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REPORT

Efficient and resilient governance of social–ecological systems

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Abstract New institutions are critically needed to improve the resilience of social–ecological systems globally. Watershed management offers an important model due to its ability to govern mixed-ownership landscapes through common property regimes, translating national goals into local action. Here, I assess the efficacy of state watershed management institutions in the Pacific Northwest, based on their ability to support local watershed groups. I use document analysis to describe and compare state institutions in Washington, Oregon, Idaho, and California. Results indicate that state institutional efficiency and resilience are the key factors determining watershed group activity and stability. The primary drivers of institutional efficiency and resilience were institutional unification, robust funding portfolios, low agency conflict, and strong support for economic multiplier effects, creative partnerships, and scholarly research. My findings elucidate the critical role of institutional efficiency and resilience in governing dynamic and complex social–ecological systems, enabling the flexibility to address emergent transformations.

Keywords Adaptive co-management · Biodiversity · Governance · Resilience · Social–ecological systems · Watershed management

INTRODUCTION

Following the initial success of the landmark U.S. federal environmental legislation, its top-down institutions failed to address growing diffused environmental impacts related to population growth and development. In the Pacific Northwest, regional experiments in collaborative governance and adaptive management (Holling 1978; Berkes et al. 2007) soon gained momentum, centered around fisheries co-management (Pinkerton 1989; Wilson et al. 2003). By the late 1990s, under federal impetus and based on the regional experiments, collaborative watershed management had spread across the region (Erickson 2014).

In contrast to traditional command-and-control regimes, watershed management uses incentives to create voluntary action across mixed-ownership landscapes. The result is the application of common property regimes to land with clearly delineated property rights, addressing a central management challenge. Watershed management functions by leveraging stakeholder praxis and rational self-interest to produce optimized solutions through repeated interactions. The conceptual roots of watershed management thus rest in the intersection of game theory (Nash 1950; Axelrod 1981), resilience theory (Holling 1973), collaborative rationality (Habermas 1984), co-management (Pinkerton 1989), adaptive management (Holling 1978), common pool resource management (Ostrom 1990), social–ecological systems (Berkes et al. 2000), and coupled land–water management (Kenney 1999).

In the United States, a collaborative approach represented a revolution in natural resource management, as competition between property rights and regulation has long dominated the legal and political landscape (Kenney 1999). In the Pacific Northwest, watershed management provides a three-pronged solution to declining water quality, water quantity, and Pacific salmon populations. Watershed groups in the region receive substantial federal salmon recovery support due to the presence of Endangered Species Act (ESA) 'listed' Pacific salmon (*Oncorhynchus* spp.) populations. The U.S. government spends hundreds of millions of dollars annually on salmonid habitat improvement in the region (U.S. General Accounting Office 2002; Reeve et al. 2006). From 1982 to

2001, in an effort to offset the impact of 31 of its hydroelectric dams and attain legal compliance under the ESA, the federal government spent an estimated 3300 million U.S. dollars on salmon recovery in the Columbia River Basin alone (U.S. General Accounting Office 2002). Over the last two decades, two federal salmon-recovery programs unique to the region provided over 6000 million U.S. dollars for watershed management: the congressionally appropriated Pacific Coastal Salmon Recovery Fund (PCSRF) and the hydroelectric utility ratepayer-funded Columbia Basin Fish and Wildlife Program (National Marine Fisheries Service 2011; Columbia Basin Fish & Wildlife Program 2012).

Despite tremendous federal investment in watershed management, the efficacy of institutions at the state level, where a large portion of restoration funds are disseminated, remains critically undetermined (Blomquist et al. 2004; National Research Council: Committee on Assessment of Water Resources Research 2004; Vaux 2005). Existing studies on restoration effectiveness fail to address institutional efficiency, which I define as the outputs or outcomes produced per a given investment, equivalent to return-on-investment. While biological restoration efficacy is essential in achieving the goals of watershed management (Roni et al. 2002), restoration methods with even the most robust scientific support will fail if the governing institutions lack implementation capacity.

An analysis of state institutions is the first step in determining the result of substantial federal watershed restoration investments in the region. Institutional design analyses have the potential to elucidate methods of improving restoration outputs without requiring new funds, critical during periods of economic contraction. Since adequate funding is a key limitation of watershed group activity and persistence, the ability of state institutions to remain financially efficient and resilient is considered a critical component of restoration effectiveness. Based on recent studies (Lewis et al. 1996; Reeve et al. 2006; Roni et al. 2010), resilient and efficient state institutions are hypothesized to be a requisite for producing the broader spatiotemporal scales of restoration needed to achieve salmon recovery.

First, I describe state watershed management institutions in the Pacific Northwest. Next, I conduct a comparative analysis of these formal institutions. I use document analysis to infer institutional efficacy and resilience, based on the ability to support watershed groups statewide over time. Other aspects of state institution's effectiveness suggested by recent research agendas (Blomquist et al. 2004), such as relating outputs to outcomes, require further research. I hypothesize that the design of state watershed management institutions has a significant impact on watershed group activity and stability.

MATERIALS AND METHODS

Study area

Following previous suggestions (Blomquist et al. 2004), I employ a regional scale of analysis. The U.S. Pacific Northwest was chosen for its nexus with federal salmon recovery funds and unique history of innovative natural resource management institutions (Erickson 2014). I utilize case study states in order to minimize social and ecological variability. The geographic definition of the Pacific Northwest utilized herein is based on previous research (Erickson 2014) and contiguous U.S. states receiving PCSRF funds: Washington, Oregon, Idaho, and California. The study area is fundamentally split into two hydrologic regions, with a large amount of inaccessible historical salmonid habitat (Fig. 1).

The regional definition used in this study is analogous to NOAA Fisheries' West Coast Region (previously Pacific Region), based on ESA Evolutionarily Significant Units (ESUs).

Data collection

I gathered data from primary and secondary sources related to state watershed management institutions, salmon-recovery planning institutions, and watershed group activity. I collected over 2,000 documents from 2011 to 2012, updated in 2014. The ratio of primary sources to secondary sources is approximately 20:1, with the majority of data consisting of programmatic state web resources, legislation, plans, and reports. Additional data sources include Executive Orders, Memoranda of Agreement and Understanding, citizen's initiative state bonds, presentations, and proceedings. The data collected include relatively few secondary sources, such as periodicals, programmatic assessments, scholarly books, and peer-reviewed journal articles. I used secondary sources to initialize research efforts by locating pertinent agencies, laws, programs, and plans for each state. I located secondary sources using Google Scholar or Google Books.

I searched federal, state, and local governments', and watershed group web resources using Google Search to identify relevant agencies, departments, programs, and policies. The search process was iterative, networked, and recursive. I prioritized documents based on source credibility, filtered by the date of publication. Newer documentation superseded previous works. I gave the most recent official state and federal documentation priority, with source consistency internal and external to the state providing low-level validation. Current legislation provided the highest level of validation.

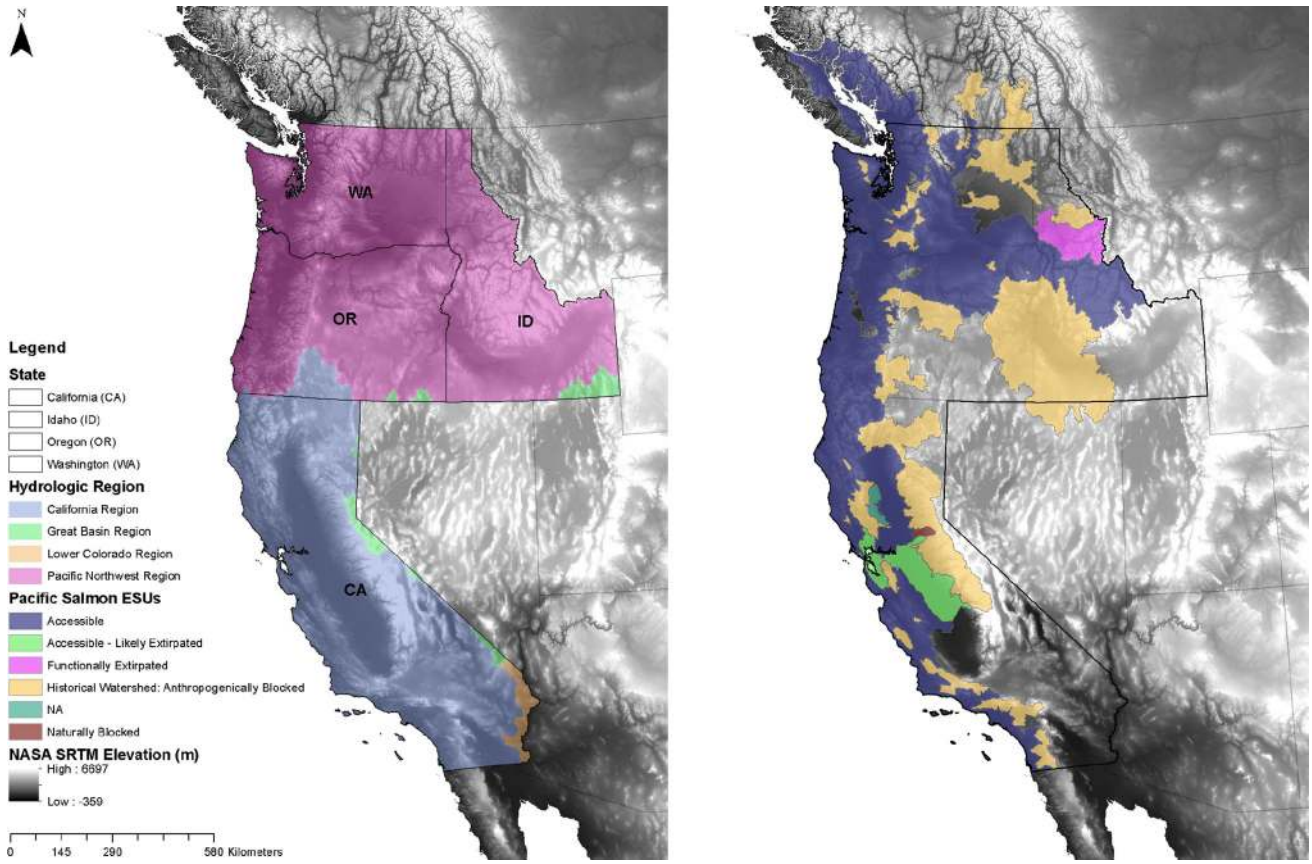

Fig. 1 Study area states, hydrologic regions, and Pacific salmon evolutionary significant unit classes

I selected state institutions and documents based on their relevance to watershed management and salmon-recovery planning, inferred from their connection to state legislation, executive orders, and memoranda. I compiled state legislation from primary sources. Additional information gathered informed the new search iterations in order to produce more robust results, in a positive feedback loop.

Watershed group longevity was inferred from state documentation on group activity and funding, with group status inferred from their web resources, programmatic state reports, and less frequently, secondary sources. Often, states published the number and names of supported watershed groups, used to inform an iterative search process. Groups that could no longer be located were considered inactive, while a search for new groups was also performed using state-specific search terms in Google Search.

Comparative analysis

I assessed state watershed management and salmon-recovery planning institutions based on their ability to support watershed groups statewide through time. The potential longevity of groups was estimated based on existing state institutions, such as funding sunsets written into law. Historical accounts of financial volatility or reliance upon state funds known to be volatile during periodic economic fluctuations were also taken into account, in order to better estimate the resilience of both state institutions and watershed groups. Thus, the longevity of groups is a product of historical trends and estimates based on policy analysis.

Formal state institutions were assessed in order to infer their institutional efficiency and resilience. Based on preliminary results, related metrics used for comparative analysis include state focus, funding portfolios, institutional integration, agency overlap, watershed coordinator support, local matching and on-the-ground grant requirements, creative partnerships, and research support. This work relates state watershed management to institutional theory, offering insights into the ability of governments to manage mixed-ownership landscapes as social–ecological systems (Folke et al. 2005; Folke 2006) through locally instituted common property regimes (Ostrom 1990; Kerr 2007).

RESULTS

The following sections provide results from the document analysis for Washington, Oregon, Idaho, and California.

Due to the complexity of state watershed management institutions, I omit components estimated to be of lesser influence. The results are organized into two sections: (1) state institutional efficiency and resilience; and, (2) watershed group activity and stability.

State institutional efficiency and resilience

Here, I provide results related to factors critical to state institutional efficiency and resilience, inferred from a preliminary analysis. The factors are organized into seven sections: (1) institutional focus; (2) financial portfolio size, stability, and diversity; (3) institutional unification, integration, and coordination; (4) agency overlap and conflict; (5) watershed coordinator support; (6) local matching and on-the-ground requirements; and, (7) creative partnerships and research support.

Institutional focus

States varied substantially in focus, reflected in their definitions of watershed management. Only Oregon has a balanced focus between water quality, water quantity, and salmon recovery, reflected in its unified institutional framework based and comprehensive watershed groups. In contrast, California focuses on water quantity in a semi-arid agricultural state with over 38 million inhabitants. Even water-quality and salmonid habitat improvements often rely on improving in-stream flows or importing higher-quality water to increase a waterbody's assimilative capacity and improve stream temperature regimes. The focus of the state and the public has shifted to Integrated Regional Water Management (IRWM) in recent years, complimentary and competitive to the state's watershed planning efforts. IRWM shifted the state's focus toward a 'hydropolitical' scale and new institutions designed to address the state's abundant hydro-modifications. Washington's framework similarly focuses on water-quantity issues related to population growth, but placing greater emphasis on salmon recovery, as it receives the largest PCSRF funds in the region.

In Washington, watershed plans are required only to address water quantity, while the state legally empowers watershed groups to recommend in-stream flows. The absence of watershed groups in the Puget Sound basin, related to ongoing disputes with indigenous groups over quantifying water rights, also reflects the state's water quantity focus. Large federal salmon-recovery funds amplify Washington's water-quantity focus, as in-stream flows are frequently a limiting factor for salmon habitat.

Idaho is the only state that focuses on water quality. In Idaho, state water-quantity management and salmon-recovery planning are secondary to the development and implementation of Water Quality Improvement Plans, or TMDLs, under the Clean Water Act. Designated state agencies provide priorities to the basin and watershed advisory groups (State of Idaho 1996), reflecting Idaho's top-down approach. Meanwhile, the largest landowners in the watershed are given the strongest voice. Maintaining property rights is a central part of Idaho's focus, fostering political expediency.

Financial portfolio size, stability, and diversity

Federal funding for salmon-recovery planning far outweighs that of water-quantity or -quality management, reflecting the existing federal paradigm. In Washington, California, and Idaho, large and stable PCSRF funding is fundamentally separate from, and often inaccessible to, watershed groups. California provides minimal PCSRF funds to watershed groups for salmon habitat restoration. In Washington, PCSRF funds are similarly distributed to watershed groups on a project-specific basis. While Idaho receives PCSRF funds, they are essentially unavailable to watershed groups, as the state offers little-to-no support to watershed groups. Idaho's few nonprofit watershed groups predominantly rely on external monetary sources, such as membership dues, municipal funding, and Clean Water Act Section 319(h) nonpoint source management grants. During the recent economic downturn, Section 319 funds markedly diminished.

Washington offers ongoing financial support to watershed groups, but limited to a 10-year period, after which groups are no longer eligible to receive state support. While Washington funds capital projects through state bonds, its operating grants are tied to the state general fund. Unlike the congressionally appropriated PCSRF, neither is likely to remain stable under extended economic contractions.

California offers large amounts of volatile funding to watershed groups through its Propositions, or citizen's initiative state bonds. New Propositions strongly control not only the amount of funding, but also the focus of management. These ephemeral management shifts create marked uncertainty for watershed groups, who are often left to find new funds or disband. In recent years, a shift in state priorities toward IRWM caused many groups to dissolve.

Oregon enjoys a large, stable, and diverse financial portfolio for unified watershed management and salmon-recovery planning. Oregon Watershed Enhancement Board (OWEB) enjoys a diverse portfolio of large and stable funding sources. OWEB receives strong support from the state lottery, written into the state's constitution though two citizen's initiatives (Measures 66 and 76). Oregon Lottery funds remained sizeable and stable throughout recent economic fluctuations. OWEB is additionally funded by

other large and stable sources, such as the PCSRF and state license-plate revenues. Even though it has the most efficient and resilient institutions, Oregon receives less PCSRF funds than California and less than half that of Washington, as shown in Table 1 (National Marine Fisheries Service 2011).

Institutional unification, integration, and coordination

Oregon is the only state where watershed management is fully unified with salmon-recovery planning under a single plan and agency. OWEB leads coordination of the Oregon Plan for Salmon and Watersheds (the Oregon Plan), the state's unified plan for watershed management and salmon recovery planning. The Oregon Plan is updated every 2 years, whereas other states have a single static coordinating memorandum at best. Similar to Washington's Salmon Recovery Funding Board, OWEB functions as the financial arm of the Oregon Plan, led by a unique citizens board.

OWEB implements the Oregon Plan by providing competitive grants for eligible projects, as well as ongoing support to watershed groups. Funds are also provided to soil and water conservation districts, which exist parallel to watershed groups. In Oregon, watershed groups can choose to integrate under state-recognized umbrella groups. Substantial coordination exists between the Oregon Plan and the Oregon Conservation Strategy, the Oregon Coast Coho Conservation Plan, and the Oregon's Native Fish Conservation Policy, intended to maintain state control of salmonid management (Fig. 2).

Agency roles and funding are clearly defined under the Oregon Plan. Oregon recently developed the Integrated Water Resources Strategy, leaving Washington as the last state in the region without a state water plan. Meanwhile, California remains the last state in the region without groundwater management. California is currently considering new groundwater regulations, based on recent massive drought-related groundwater loss (Amos et al. 2014; Borsa et al. 2014; Castle et al. 2014).

In California, coordination remains critically absent. As the state's proposed watershed management framework fell apart amid a budget crisis, only fragments remain. The state's most recent legislative efforts to establish a new framework similarly ran aground. California's IRWM, Watershed Management Initiative, Statewide Watershed Management Program, and salmon-recovery programs remain fundamentally separate. Multiple overlapping Propositions and programs reflect the competitive and oft-inefficient nature of California's institutions, where agencies compete for funding and power through proxy wars.

Table 1 PCSRF administering state agencies or departments

	Agency/department	Program/entity
California	Department of Fish and Wildlife	Fisheries Restoration Grant Program
Idaho	Office of Species Conservation	PCSRF Board
Oregon	Oregon Watershed Enhancement Board	Agency-wide
Washington	Recreation and Conservation Office	Salmon Recovery Funding Board

Similar to California, Washington conducts three types of watershed management through separate institutions: nonpoint source management, collaborative watershed management, and salmon-recovery planning (Erickson 2014). Although collaborative watershed management and salmon-recovery planning are coordinated through both a Memorandum of Understanding (State of Washington 2011) and legislation, coordination occurs only where Planning Units' and ESA-listed salmonid populations overlap.

In Idaho, the only mechanism for coordination is the Bull Trout Conservation Plan of 1996, which utilizes water quality focused watershed groups to identify and address limiting factors for bull trout (*Salvelinus confluentus*) populations (State of Idaho 1996). Similar to California and Washington, Idaho maintains wholly separate institutions for water-quality management and salmon-recovery planning, while collaborative watershed management is fundamentally absent. Idaho lacks state support for collaborative watershed management, replaced by state-directed water-quality advisory groups. Integration and coordination of even the state's limited institutions remain minimal.

Agency overlap and conflict

In comparison to California, Washington and Idaho experience relatively limited agency overlap and conflict. The relative isolation of management responsibilities effectively reduced agency overlap at the cost of institutional efficiency. Agency overlap and conflict in Idaho were also reduced by the small size of state government. Meanwhile, California is characterized by high level of agency overlap, fostering entrenched agency conflict and bureaucratic expansionism. The Oregon Plan limits agency overlap and conflict by clearly defining and funding agency roles. Conflict is further limited by OWEB's citizens board, which reduces bureaucratic expansionism.

By granting a single cabinet-level agency with the explicit authority of coordinating the implementation of a unified plan, Oregon produces strong agency collaboration. The institutional efficiency and resilience of Oregon further reduces conflict by stabilizing the allocation of financial resources through time, drawn from a diverse and robust

Fig. 2 Willamette Valley, Oregon (Photo by Adam Erickson)

financial portfolio. Meanwhile, California's agencies frequently compete to win large episodic funds produced by Propositions. Entire programs rise and fall in California with the allocation of these new funds, effectively rewarding agency conflict at the cost of taxpayers and state leadership.

Watershed coordinator support

Watershed coordinators can leverage operational funds to generate a local economic multiplier effect. Often, this effect occurs through the local match requirements of grants, whereby coordinators are required to source additional funding partners in order to receive funds from the state. In California, every dollar invested in watershed coordinators yielded an estimated $6.14 (State of California 2008), while Oregon's watershed coordinators produced a comparable $5.09 per dollar invested (Hibbard and Lurie 2005). State support for watershed coordinators is thus considered an integral aspect of institutional efficiency, in order to maximize the return-on-investment.

Idaho is the only state to lack support for watershed coordinators. Watershed Advisory Groups do not have group coordinators, except where they may overlap with the few nonprofit watershed groups. The top-down nature of Idaho's watershed planning for water-quality management limits the capacity of watershed management across the state, by failing to capitalize on the watershed coordinator multiplier effect.

Washington offers direct support to watershed coordinators, but limited to a 10-year period and reduced in scope. The ability of groups to survive the state's funding sunset remains to be determined, with Planning Units only now beginning to cross this threshold. California offers similarly unstable support for watershed coordinators. Only sporadic funds are available, limited to the cost of a single watershed coordinator. In stark contrast to other states, Oregon offers stable ongoing support for watershed coordinators through its Council Capacity Grants, enabling watershed groups to build both social and financial capital over time. Oregon's institutional efficiency and financial portfolio are robust enough to support watershed coordinators statewide.

Local matching and on-the-ground requirements

Related to the watershed coordinator multiplier effect, local matching and on-the-ground funding requirements may increase the return on state investments. In California, watershed coordinator grants require a minimum local match of 25 %, identical to OWEB. Also like OWEB, California Department of Fish and Wildlife's Salmon and Steelhead Trout Restoration Account requires 65 % of its funds to be directed to on-the-ground projects. California's IRWM grant process gives priority to groups with the largest local matching funds. This has controversially produced a southern and urban bias in IRWM grant awards, where large municipalities can contribute the greatest match funds.

While Idaho offers neither watershed coordinator grants nor capital grants, Washington offers both to group, but on a limited basis. After receiving planning grants for 5 years,

groups may apply for competitive implementation grants for an additional 5 years. Washington requires a 10 % match for implementation grants. Separate salmon-recovery groups are required to secure a 15 % local match to receive state grants, though they typically far outpace this percentage. From 1999 to 2007, Salmon Recovery Funding Board provided Lead Entities with over $248 million in grants, totaling over $400 million after taking local matching into account (State of Washington 2008). Salmon Recovery Grants are funded by the PCSRF and through the sale of state bonds, separate from Washington's watershed management funds.

Creative partnerships and research support

While each state participates in Bonneville Environmental Foundation's Model Watershed Program, which provides 10 years of funding to foster regional model approaches, supports for creative partnerships and external research were fundamentally limited to Oregon. Oregon's Special Investment Partnerships (SIP) program is one of the most promising efforts in the Pacific Northwest, as it is uniquely positioned to produce outcomes at scientifically desirable broad spatiotemporal scales (Reeve et al. 2006; Roni et al. 2010), by focusing on long-term large-scale ecological outcomes. Oregon also supports the Whole Watershed Restoration Initiative to restore land across public and private land in priority watersheds, while offering Research Grants to address the stated OWEB Research Priorities. Direct funding of scholarly research can provide critical unbiased assessment, leveraging peer-review to ensure research integrity.

In contrast, California and Idaho offer little-to-no support for innovation, while Washington's efforts are focused on the highly urban Puget Sound basin. Washington's closest effort to Oregon's SIP Program is its Regional Organizations, which loosely link watershed management to ESU-sale salmon-recovery planning.

Watershed group activity and stability

The activity and stability of watershed groups in each of the four states clearly reflect state institutional differences. In California, many watershed groups formed and dissolved due to its tumultuous Propositions and related institutional shuffling. While Idaho's watershed groups have remained stable, few have formed. A handful of nonprofit watershed groups in Idaho rely on funding sources primarily external to the state, which provide only a little, if any, of watershed group support.

The potential benefit of Idaho's approach is that it formalizes a limited form of watershed management without requiring additional state investment, in a state where limited government is valued. The political expediency of this approach has fostered highly stable groups at both the basin and watershed scales, which maintain greater social capital through institutional learning than groups in other states. While many of California's groups have disbanded entirely, at least one of Idaho's groups maintains all of its original members from nearly two decades ago. Part of this dynamic may be attributable to the relative stability and place-based traditional culture of Idaho's landowners, contrasting with California's rapidly changing demographics.

Thanks to the legacy of ephemeral programs, California maintains a hodgepodge of co-management groups so varied in type, it has inspired satirical depiction (Born and Genskow 1999). The state continues to lack clear management direction and focus. With the bulk of Proposition funds focused on IRWM, watershed groups are only explicitly supported by watershed coordinator grants, few in number and capped at the cost of a single full-time coordinator. Furthermore, these grants are seldom available, leaving groups high and dry.

While Washington has many active and thus-far stable watershed groups, the state's programmatic funding sunset is anticipated to have dire implications for watershed groups, many of which are currently approaching this threshold. Even a linkage to salmon-recovery planning has done little to help the watershed groups, which lack direct access to PCSRF funds. As a recent state report notes, "Where fish recovery goals and watershed plan implementation activities have been and continue to be complementary, the biggest challenge is the continuing decline in eligibility for [watershed group] funding from the state…" (State of Washington 2012) (Fig. 3).

Oregon provides statewide financial support to watershed groups on an ongoing basis, the only state to achieve this feat, along with competitive capital grants. While Oregon's watershed groups are among the oldest in the region, few, if any, have dissolved. Oregon's dedicated and coordinated institutions, supported by multiple high-quality funding sources, are able to provide a level of support to watershed groups beyond any other state, yielding the most active and stable watershed groups in the region.

DISCUSSION

New institutions are needed to improve the resilience of complex social–ecological systems (Folke et al. 2002; Folke et al. 2011; Westley et al. 2011). These new institutions should be flexible and open, utilizing multi-level governance to allow greater adaptive capacity (Folke et al. 2002; Erickson 2014). Effective institutions must be able to adapt to system shifts occurring with

Fig. 3 Chum salmon (*Oncorhynchus keta*) after spawning in a small stream draining into the Puget Sound, Washington (Photo by Adam Erickson)

varying periodicity and duration, by utilizing broad and flexible governance frameworks (Folke et al. 2002). Finally, new institutions should fuse private and public sector involvements, as well as top-down and bottom-up managements, to create dynamic learning networks that capitalize on the natural adaptive capacity of local groups (Westley et al. 2011).

While unified watershed management broadly meets these requirements, it is the exception rather than the rule, limited to Oregon in this study. Furthermore, even the Pacific Northwest remains plagued by the prevalent dynamic whereby conservation in one area may be met with increased extractive activity in another (Westley et al. 2011), due to a relative resource imbalance. California's massive water projects and hunger for hydroelectric energy from as far north as British Columbia exhibit this dynamic, while its critical regional role in national food production and economic output highlight the complexity of global socioeconomic networks. A disconnect clearly remains between place-based management and even regional-scale social–ecological systems. As populations continually grow, regions may face more programs like IRWM that uncouple resources from ecosystems, due to insurmountable human pressure.

While political boundaries remain simple and static, social–ecological systems are fundamentally complex and dynamic; this tension is at the core of current governance challenges, requiring flexible or permeable boundaries. While nesting and localization can help one alleviate challenges related to multilevel governance (Erickson 2014), the analysis presented herein provides new insights into the nature of institutions needed to improve social–ecological resilience. The results presented indicate that institutional efficiency and resilience are requisite components of effective social–ecological systems governance.

CONCLUSION

There is a prevalent myth that the watershed movement was the culmination of spontaneous bottom-up efforts (Born and Genskow 1999; Kenney 1999; Getches 2001). Findings indicate that the Pacific Northwest watershed movement was considerably top-down in origin. The strongest driver of the watershed movement in the region was an influx of federal funds related to the CWA and ESA, distributed by states. State financial support is crucial to the formation, persistence, and efficacy of watershed groups, and thus restoration.

There is a clear relationship between the design of state institutions and the activity of watershed groups. While a recession recently impacted states, the impact was markedly heterogeneous. Idaho had its sole watershed management funds curtailed through reductions to CWA Section 319 grants. Washington and California both faced painful funding cuts related to shrinking state budgets. In contrast, Oregon experienced relatively little change, continuing to provide strong support for watershed groups.

Contrary to popular beliefs, results indicate that the resilience of Oregon's institutions is largely attributable to their efficiency, rather than funding level, which in turn may generate public support enabling constitutionally

guaranteed funding. Oregon's institutional efficiency is epitomized by its single dedicated agency and plan, with interagency coordination throughout. A diverse high-quality funding portfolio based around the PCSRF, state lottery, and license-plate revenues granted OWEB the flexibility to develop additional funding sources in the face of looming constrictions, in a clear example of adaptive institutional resilience.

In contrast, California shows how overlapping and competing institutions can consume copious financial resources before they reach the ground. Following Hardin (1968), the phenomenon represents a tragedy of governance. There is little doubt that these challenges of governance have contributed the continued decline of California's native Pacific salmon (Katz et al. 2013). California's large and unstable Propositions created a boom-and-bust cycle for watershed groups, shifting the state's focus with each new bond, causing widespread group dissolution and the loss of human capital. Meanwhile, Washington is hampered by a lack of integration, while Idaho is constrained by a liberal model that largely ignores watershed groups.

Even meager funding sources can be unstable. Idaho's funding is essentially limited to Section 319(h) grants, which offer little funding and fluctuate markedly. While Idaho struggled to maintain its low funding level, Oregon enjoyed both copious and stable funding. The integration of Oregon's institutions is the state's greatest institutional asset. The continued spread of human impacts similarly carries increasingly coupled effects on water quality, water quantity, and salmonid habitat. State institutions in Oregon benefit by reflecting the interrelated nature of watersheds. Thus, state watershed management institutions may benefit greatly from a social–ecological systems approach to management (Folke et al. 2005; Folke 2006).

Results indicate that the most effective method of ensuring state institution and watershed group longevity is to implement a single institutional framework integrating collaborative watershed management, nonpoint source pollution control, and salmon-recovery planning. States should unify their watershed management frameworks through a single framework document, single plan, single dedicated agency, and single source of monitoring, reporting, and technical assistance, all under a single roof. Efficient and comprehensive institutions reduce agency competition, operational costs, confusion, and ultimately, group dissolution. The Oregon Plan provides a clear model, adaptively clarifying the State's strategies on a biennial basis.

States should also prioritize funding for watershed coordinators, noted for their exceptional ability to leverage funding (Nielsen-Pincus and Moseley 2010). The watershed coordinator multiplier effect improves both restoration capacity and rural economic development. Watershed groups capable of sourcing funding through creative partnerships or model programs are likely to thrive. As with Oregon's SIP program, states should not wait for new partnerships, but instead plant the institutional seed needed to grow long-term collaborations. Recent research suggests that intensive basinwide efforts such as the SIP program are essential in order for salmon-recovery efforts to succeed (Roni et al. 2010), elucidating a path for a future management.

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