federal level, too (Danver 2011b). Overall, these efforts from the state and Congress deployed strikingly similar language of public interest and optimum development reminiscent of WRRA but with a policy, not a research, focus.

The state water planning process encompassed much. At the time the board completed its first State Water Plan in 1976, it listed nineteen subject areas related to water that demanded attention and planning: agriculture, aquaculture, electric power, environmental

[5] In 1974, the board combined with the state Department of Water Administration to create the Idaho Department of Water Resources (IDWR) (Idaho Department of Water Resources n.d.b).

[6] Available State Water Plans are available online (Idaho Department of Water Resources n.d.c).

quality, fish and wildlife, flood damage reduction, forestry, Indian resource use, international considerations, interstate considerations, lakes and reservoir management, land measures, mining, municipal and industrial, navigation, recreation, studies and research, urban lands, and water quality (Idaho Water Resource Board 1976). Such a list offers a useful way to glimpse prominent water issues identified in Idaho. To conserve, develop, manage, and use *all* Idaho's water—that was the goal. Also, it is clear that the plans, and much of the research to support them, served policy, not scientific, purposes—something that was not uncommon worldwide (e.g., Gilmartin 2015). It was within this set of priorities that IWRRI operated locally, even if this could not capture the entirety of IWRRI's mission, for basic science often needed to precede answering some of these applied questions. In other words, IWRRI stood ready to provide the essential research needed to develop, implement, and improve state water policy and practices. From federal to state to university—and all within a global context of growing crisis—multiple levels interacted with remarkable consistency in aims, reflecting the era's common perspectives.

Case studies

Since 1964, IWRRI and its counterparts in other states sponsored or supported thousands of research projects (Burton 1986). Altogether such work advanced knowledge and technology that could be applied, ideally, to improve management of water resources at a time when governments the world over confronted water shortages and pollution problems, demonstrating one way IWRRI worked in local issues but within global patterns (McNeill 2000). IWRRI has sponsored in the neighborhood of a thousand projects, and so a thorough summary is impossible.[7] Instead of a comprehensive account, we approach a range of three types of waterscapes—wild, industrial, and rural—to show a spectrum of issues and approaches. They represent distinct geographic diversity and resource challenges, all of which required multidisciplinary investigations. In this way, they are representative of the mission of IWRRI as it implemented WRRA in the last half-century.

Wild waterscapes: learning to value wild rivers

For the most part, IWRRI and the other state institutes coordinated water resources research to fulfill WRRA's main purpose of developing water resources. However, gathering forces in American culture and politics chose *non-development* as an important alternative. By the mid-twentieth century, sufficient interest in wilderness mobilized many advocates for preservation of land free from roads and rivers free from dams (Harvey 2000; 2005; Nash 2014; Sutter 2002). Congress passed the Wilderness Act of 1964 (Wilderness Act 1964) about 6 weeks after WRRA and 4 years later added the Wild and Scenic Rivers Act (WSRA) (Wild and Scenic Rivers Act 1968) with important help from Idaho's own Senator Frank Church (Dant Ewert 2001; Robison 2014). By complementing policies that developed rivers, WSRA preserved some streams without dams or other construction projects, declaring "that certain selected rivers of the Nation which, with their immediate environments, possess outstandingly remarkable scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values shall be preserved in free-flowing condition, and that they and their immediate environments shall be protected for the benefit

[7] No single source lists all of IWRRI's projects. However, internal files and annual reports can verify this number (e.g., Water resources research institute records 1961–1981).

and enjoyment of present and future generations" (Wild and Scenic Rivers Act 1968, 906). Once designated, a river would be managed "to protect and enhance the values which caused it to be included" (Wild and Scenic Rivers Act 1968, 916) in the system, the most protected status of any national landscape. The law immediately identified eight wild rivers and twenty-seven others to be studied for subsequent inclusion in the National Wild and Scenic Rivers System.[8] Among those first eight wild rivers were the middle forks of both Idaho's Clearwater River and Salmon River; five of the so-called study rivers also were in Idaho (Bruneau, Moyie, Priest, Saint Joe, and [lower] Salmon) (Wild and Scenic Rivers Act 1968).

WSRA required federal agencies to study designated or potential rivers that flowed through federal lands. But those managers may not have been the best or only suitable researchers. IWRRI sponsored a symposium, and the notetakers present understood this: "University groups would seem ideally suited to this type of study, having a residual of research ability available to do the job" (Herbst and Michalson 1970, p. 38). For Idaho, at least, IWRRI took the lead in trying to make some sense out of and recommendations for WSRA, showing an early example how WRRA and IWRRI could be put to use—even when the water resource being considered was a free-flowing river.

IWRRI sponsored two programs—a symposium and a multi-year multidisciplinary methodology study—that revealed the contours and conundrums of researching wild rivers *as* a water resource. In both cases, researchers grappled with how to develop a "criteria to be used to evaluate the study rivers selected by Congress" (Herbst and Michalson 1970, p. 1) for possible inclusion in the new National Wild and Scenic River System and thus ensuring WSRA moved forward and expanded through the nation's landscape. However, WSRA furnished little specific guidance about how to implement the study rivers thus generating an opportunity for creativity, as well as confusion.

The Wild and Scenic Rivers Symposium took place in July 1969 at Salmon River Lodge near Shoup, Idaho, and brought university researchers (from UI and beyond) together with federal and state resource managers, as well as representatives from environmental organizations. Those at the lodge expressed marked ambiguity and downright confusion over the task Congress set for them, despite working in a "very productive, relaxed atmosphere" (Herbst and Michalson 1970, p. 2). A key rough spot concerned the basis of the criteria to be used in assessing the study rivers. Would they use objective or subjective criteria? Or as one fisheries biologist baldly contrasted the options, they wondered "whether it would be emotional or objective information" (Herbst and Michalson 1970, p. 6). Because most researchers associated with IWRRI came from scientific and engineering fields, they naturally gravitated toward quantifiable criteria. Overall participants also understood that this might not be appropriate for *selecting* rivers, although scientific data certainly were appropriate for *monitoring* them. Researchers noted the crux of the issue time and again: competing uses (e.g., wild river status or hydroelectric dam) on a potential river required choices; choices meant ranking values; ranking values required defining values (social or economic); and defining those did not comport well to scientific methods and the expertise most researchers brought to the symposium. At one point, one of the rare social scientists present—an agricultural economist—attempted to apply economic valuation, but flatly explained that economic tools could not adequately capture all the values wild rivers contained (Herbst and Michalson 1970, pp. 26–33). Similarly, Brock Evans who represented the Sierra Club indicated that organizations like his seldom fit in traditional

[8] The first director of IWRRI, Calvin Warnick, drafted a state law for a State Scenic and Recreational Rivers System (Warnick n.d.).

frameworks like those represented at the symposium, because the club's "interests are non-economic," and they "are talking about a philosophy or land ethic" (Herbst and Michalson 1970, 18). Such ambivalence was representative for the gathering.

When the conveners published proceedings from the symposium, they identified this crucial problem without resolving it. The authors explained, "This is a broader problem than just economics or engineering", recognizing they would need to move beyond approaches measured quantitatively; four sentences later, though, they stated, "The criteria to objectively select these rivers should also be outlined" (Herbst and Michalson 1970, p. 41). So, they knew their ongoing study needed to incorporate things not captured objectively, but they also aimed to develop objective criteria. This is not to blame these researchers for somehow missing an easy solution—there were no easy solutions. Instead, it is essential to note just how in flux this issue (wild rivers) was in relationship to the newly formed IWRRI. To be certain, researchers genuinely hoped to formulate effective tools to advise Congress, but repeatedly they confronted, either explicitly or in blind spots, their disciplines' inability to fully incorporate the values wild rivers represented.

But the symposium was merely a part of IWRRI's larger methodological study project, an endeavor through IWRRI's Scenic Rivers Study Unit formed to develop criteria to be "used to identify and estimate all the economic, esthetic, scenic, and other values for wild rivers" (Michalson and Kirkland 1970, pp. 1–2) for the Congressionally-mandated study rivers. The undertaking was ambitious. Using the Salmon River as the case, the study unit planned to develop a model that would capture both economic and aesthetic values while identifying existing activities and potential changes and their consequences if Congress protected river stretches. The committee initially identified eleven subprojects, a number that grew to fifteen before completion: agriculture, anthropology, commercial fisheries, flood control, forest and range resources, history, hunting, hydroelectric power, irrigation, minerals, navigation, outdoor recreation, transportation and access, water for municipal and industrial use, and water quality control.[9] In each category, IWRRI inventoried current economic benefits and projected future use depending on the level of protected status the river received.[10] Although researchers explored myriad factors, the models they developed oriented mainly toward economic impacts since such criteria were more easily quantified (and spoke the main language of Congress—that is, money) (Michalson and Kirkland 1970). These subprojects reported their findings in a series of reports produced in the early 1970s.[11]

Detailed summaries cannot be included here; however, a few brief representative examples illustrate the substantial research efforts, as well as their range and conclusions. The water quality report (Watts 1971), for instance, noted the importance of water quality for both ecological functioning and recreational experiences. Pollution, such as excess phosphate or nitrates from agriculture or fecal coliform from the town of Salmon dumping raw sewage into the river, fell within legal limits but merited attention and efforts to improve (Watts 1971). The report emphasized the river's high quality but recognized it could be better and would allow virtually no logging to maintain the current levels (Watts 1971). Moving up the watershed from the river, the range resource report (Herbst 1973)

[9] Most of the subproject reports included basic background information, including the aim of the proposal and the list of multiple subprojects outlined here. See for instance Mallet and Bjornn (1970, pp. 2–4).

[10] WSRA distinguished three types of protection: wild, scenic, and recreational (Wild and scenic rivers act 1968).

[11] These studies, and many others, can be located in the Idaho Waters Digital Library collection available http://www.lib.uidaho.edu/digital/iwdl/ (accessed 29 February 2016).

assessed the way grazing in the Salmon River basin might be affected by wild river status. Comparatively little grazing occurred in the basin—368,000 animal unit months across approximately five million acres[12]—and any reduction would be small and in keeping with the general intensification trend that characterized western grazing management (Herbst 1973). The report even claimed that because of their deep association with western myths and scenes as depicted in movies, livestock would be welcomed by many recreating on the river: “Many Easterner’s [sic] vacation has been brightened by seeing cowboys working cattle or driving through a band of sheep being herded down a ‘western’ road” (Herbst 1973, 18). As with water quality, range resources appeared to be minimally affected by the changes WSRA prompted. Whereas both the water quality and range resources reports indicated wild river status could be accommodated, the fish report (Mallet and Bjornn 1970) went beyond basic acceptance of wild status by noting how river development would unequivocally hurt the commercial and recreational fishery. Idaho rivers contributed a substantial percentage of the Columbia River’s anadromous fish stocks with the Salmon River being the most important and worth perhaps $3 million (Mallet and Bjornn 1970). Developing the river would harm fish, meaning WSRA offered an opportunity to protect and even enhance the resource both economically and aesthetically (Mallet and Bjornn 1970). These reports and the dozen others gathered the best information available—which was often minimal—to assess the basin thoroughly and to model a way to account for other basins and their potential under WSRA.[13]

The Salmon River methodological study that IWRRI sponsored represented a significant research enterprise and engaged broader economic, environmental, and political trends. For the most part, the collective research reinforced a basic tenet: changing a river—or choosing not to—affected a wide range of economic and social categories in both the immediate and wider region. Most researchers at the time sought ways to accommodate competing uses, believing that proper management would allow protection on the Salmon River along with traditional extractive activities in the basin. This desire to accommodate multiple uses characterizes well the approach by many land managers at the time who believed that their expertise could combine extractive uses (e.g., logging) with non-consumptive uses (e.g., rafting) (Steen 2004; Williams 2009). Researchers found many reasons to believe that wild or scenic designation of the Salmon River could work with minimal economic impacts. That these researchers spanned expertise in hunting (Gordon 1971), irrigation (Warnick 1971), civil engineering (Peebles 1970), and forestry (Herbst 1972) demonstrates the way that water synthesized a broad spectrum of components and serves as a useful indicator of many historical and contemporary issues beyond simply water resources. In particular, it demonstrates especially well how IWRRI tapped into the era’s zeitgeist in the search for ways to incorporate wilderness into various other management strategies (Marsh 2014). Into the mid-1970s, researchers associated with IWRRI accomplished interesting, important, and relevant research by working on wild rivers and their larger ecological, social, and economic contexts. They attempted to systematize how to study such rivers, paying attention to economic and environmental impacts with an eye

12 An animal unit month (AUM) is the monthly forage needs for one cow-calf combination or five sheep.

13 Only one report—mining (Savage 1970)—saw a fundamental incompatibility between its resource and protected status for rivers. The rest might have noted some sacrifices but ultimately saw a way to accommodate competing interests. The mining exception proved the rule. At the time in Idaho, a significant public policy controversy over whether the American Smelting and Refining Corporation (ASARCO) could open a mine in the White Cloud mountains defined the state’s environmental politics and drove Savage’s perspective in part (Marsh 2014; Neil 2005; Robison 2014).

toward advising policymakers and in doing so applied and extended the principles of WRRA.

Still, looking back, such research can strike one as anomalous, as somehow outside the appropriate purview. By some fairly traditional definitions, wild, even potentially wild, rivers do not seem to be a water *resource*, at least not the sort of resource IWRRI and similar institutes investigated. For instance, recently the National Research Council (2004) published *Confronting the Nation's Water Problems: The Role of Research* in which the authors chronicled an abundant set of water resource research issues and categories. Nothing exists related to wild rivers. Thus, perceived resource issues clearly evolved and affected IWRRI's research activity. Virtually no studies on wild rivers appear after the WSRA had been on the books for a decade. And so, a wide-ranging topic that occupied much time in the Institute's early years and generated significant data largely disappeared.

Industrial waterscapes: tracing and mitigating water pollution from mining

Mining became Idaho's first industrial enterprise, beginning with gold discoveries in 1860 in the Clearwater River basin and the much bigger strike in 1884 near Wallace in what became known as the Coeur d'Alene Mining District and is now referred to as the Silver Valley (Aiken 2005; Marsh 2014). For a century, corporations, led by the Bunker Hill Company, took out tons of galena ore from the mountains, processed it, and created toxic byproducts that polluted the air and fouled waterways as a normal part of doing business (Aiken 2005; Marsh 2014). The Coeur d'Alene River received effluent that flowed downstream and, according to farmers, harmed crops and livestock as early as 1899 (Aiken 2005). Similar complaints appeared periodically through the twentieth century, and scientific investigators found merit in such complaints. A major fisheries study in 1932, for instance, found the Coeur d'Alene River "practically devoid of fish fauna, bottom fauna or plankton organisms" (Ellis 1932, p. 125). Still, as late as the 1940s, industry argued that dumping waste into rivers "was in the public interest" (Aiken 2005, p. 114).

The waste existed because all mining produces waste, and even technological innovations designed to improve mining produced pollution. Early industrial mining practices put ore through concentrators with high degrees of inefficiencies. For instance, an early method, jigging, mixed large quantities of water with crushed ore to separate larger pieces of rock and ore and allowed gravity to separate those high in metal concentrations from the remaining material. This method recovered less than 75% of the metals (National Research Council 2005). The process dumped the tailings and sludge, high in metal concentration, in nearby streams where it entered and moved downstream through the watershed (National Research Council 2005). Although pollutants persisted, companies tried some measures to reduce them in northern Idaho waterways. Early on, they trapped tailings behind dams and eventually developed settling ponds (National Research Council 2005). Technological changes in concentrating to a flotation process improved the efficiency by removing metal from the ore up to 95% by the 1950s (National Research Council 2005). However, the pollution tradeoff here was that the remaining metals were much finer and thus moved through the watershed with greater speed, distance, and elusiveness and thus extended mining's impact (National Research Council 2005). In addition, by the mid-1960s, raw sewage from more than 14,000 residents in the upper watershed continued to be dumped into the Coeur d'Alene River system and more than 2200 tons of mine slimes dumped daily into the South Fork of the Coeur d'Alene River (Morilla 1975). Only in 1968 did dumping mine waste into streams outright end (National Research Council 2005), a change that recent sediment stratigraphic research confirms improved, but did not stop, toxic metals from flowing into the lake (Morra et al. 2015).

Meanwhile, pollution had become a national political issue, a focus of the nascent environmental movement. The Clean Air Act (1963) and the Clean Water Act (1972)—both of which included major amendments subsequently—exemplified this trend.[14] In 1980, reacting to increasing problems with toxic legacies from American industry that abandoned sites, Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (1980), popularly called Superfund or CERCLA. This law provided pathways for cleaning up hazardous sites like the Silver Valley. The Environmental Protection Agency (EPA) intervened and listed the Coeur d'Alene Basin on the National Priorities List in 1983, which promised millions of dollars in remediation work, as well as scientific research to which IWRRI could contribute (National Research Council 2005).

Idaho could not help but be pulled into this orbit of environmental regulation, and researchers in the state began chronicling to a higher degree than before the existing and potential pollution problems to which mining contributed. Much like the accumulation of metals on the lakebed, studies gradually built up knowledge so researchers gained stronger evidence of how mining influenced regional watersheds.[15] In the early 1970s, investigators from both the University of Idaho and Washington State University produced a major study on the biological effects of metals pollution and determined that algae concentrated the metals (especially lead and zinc) which increased concentrations in fish tissue (Funk et al. 1973). The scientists mused that the metals must be innocuous, because fish in laboratory conditions with equal pollution levels were harmed but the fish seemed to function fine in the upper reaches of Spokane River (Funk et al. 1973). The study encompassed all of Lake Coeur d'Alene as well as incorporating the Spokane River, a large study area demonstrating the growing sophistication and scale of research capacities.

On the basis of such studies and more, IWRRI published for a general audience in the mid-1970s an overview of the state's water problems and research being conducted or proposed (Idaho Water Resources Research Institute 1976). Mining was a central problem, and this state-of-the-field report highlighted the multifaceted nature of the situation. Researchers knew, for example, that fish downstream had two to three times the zinc level in their muscle tissue than those in the upper watershed (Idaho Water Resources Research Institute 1976, p. 28). They knew, also, that leaks from abandoned piles of waste meant metals moved into the groundwater system and threatened to become a wide-ranging problem with an extent that remained yet unknown (Idaho Water Resources Research Institute 1976, p. 29). And they knew, finally and fundamentally, that these mining wastes were "a potential source of metal contamination of the water resource system" (Idaho Water Resources Research Institute 1976, p. 30), but their knowledge remained tentative.

The work scientists pursued concerning mining effects also contributed to methodological innovations. For instance, researchers used core samples from trees adjacent to the Spokane River to identify trace metals going back in time many decades (Funk et al. 1975). This method represented a somewhat novel approach at the time to monitor the movement of metals through an ecosystem's various trophic levels. Besides just tracking pollution down, researchers searched for methods to ameliorate toxic effects with varying results.

[14] The director of IWRRI expressed some concern about the new clean water law, recognizing the need to improve water quality but not certain if the public would be willing to pay the new costs (Gladwell 1973).

[15] When Nancy L. Savage (1986) compiled a bibliography in 1986, she counted 239 studies on the Coeur d'Alene aquatic system.

Carleson et al. (1988) used chelation to remove cadmium and zinc from wastewater, while Mok et al. (1986) figured ways to extract arsenic from water samples, allowing the researchers to trace toxicity using a simple method. And these represent barely even the surface of IWRRI and related research that plunged the depths of mining pollution's biological and physical reach in the Lake Coeur d'Alene system.

When IWRRI researchers turned to the Silver Valley, they found a multifaceted water quality problem that demanded both understanding and, with luck, ameliorative methods. In other words, IWRRI's presence in Idaho's primary mining district catalyzed both understanding and remediation of the industry's toxic legacies. The institute has published scores of reports on mining's effects on Idaho's waters, helping to transform the scientific community's understanding of the mining industry's deleterious impacts and pioneering efforts to reverse toxic legacies in Idaho's waters by going beyond simple observation and creating innovative solutions. And like in other areas, national priorities helped to drive the research agenda.

Rural waterscapes: improving efficiency and promoting maximization in irrigated agriculture

Perhaps nothing represents water in Idaho better than an irrigation ditch, and irrigation agriculture makes a strong claim historically as the state's central water issue. Farmers tapped the state's water resources early during colonizing settlement, creating a pattern of use with large economic and ecological consequences over extended time and geographic scales (Fiege 1999). Irrigation diverted and used water in farm fields beginning with Protestant and Latter-day Saint missionaries among Idaho's Native peoples before the mid-nineteenth century (Marsh 2014). By the last two decades of the nineteenth century, farmers began an unrelenting campaign to bring water to arid lands to grow food, and they persistently found ways to use both private and federal investments to expand their holdings (Lovin 2002). Despite remarkable growth, problems plagued Snake River Plain irrigators from the beginning through water shortages, technological inadequacies, unprofitable practices, and water pollution (Lovin 1985). Even though farmers, engineers, and policymakers worked hard for decades to ameliorate irrigation's persistent problems, IWRRI arrived at an opportune time, as the state's irrigators moved through the post-World War II era still needing advice and answers to their technical dilemmas with law, economics, and environment changing in rapid ways.

From IWRRI's research perspective, several problems needed solutions. And its approach and orientation necessarily differed from the experience with wild rivers or mining. As with wild rivers, IWRR assessed the current situation; and as with mining, IWRRI understood the need to mitigate past and ongoing problems. But more than elsewhere, IWRRI found the need to partner with others—individual farmers and government bureaus—to manage water for an ongoing basis. Because water was both relatively scarce and central to profit, IWRRI promoted maximization and efficiency—water management's prevailing global values (Ingraham et al. 2008)—to meet irrigators' needs while also resolving various pollution challenges. For instance, just before IWRRI was established, a UI report (Water Resources Committee 1963) unquestioningly named profit maximization as a central goal in working with farmers. To be sure, some basics in water science required answers, but mostly IWRRI addressed practical problems, which was consistent with prevailing patterns of hydrological research (Rajaram et al. 2015). Arguably, when IWRRI and Idaho irrigation came together, WRRA found its greatest application: the practical research WRRA's authors most hoped to realize to save water and costs and thus promote profitability for private interests and conservation over time. Still, IWRRI and Idaho irrigators faced a long road before them. Yet all parties seemed engaged: the state changed laws, irrigators called for assistance and cooperated with others, and IWRRI deepened research.

In the 1960s, though, challenges remained numerous, including lack of basic, sufficient, and accurate data (Peebles 1969) with groundwater offering particularly thorny problems.[16] The focus on groundwater in Idaho anticipated the focus of subsurface research that dominated hydrology in the 1970s and 1980s (Rajaram et al. 2015). Pumping from aquifers through pivot irrigation systems after World War II proved to be one of the most significant innovations in global water use with Idaho and other western states seeing it promising a technological solution to ecological scarcity (McNeill 2000; Opie 1993). Although pumping might bring up more water for southern Idaho farmers' fields, the economic (Cheline and Haynes 1967) and ecological (Peebles 1969) costs remained largely unknown, not to mention general ignorance about how water moved through the subsurface (Bloomsburg and Brockway 1968), especially after applying it on fields led to recharge issues (Williams and Wallace 1972). IWRRI recognized these problems at once, noting "serious overpumping" (Peebles 1969, p. 6) without sufficient knowledge about supply, while no state agency stood ready to regulate it. Besides depletion and shortages, groundwater pumping threatened havoc created from subsidence (Gladwell 1977). One study reported with refreshing candor: "Groundwater is being pumped to greater and greater heights. The economic impact of this is not presently known" (Cheline and Haynes 1967, p. 1). Although that IWRRI study focused on economic costs, the conclusion symbolized Idaho's larger ignorance over groundwater use in economic and ecological terms. And trying to remedy this lack of knowledge lasted decades (Hutchings and Petrich 2002b; Petrich and Urban 2004). As the twenty-first century dawned, IWRRI researchers reported 350,000 acre-feet annually pumped from the Snake River aquifer, an alarming amount that finally, if belatedly, pushed the state to manage recharge deliberately (Johnson et al. 1999).

Researchers also did not understand fully how seepage from irrigation canals and fields interacted with groundwater, and the public still did not always recognize that surface and subsurface water worked as part of the same hydrological system (Gladwell 1977). Because seepage wasted water and worsened irrigation efficiency, it worried farmers who had long battled water shortages (Lovin 1981) and conservationists who made "efficiency" the touchstone of their management program (Hays 1959; Ingraham et al. 2008). IWRRI approached seepage, then, as both a practical problem to improve efficiency in delivering water and a scientific question to discover how surface and subsurface water interacted. The mechanics of how water moved through water tables remained murky and difficult to monitor, so researchers worked to resolve that ignorance and to develop better tools to monitor water movement in the ground and across soils (Bloomsburg and Brockway 1968).[17] In one example in the Rigby-Ririe area in southeastern Idaho in the shadows of the Grand Tetons, researchers confronted a place that farmers had irrigated since the late nineteenth century. One ironic result—common nearly everywhere irrigation was practiced—was a high groundwater table from overwatering and seepage (Brockway et al.

[16] It is worth remembering that one of Idaho's congressional representatives noted the desire in the state for more groundwater research during the debate over WRRA (Cong. Rec. 1964a).

[17] Importantly, this work and many others like it included not just IWRRI scientists but cooperated with local farmers in southern Idaho and U.S. Department of Agriculture efforts, showing the collaborative role that has remained a hallmark of WRRA's impact and research function (Brockway and Worstell 1968).

1971); so in an arid environment plants suffered from too much water from below (Fiege 1999). To track such problems, modeling, a method that came to increase in importance among water researchers (Rajaram et al. 2015), found in the early 1970s approximately 28% of the yearly diversion into the canal system was lost with around half a million acre feet added to the aquifer during irrigation season (Brockway et al. 1971). Reducing seepage would make more water available for fields, lower the water table, and reduce farmers' use which exceeded their decreed water rights (Brockway et al. 1971). A more extensive study a few years later sampled multiple types of irrigation systems and reported efficiency rates as low as 10% but predicted they could be improved to as high as 60% (Claiborn 1975). Researchers also modeled how wastewater recharged groundwater resources, a process they hoped would be helpful but that farmers worried about eventual effects on crops (Bond et al. 1972; Williams and Wallace 1972). As is readily evident, seepage and the attendant inefficiencies in irrigated agriculture constituted a multifaceted problem that affected legal, economic, and ecological realms.[18] IWRRI's scientists tackled again and again various ways to learn about these problems.

But seepage was not the sole efficiency question, as long-standing and emerging concerns about water quality and sedimentation showed. In the early 1970s in the Boise Valley, researchers began projects to study how chemicals from fertilizers moved through the hydrological system, investigations that also led them to turn toward sedimentation. Fertilizers and pesticides also played a significant and increasing role after World War II in modern agriculture (McNeill 2000). These chemicals applied to fields inevitably found their way into the hydrological system, joining other agricultural pollutants such as animal waste (Williams et al. 1969). Researchers worked to understand how much and the way these substances moved through the ecosystem to see whether it deteriorated the environment (Naylor et al. 1972). Early studies tracked losses of nitrogen-nitrates, phosphate, and other solids through the subsurface where they percolated after farmers added fertilizer to their irrigation water (Busch et al. 1972). Beyond simply tracking such losses, IWRRI sponsored research seeking to mitigate them. Settling ponds—similar to mining—offered one possibility to retain up to 93% of the solids washed away through irrigation and almost 80% of the nitrogen and phosphates (Brockway 1976; Carlson 1974); in other words, the ponds improved irrigation efficiency and contained sedimentation. Figuring out a way to reduce this process was important, because significant soil loss came through the agricultural process. A study designed to trace nitrogen through the agricultural system ended up identifying significant soil losses—just shy of 1000 lb of sediment per acre planted in beets and more than 3000 lb per acre in onion fields (Naylor et al. 1972). Such trends continued, and questions only grew.

One reason sedimentation and water quality preoccupied IWRRI came from federal legislation. When Congress passed the Clean Water Act (CWA) in 1972, it exempted non-point source pollution—a significant achievement for the agricultural lobby that delayed action on erosion from agriculture (Wilkinson 1992). Nevertheless, IWRRI's director, John S. Gladwell, immediately recognized that with the CWA came a new policy and enforcement regime, stating clearly, "The fact that must be accepted is that social costs will no longer be absorbed by society through a lower quality environment. They will be reflected in prices—and those operations that can efficiently absorb or redirect those added costs will survive" (Gladwell 1973, p. 2). The remark provided a crucial touchstone for IWRRI research. It showed the interaction between ecological conditions, law, and

[18] In the late 1980s, a review article (Sonnen et al. 1987) still could not provide adequate conclusions about the relationship between irrigation and groundwater.

economics—a classic multidisciplinary problem to wrestle with, but the sort of problem researchers often struggled to complete (Rajaram et al. 2015). IWRRI's director noted environmental decline would no longer find social acceptance; finding a way to improve practices became prioritized. When Congress amended the CWA in 1987 to include non-point source pollution (Wilkinson 1992), even more focus came to bear on this issue.

These cumulative issues continued to occupy researchers largely because they continued to matter to irrigators and other water users. The early years of the twenty-first century still found IWRRI researchers seeking answers to groundwater recharge and flow—the same questions that occupied them immediately after the Institute started. However, new methods changed their practices. In recent decades, researchers track groundwater behavior using environmental isotopes. Researchers can follow these tracers through the hydrological system to estimate direction of movement as well as age of the aquifer which helped identify recharge patterns (Hutchings and Petrich 2002a).

IWRRI irrigation research represented similar themes as found in both wild rivers and mining. For example, as with the wild rivers work, irrigation researchers included social scientists, notably economists seeking to maximize scarce resources, in ways that extended interdisciplinary investigations. And some of the methods examined, such as holding ponds, translated almost directly from mining contexts. Yet, because it permeated so much of the state and the nature of property and water rights, irrigation research demanded cooperation with landowners to a far greater degree than anything seen in other areas in the research portfolio. In some ways, *this* research matched the legislation's intent best for both its partnership and practicality aspects.

Conclusion

Speaking to a group of Idaho Democrats in the mid-1970s, IWRRI Director John S. Gladwell noted important context. "Although most of our major water resource related problems have a technical base," he explained, "they inevitably come to a head because of social interpretations of those technical aspects" (Gladwell n.d., p. 1). Gladwell recognized the murky waters in which IWRRI found itself consistently. Policymakers and stakeholders the Institute served desired and demanded information and solutions they deemed scientific—what they imagined to be rational and objective. But such a scenario did not—and does not—exist, especially for western water concerns. Instead, IWRRI researchers operated at the behest of legal and economic impulses, as well as scientific contexts. The originating legislation demanded it. None of this is to say that IWRRI merely followed political whims or served corporate bottom lines while allowing scientific practice to be pulled inexorably into biased social orbits. But it is a reminder that Congress created and funded water research centers to solve problems with solutions that tended to help society and economic interests. Whether that meant a fleeting but intense focus on preserving wild rivers without economic hardships or an emphasis on promoting efficiency without bothering with equity (Ingraham et al. 2008), Idaho's water researchers reflected mainstream practical issues. Just as did other water resource specialists, IWRRI desired inclusion of social scientists but often found the fit awkward, which suggested some of the limits and constraints to practical-oriented research (Rajaram et al. 2015). Nevertheless, the cumulative work on remediating mine pollution and agricultural problems paid immediate benefits in a healthier environment and economy, as well as generating new scientific information and innovative techniques. Such is the way with research institutions connected to public institutions—shifting priorities, awkward pairings, and piecemeal progress, all of which reflect the messiness of political, economic, and scientific processes. And so, histories of state water research institutes, like IWRRI, shed much light on the political, economic, and environmental worlds in which they worked. The science dedicated researchers conducted as part of IWRRI's efforts to understand, improve, and manage the state's wild, industrial, and rural waterscapes revealed this principle.

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Compliance with ethical standards

Conflict of interest Adam M. Sowards is employed by the University of Idaho.

References

Aiken KG (2005) Idaho's Bunker Hill: the rise and fall of a great mining company, 1885–1981. University of Oklahoma press, Norman

Aiken KG (2014) Idiosyncrasy and enigma: Idaho politics. In: Sowards AM (ed) Idaho's place: a new history of the gem state. University of Washington press, Seattle, pp 76–104

Anderson CP (1964) Remarks, Ninth annual New Mexico water conference, New Mexico State University, March 19, 1964. In: Congressional record. 1964. 88th Cong., 2nd sess. Vol. 110, pt. 5

Baker RA (1985) Conservation politics: the senate career of Clinton P. Anderson. University of New Mexico press, Albuquerque

Biographical Directory of the United States Congress (n.d.) White, Compton Ignatius, Jr. http://bioguide.congress.gov/scripts/biodisplay.pl?index=W000362. Accessed 19 Feb 2016

Blackbourn D (2006) The conquest of nature: water, landscape, and the making of modern Germany. Norton, New York

Bloomsburg GL, Brockway CE (1968) Movement of water from canals to ground water table. Research technical completion report project A-009-Ida. Moscow: Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/46. Accessed 8 March 2016

Bond JG, Williams RE, Shadid O (1972) Delineation of areas for terrestrial disposal of waste water. Water Resour Res 8:1560–1573

Brockway CE (1976) Completion report settling basins for irrigation return flow and fresh pack effluent. Moscow: Idaho water resource research institute. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/458. Accessed 14 March 2016

Brockway CE, Worstell RV (1968) Field evaluation of seepage measurement methods. N.p.: Agricultural research service, U. S. department of agriculture, in cooperation with Idaho engineering experiment station. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/391. Accessed 10 March 2016

Brockway CE, Bondurant JA, Worstell RV (1971) Systems analysis of irrigation water management in eastern Idaho, progress report no. 1. Moscow: College of engineering, engineering experiment station. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/346. Accessed 10 March 2016

Brooks KB (2006) Public power, private dams: the Hell's Canyon high dam controversy. University of Washington press, Seattle

Burton JS (1986) History of the federal-state cooperative water resource research institute program. Water Resour Bull 22:637–647

Busch JR, Fitzsimmons DW, Lewis GC, Naylor DV, Carlson RD (1972) Cultural influences on irrigation drainage water. Age of changing priorities for land and water, irrigation and drainage division specialty conference, Spokane, pp 45–56. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/142. Accessed 9 March 2016

Carleson TE, Brazil B, Moussavi M (1988) Investigation of novel adsorptive separation methods for removal of trace heavy metals from polluted areas. Research technical completion report 14-08-0001-G1419-07. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/176. Accessed 19 May 2016

Carlson RD (1974) Water, nutrient and sediment budget for an irrigated farm in the Boise valley. Thesis: University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/270. Accessed 9 March 2016

Cheline R, Haynes R (1967) Relationship of pumping lift to economic use of groundwater for irrigation. Idaho agricultural research progress report no. 130. Moscow: University of Idaho, college of agriculture. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/49. Accessed 8 March 2016

Cioc M (2009) The Rhine as a world river. In: Burke E III, Pomeranz K (eds) The environment and world history. University of California press, Berkeley, pp 165–190

Claiborn BA (1975) Predicting attainable irrigation efficiencies in the upper Snake River region. Moscow: Idaho water resources research institute. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/355. Accessed 14 March 2016

Clean Air Act (1963) Public Law 88-206 US Statutes at Large 77: 392–401

Clean Water Act (1972) Public Law 92-500 US Statutes at Large 86: 816–903

Comprehensive Environmental Response, Compensation, and Liability Act (1980) Public Law 96-510 US Statutes at Large 94: 2767–2811

Congressional record (1964a) 88th Cong., 2nd sess. Vol. 110, pt. 9

Congressional record (1964b) 88th Cong., 2nd sess. Vol. 110, pt. 12

Congressional record (1964c) 88th Cong., 2nd sess. Vol. 110, pt. 13

Dant Ewert SE (2001) Evolution of an environmentalist: senator Frank Church and the hells canyon controversy. Montana 51:36–51

Danver SL (2011a) Senate select committee on national water resources. In: Danver SL, Burch JR (eds) Encyclopedia of water politics and policy in the United States. CQ press, Washington, pp 353–354

Danver SL (2011b) Water resources planning act of 1965. In: Danver SL, Burch JR (eds) Encyclopedia of water politics and policy in the United States. CQ press, Washington, pp 388–389

Danver SL (2011c) Water resources research act of 1964. In: Danver SL, Burch JR (eds) Encyclopedia of water politics and policy in the United States. CQ press, Washington, pp 389–390

Ellis MM (1932) Pollution of the Coeur d'Alene River and adjacent waters by mine wastes. US Bureau of Fisheries. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/186. Accessed 18 April 2016

Fiege M (1999) Irrigated eden: the making of an agricultural landscape in the American west. University of Washington press, Seattle

Funk WH, et al. (1975) An integrated study on the impact of metallic trace element pollution in the Coeur d'Alene-Spokane rivers and lake drainage system. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/90. Accessed 18 May 2016

Funk WH, Rabe FW, Filby R (1973) The biological impact of combined metallic and organic pollution in the Coeur d'Alene-Spokane River drainage system. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/98. Accessed 15 May 2016

Gilmartin D (2015) Blood and water: the Indus river basin in modern history. University of California press, Oakland

Gladwell JS (1973) Some implications of the federal water pollution control act of 1972—P. L. 92-500. Annual meeting, Pacific northwest region, American society of agricultural engineers, Calgary, Alberta. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/266. Accessed 14 March 2016

Gladwell JS (1977) The coming water crisis. In: Water resources research institute records, 1961–1981, box 6, folder 235, Special Collections and Archives, University of Idaho Library, Moscow

Gladwell JS (n.d.) Water: Idaho's limiting resource. In: Water resources research institute records, 1961–1981, box 6, folder 235, Special Collections and Archives, University of Idaho Library, Moscow

Gordon D (1971) A methodology study to develop evaluation criteria for wild and scenic rivers: a socio-economic analysis of hunting in Salmon River drainage subproject. Moscow: Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/129. Accessed 1 March 2016

Harvey MWT (2000) A symbol of wilderness: Echo Park and the American conservation movement. University of Washington press, Seattle

Harvey M (2005) Wilderness forever: Howard Zahniser and the path to the wilderness act. University of Washington press, Seattle
Hays SP (1959) Conservation and the gospel of efficiency: the progressive conservation movement, 1890-1920. Harvard University press, Cambridge
Herbst JR (1972) A methodology study to develop evaluation criteria for wild and scenic rivers: report of forest subproject. Moscow: Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/108. Accessed 1 March 2016
Herbst JR (1973) Scenic rivers study: report of range subproject. Moscow: Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/232. Accessed 1 March 2016
Herbst J, Michalson EL (eds) (1970) A wild and scenic rivers symposium. Water resources research institute of the University of Idaho, Idaho waters digital library, Moscow. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/202. Accessed 25 Feb 2016
Hirt PW (2012) The wired northwest: the history of electric power, 1870s–1970s. University press of Kansas, Lawrence
Hutchings J, Petrich CR (2002a) Ground water recharge and flow in the regional treasure valley aquifer system: geochemistry and isotope study. Idaho water resources research institute, University of Idaho, Boise
Hutchings J, Petrich CR (2002b) Influence of canal seepage of aquifer recharge near the New York canal. Moscow and Boise: Idaho water resources research institute. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/429. Accessed 14 March 2016
Idaho Department of Water Resources (n.d.a) About IDWR. https://www.idwr.idaho.gov/about-IDWR.html. Accessed 23 Feb 2016
Idaho Department of Water Resources (n.d.b) Idaho water resource board. https://www.idwr.idaho.gov/about-IDWR.html. Accessed 23 Feb 2016
Idaho Department of Water Resources (n.d.c) State water plan. http://www.idwr.idaho.gov/waterboard/WaterPlanning/Statewaterplanning/State_Planning.htm. Accessed 23 Feb 2016
Idaho Water Resource Board (1974) The objectives: state water plan—part one. Idaho water resource board, Boise
Idaho Water Resource Board (1976) The state water plan—part two. Idaho water resource board, Boise
Idaho Water Resources Research Institute (1976) Idaho's water: a vulnerable resource. Idaho Water Resources Research Institute and University of Idaho, Moscow
Ingraham H, Whiteley JM, Perry RW (2008) The importance of equity and the limits of efficiency in water resources. In: Whiteley JM, Ingram H, Perry RW (eds) Water, place, and equity. The MIT press, Cambridge, pp 1–32
Johnson GS, Sullivan WH, Cosgrove DM, Schmidt RD (1999) Recharge of the Snake River plain aquifer transitioning from incidental to managed. J Am Water Resour Assoc 35:123–131
Kingsland SE (2005) The evolution of American ecology, 1890–2000. Johns Hopkins University press, Baltimore
Lovin HT (1981) "Duty of water" in Idaho: a "new west" irrigation controversy, 1890–1920. Ariz West 23:5–28
Lovin HT (1985) Free enterprise and large-scale reclamation on the Twin Falls-north side project, 1907–1930. Idaho Yesterdays 29:2–14
Lovin HT (2002) Dreamers, schemers, and doers of Idaho irrigation. Agr Hist 76:232–243
Mallet J, Bjornn TC (1970) A methodology study to develop evaluation criteria for wild and scenic rivers: report of sport and commercial fisheries subproject Moscow: water resources research institute, University of Idaho, November 1970. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/193. Accessed 29 Feb 2016
Marsh KR (2014) Crossing divides: an environmental history of Idaho. In: Sowards AM (ed) Idaho's place: a new history of the gem state. University of Washington press, Seattle, pp 44–72
McNeill JR (2000) Something new under the sun: an environmental history of the twentieth-century world. Norton, New York
Michalson EL, Kirkland L (1970) A methodology study to develop evaluation criteria for wild and scenic rivers: progress report number one. Moscow: scenic rivers study unit, water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/209. Accessed 29 Feb 2016
Miller C (2012) Public land, public debates: a century of controversy. Oregon State University press, Corvallis
Mok WM, Shah NK, Wai CM (1986) Extraction of arsenic(III) and arsenic(V) from natural waters for neutron activation analysis. Anal Chem 58:110–113

Morilla, A G (1975) Hydrogeologic analysis of an abandoned tailings pile. Thesis: University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/singleitem/collection/idahowater/id/188. Accessed 18 April 2016

Morra MJ, Carter MM, Rember WC, Kaste JM (2015) Reconstructing the history of mining and remediation in the Coeur d'Alene Idaho mining district using lake sediments. Chemosphere 134:319–327. doi:10.1016/j.chemosphere.2015.04.055

Nash RF (2014) Wilderness and the American mind, 5th edn. Yale University Press, New Haven

National Research Council, Committee on Assessment of Water Resources Research (2004) Confronting the nation's water problems: the role of research. National Academies press, Washington

National Research Council, Committee on Superfund Site Assessment and Remediation in the Coeur d'Alene River Basin (2005) Superfund and mining megasites: lessons from the Coeur d'Alene River basin. National Academies press, Washington

Naylor DV, Lewis GC, Fitzsimmons DW, Busch JR (1972) Nitrogen in surface runoff resulting from addition of fertilizers to irrigation water. Proceedings, twenty-third annual fertilizer conference of the Pacific Northwest, Boise, pp 67–73. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/115. Accessed 9 March 2016

Neil JM (2005) To the White Clouds: Idaho's conservation saga, 1900–1970. Washington State University press, Pullman

Opie J (1993) Ogallala: water for a dry land. University of Nebraska press, Lincoln

Peebles JJ (1969) Problems in preparing a state water inventory. Information circular no. 1. Moscow: Water resources research institute. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/224. Accessed 8 March 2016

Peebles JJ (1970) A methodology study to develop evaluation criteria for wild and scenic rivers: report of flood control subproject. Moscow: Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/211. Accessed 1 March 2016

Petrich CR, Urban SM (2004) Characterization of ground water flow in the lower Boise River basin. Moscow: Idaho water resources research institute. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/76. Accessed 14 March 2016

Rajaram H, Bahr JM, Blöschl G, Cai X, Mackay DS, Michalak AM, Montanari A, Sanchez-Villa X, Sander G (2015) A reflection on the first 50 years of water resources research. Water Resour Res 51:7829–7837. doi:10.1002/2015WR018089

Reisner M (1993) Cadillac desert: the west and its disappearing water, rev. edn. Penguin, New York

Robison K (2014) Defending Idaho's natural heritage. N.p.: self-published

Savage CN (1970) A methodology study to develop evaluation criteria for wild and scenic rivers: report of evaluation of minerals and mineral potential of the Salmon River drainage in Idaho subproject. Moscow: Scenic rivers study unit, Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/213. Accessed 1 March 2016

Savage NL (1986) A topical review of environmental studies in the Coeur d'Alene River-Lake system. Idaho water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/93. Accessed 19 May 2016

Schulte SC (2002) Wayne Aspinall and the shaping of the American west. University press of Colorado, Niwot

Smith TG (2006) Green republican: John Salyor and the preservation of America's wilderness. University of Pittsburgh press, Pittsburgh

Sonnen MB, Thomas JL, Guitjens JC (1987) Irrigation effects in six western states. J irrig drain Eng 113:57–68

State of Idaho Legislature (n.d.) Constitution of the state of Idaho: article XI water rights. http://legislature.idaho.gov/idstat/IC/ArtXVSect7.htm. Accessed 23 Feb 2016

Steen HK (2004) The U.S. forest service: a history, centennial edn. University of Washington press, Seattle

Sutter PS (2002) Driven wild: how the fight against automobile launched the modern wilderness movement. University of Washington press, Seattle

Sturgeon SC (2002) The politics of western water: the congressional career of Wayne Aspinall. University of Arizona press, Tucson

Warnick CC (1963) Statement of professor Calvin C. Warnick before the subcommittee on irrigation and reclamation of the interior and insular affairs committee. In: Water resources research institute records, 1961–1981, box 1, folder 2, Special Collections and Archives, University of Idaho Library, Moscow

Warnick CC (1971) A methodology study to develop evaluation criteria for wild and scenic rivers: report of irrigation subproject. Moscow: Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/136. Accessed 1 March 2016

Water Resources Committee (1963) Research in water resources for Idaho. Moscow: University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/71. Accessed 22 Feb 2016

Water resources research act (1964) Public Law 88-379 US Statutes at Large 78: 329–333

Water resources research institute records (1961–1981). Special Collections and Archives, University of Idaho Library, Moscow

Watts FJ (1971) A methodology study to develop evaluation criteria for wild and scenic rivers: report of water quality subproject. Moscow: Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/138. Accessed 1 March 2016

Wild and scenic rivers act (1968) Public Law 90-542 US Statutes at Large 82: 906–918

Wilderness act (1964) Public Law 88-577 US Statutes at Large 78: 890–897

Wilkinson CF (1992) Crossing the next meridian: land, water, and the future of the west. Island press, Washington

Williams GW (2009) The U.S. forest service in the Pacific northwest: a history. Oregon State University press, Corvallis

Williams RE, Wallace AT (1972) Investigation of factors relative to ground water recharge in Idaho. Research technical completion report project A-028-IDA. Moscow: Water resources research institute, University of Idaho. Idaho waters digital library. http://digital.lib.uidaho.edu/cdm/ref/collection/idahowater/id/121. Accessed 8 March 2016

Williams RE, Eier DD, Wallace AT (1969) Feasibility of re-use of treated wastewater for irrigation, fertilization and ground-water recharge in Idaho. Moscow: Idaho bureau of mines and geology. Idaho waters digital library. http://digital.lib.uidaho.edu/utils/getfile/collection/idahowater/id/230. Accessed 15 March 2015

Worster D (1994) Nature's economy: a history of ecological ideas, 2nd edn. Cambridge University press, New York

Warnick CC (nd) An act to provide for a state scenic and recreational rivers system, and for other purposes, draft. University of Idaho personnel vertical file. Special Collections and Archives, University of Idaho Library, Moscow

Adam M. Sowards is a professor of history at the University of Idaho (Moscow, ID). A specialist in environmental history of the North American West, he is the author or editor of several books including most recently, *Idaho's Place: A New History of the Gem State* (2014). His research interests focus on public lands management, wilderness advocacy and environmentalism, and history of natural resources science.

Brynn M. Lacabanne Brynn M. Lacabanne is the Pretreament and Biosolids Specialist at the Idaho Department of Environmental Quality and a graduate of the University of Idaho's masters program in environmental science. With a background in ecological restoration, she is interested in environmental toxicology, wetland restoration, desert watershed management, and the environmental impact of the Treasure Valley's growing population, specifically as it relates to pollutant discharge and the municipal separate storm sewer system (MS4).