Of Time and the River

The government agencies responsible for managing our western rivers need to better align their activities with ecosystem values.

BY ANGUS DUNCAN

Water has been stored, channeled, drawn off, and moved about from one place to another across the western landscape for the past 150 years. The hydrographs of western water basins have been modified by the western impulse to manipulate, remake, or shift from one place and time to another until parts of some river beds are dry by midsummer, while plains that used to bake in the heat are now flooded and green, producing goods for world markets. Low-gradient mountain valleys that once were beaver backwater and camas marsh have been drained and diked and planted with mint and alfalfa. Snowmelts and spring floods that defined millennia of aquatic biota in western watersheds define them very differently today—their waters impounded and held for summer irrigating or shifted forward into the following winter to meet electric power demands. Slackwater pools behind New Deal dams are sluggish and warm, creating habitat for different species than those evolution introduced and nurtured for thousands of years before.

The litany of changes in the reports from different western watersheds has familiar texts and cadences. Collectively, they describe the development model that has been used to shape and manage all western water basins. Finite water supplies have been managed—and consumed—on a presumption of abundance. The effects of direct consumption of water have been compounded by indirect consumption—degraded water quality caused by modifying water temperatures, chemistry, sediment loads, stream beds, riparian and upland structure, and timing of flows. Biological effects of physical stream alterations, in their turn, have been compounded by direct harvest of species with commercial value—beaver and salmon among others.

National and western values now call for redress of these effects, for a recovery of threatened and endangered species and the concomitant rehabilitation of watershed habitats. The emerging science of

stream ecology teaches the significance of complexity, diversity, and sufficiency in biological systems and in the hydrology and topography of streams and adjacent lands. But development pressures on western waters have not abated despite a growing recognition of scarcity and over-allocation. Demand for some uses, such as irrigation and recreation, has intensified in ways that reinforce the developed status quo and hamper watershed restoration.

Calls for environmental protection could once be met in a fashion that seemed to satisfy all parties: protect a little more land or water in a wilderness area, add irrigation storage capacity downstream, insert a fish hatchery to offset losses of productivity in natural habitat.

Easy solutions are more elusive today, however. With much of the available watershed resource already committed to commercial use and demand not slackening, we must divide up a shortage while reserving—or reclaiming from present users—enough of the watershed to restore it to sustainable levels of biological health and ecological integrity.

Can we do this with the tools available—laws, agencies, institutions—almost all of which are legacies of the development model? Or are the tasks sufficiently different that new river governance models and institutions must be devised?

Institutional Legacy

The visible tools of the development model are prior appropriation of water rights, allowable cut of timber, harvest allocation of fisheries, animal unit months,[1] and hydropower licensing. Less direct, but equally significant, are land use and zoning laws, transportation strategies, subsidies, and tax incentives, all of which encourage economic development of natural resources without a corresponding concern for environmental outcomes. These are all expressions of the development model that has governed the West since Euro-American settlement began. Each represents a pragmatic solution to a need particular to a place and time, and each was usually well suited to the need when it arose.

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Prior appropriation as a basis for securing water rights, for example, emerged in California's mining camps, where it provided an elegant, equitable basis for allocating water among multiple claimants. When the problem is stated narrowly—how to distribute limited supplies of water, in some cases remote to the miners' claims, in a way that will be respected as fair by all parties—the tool fits the task. It is only later, when the statement of the problem is enlarged with other considerations—preserving the biological health of the streams, for instance—that the pioneer solution becomes a status quo impediment to solving the newly stated problem. The tool wasn't constructed to protect stream health. It should come as no surprise that it is unable to do so.

The development model relied heavily on the principle of first-come, first-served, whether for water or land or mining claims. Because its object was to promote development, it required the beneficiary to use the resource or lose it to someone who would. So, today, western states struggle to find a basis in water law that would sidestep this principle and allow unused—"wasted"—flows to be left in-stream, rather than be reallocated and permanently lost to junior appropriators with claims to it supported by history and principle.

Unfortunately, the agencies today that have conservation responsibilities rely on the Progressive Era definition of conservation as a tool to sustain harvest. Their best tools are designed for extraction, not the protection of ecosystems.

There is a fundamental mismatch between human institutions geared to efficient consumption and ecosystems existing in an equilibrium that may be disturbed from time to time but that requires most of its parts most of the time.

Human consumption can permanently disrupt ecosystems by directly harvesting species to extirpation, by simplifying genetic diversity to a point at which species resilience is lost, by displacing species from their essential habitat, or by so degrading the habitat that it can no longer sustain its natural biota. The institutions established in the West to facilitate development affected river

ecosystems in each of these ways.

Commercial demand for beaver pelts, buffalo robes, and canned salmon took their devastating toll on these species in the 19th century. Most western river ecosystems, however, survived frontier levels of consumption substantially intact. It was not until population levels rose, more efficient technology was devised, and economic development was systematically supported by government laws, investments, and subsidies that habitat degradation and biological re-engineering began to take their vastly greater toll.

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Boundaries

More than a century ago, John Wesley Powell advised us to organize development of the West along "hydrographic basin" lines. But state and local boundaries were set at the convenience of commercial and political interests, indifferent to Powell's advice. Upper basins are divided from lower ones, and left banks from right. Rivers that should have been the unifying spines of states are their dividing lines instead.

Coherent management of watersheds, whether for efficient consumption or conservation, is hostage to these lines on maps. Water conserved in Oregon to augment Snake River flows, for example, may be withdrawn by an Idaho farmer across the river. Lower Colorado River states jostle each other, the Upper Colorado states, and Mexico for increased shares of a declining resource. Discontinuities in management authority encourage a parochial competition to consume. The biggest consumer is rewarded with the largest permanent resource allocation, while modest appetites are penalized.

Other lines divide watersheds. National forests are oriented to ridgelines, since that's where the harvestable timber exists. Two or more Forest Service planning units may share jurisdiction in a single watershed with Bureau of Land Management grasslands and with private holdings in stream bottoms governed by state and local land use laws.

We have even interposed a boundary line between surface and subsurface waters, allowing us to manage and allocate waters and riparian areas as though they were quite unattached to each other. This distorts our understanding of the hydrological cycle in ways that advantage some water users while degrading the hydrological basis of the river ecosystem. Detaching streams from their floodplains elevates stream temperatures, increases channelization, reduces sanctuary from predators, damages food webs, and generally diminishes the ecosystem diversity on which the stream's biota rely.

Boundaries lend superficial credence to notions like "waters of the state," as though the hydrological cycle does not move water across state lines. Yet there has come to be a different kind of possession of rivers, a "hydrocommons," that extends beyond the physical drainage to include all the users of a river basin's products.[2] Interbasin transfers of water—most famously from Owens Valley to Los Angeles—are the most explicit example of extra-basin claims established by usage. Power generated on the Colorado River may be transmitted to Los Angeles or eastward to Arizona and New Mexico. Wheat from North Dakota is trucked to Lewiston, Idaho, barged downriver to Portland, and shipped to Japan. These uses are new economic claims that must be either satisfied by the river basin or backed out at some economic and political cost. Because they place demands on western rivers, they may diminish the basis for life in one watershed or ecosystem to enrich another as surely as if the water itself had been transported.

Consumptive Policies

Federal and state policies for the last century have been designed to accelerate development of the American West and the economic use of its natural wealth. The litany of grazing, mining, and other laws encouraging economic activity is well known. Powell was not proposing conservation set-asides in his hydrographic basins, but, instead, efficient and sustainable consumption, foreshadowing the Progressive Era model of conservation developed by Theodore Roosevelt and Gifford Pinchot.

A distinctive culture has been nourished and encouraged by these policies. Living wages have been produced for many, substantial wealth

for a few, and enviable communities for all, in which gracious and rewarding lives can be lived.

Both the benefits to human communities and the costs to other biota are products of conscious government policies to encourage development that relies on direct and indirect subsidies and public investments. While nature celebrates diversity, civilization values productivity, which in the short term means uniformity and homogeneity. A field of soybeans replaces the diverse flora and fauna of prairie grasslands; a tree farm replaces a forest. Stairstepping slackwater reservoirs are substituted for a turbulent, free-flowing, spring-flooding western river.

Government resource managers responded to the policy signals by adopting client relationships with their commercial counterparts. By serving a collective of private interests, the public interest would be served. And while the policy signals have become distinctly mixed with conservation messages in the past 20 years, the client relationships endure, maintaining the status quo and resisting pressure to change.

Subsidies are often just as firmly embedded and are slow to respond to changing signals. The subsidies can be as open as land grants and loans that are interest-free or freely forgiven. They can be subtle—power-at-cost for irrigators and aluminum plants. Or they can be obscure—reservoirs that lift and carry water nearer an irrigator's fields, at no charge.

Frustrated resource managers are given ambiguous agency mission statements that mix support of commercial activities with conservation. But agency budgets are often associated directly with the commercial, income-producing side of the house. Fish and wildlife departments are supported by license fees, forest management is linked to timber revenues, and power marketing administrations are supported by power sales revenues. It is the courageous and usually short-tenured agency leader who will consistently act to reduce agency income.

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Fragmented Management

A watershed's upland flora and fauna, biotic integrity, riparian area, stream structure, and hydrology are a single system in nature. Disconnect the parts and the whole unravels. Variety is integral to biological systems; fragmentation is inimical.

For supporting human consumption, however, each element is best managed separately and for a different purpose. Forest productivity is judged on a delivered board-feet basis. Fishery managers seek maximum landed pounds of salmon or number of angler days. Hydropower requirements are best served by water in the river, held in reservoirs for periods of maximum electric demand and managed to meet electric load curves in cities hundreds of miles away, while irrigated agriculture receives benefits from water taken out of the river and spread on fields, to return on a schedule not synchronized with power dispatchers.

The problem is not only that these uses are at cross-purposes with each other; a certain amount of compromise and jostling for position mitigates this conflict. More difficult to offset is the incentive each user has to externalize costs to other users, or to the ecosystem. Thus the forest manager might be inclined to leave more trees in riparian areas if she knew this would result in stronger salmon runs. If the consequence of her actions was not stronger runs, but more fish for downstream harvest, however, the incentive to leave more trees would evaporate.

Coordination of management goals and actions is difficult at best, even within a single user set. An Idaho-bound Columbia River salmon, for instance, may pass through more than a dozen fish management authorities on its return from ocean to natal stream, and many more land and water management regimes. What is the likelihood that all these institutions and regimes are in alignment?

The ill effects of fragmentation can be overstated, of course. Acknowledging the interconnectedness of all things can be a short road to paralysis. There are no bright lines between ecosystems; ecosystems exist only by overlapping and interacting with other ecosystems. Columbia River salmon travel from Idaho to international waters off the Aleutian Islands where they intermingle with fish from Russian East Asia.

Where does their ecosystem begin and end?

While ecosystems resist boundaries, people have to manage their interactions with the surrounding environment. To do so, they have to define the environment in segments small enough to be intellectually manageable. The challenge for national resource policy is to orchestrate local actions in ways consistent with broad ecosystem and landscape functions and to reorder antiquated national and state policies to conform.

Ecological Balance

By the last quarter of the 20th century, it had become clear that the Progressive Era conservation strategies of Theodore Roosevelt and Gifford Pinchot were succeeding only in the narrow sense of stretching resources for harvest. These strategies grew more trees; they did not protect forests. The emerging science of ecology took a different approach; it taught that species and their life support systems are interconnected in complex linkages and feedback loops and that species survival was closely associated with species and habitat diversity.

Ecological science is generally accepted now as the best and most useful explanation of how extra-organism biological systems work. But there is always lag time between scientific understanding and modifying human practices and institutions to conform. Hence the uncomfortable middle ground that natural resource public policy occupies today, variously expressed as *multiple use* of resources, *balance* between human consumption and the requirements of natural systems, or *equal* treatment for conservation of species and habitats.

Why not *balance*? First, while natural systems can handle concepts such as *equilibrium*, they do not tolerate *compromise*. And in natural resource management, balance is usually a code word for compromise. Unlike contests for budget shares or tax breaks, natural systems have thresholds that must be respected for species to survive. If summer stream temperatures are persistently at 80 degrees and fish mortality is pandemic above 68 degrees, splitting the difference does little good.

Second, in such contests, the status quo is the default outcome, unless a sufficient and affirmative

STEPS TOWARD IMPROVED GOVERNANCE

- Give priority, not just equal, treatment to protecting ecosystem functions when competing against new or existing economic uses.
- Build collaborative management institutions and tools—as alternatives to litigation and other, narrower processes—that offer rewards, including access to decision making for parties that have been excluded in historical allocations of control.
- Consolidate agencies with overlapping missions, or integrate their activities along ecological lines that are congruent with watershed boundaries.
- Avoid further locking in of watershed uses—such as new water rights, unregulated access to groundwater supplies, Federal Energy Regulatory Commission relicensings, and habitat conservation plans—without testing the ecological effects. Any new rights issued should be subject to modifications to reflect new scientific findings.
- Increase access to resource decision making by nontraditional stakeholders, and educate all stakeholders in the teachings of ecosystem science.
- Shape an intermediating role for ecosystem science and scientists in decision making processes at all levels.
- Employ ecosystem science in habitat conservation and use and apply it as a conceptual frame of reference for measuring actions and consequences.
- Identify and seek to resolve inconsistencies between prevailing policies and practices on the one hand and ecological structure and functions on the other. For example, the government has separate regulatory regimes for water quality and quantity; these should be integrated.
- Create tools to facilitate, not just intrastate but basinwide, water transfers, and phase out subsidies that have outlived their usefulness.
- Transition and cushion communities facing especially harsh or precipitous change from historical circumstances.
- Develop predictable and durable sources of funding for watershed restoration needs.■ *AD*

case for change can be made to political leaders. After 180 years of intensive river development, the status quo is not in ecology's corner.

Third, if humans are the judge and jury, human needs will carry more weight. That's why species with commercial or aesthetic appeal do better in these proceedings. Policies farsighted enough to account for the importance to human destinies of preserving natural systems would reinforce the argument for conserving those systems. But human needs tend to focus one or two generations ahead at most. Natural cycles, and the consequences of human interference in them, can extend far beyond this near horizon. Species extinction may be the outcome of a housing project that will be abandoned within 100 years, but the extinction is not recallable.

Fourth, in forums of public policymaking, arguments and effects that are imprecise, hard to quantify, diffuse over large expanses, or remote in time are valued less than the precise, the immediate, and the quantifiable. In economist's jargon, they are "discounted." The immediate consequences of shifting water flows away from power or irrigation use and back toward the natural hydrograph are higher costs and lost revenues to economic users. The benefits to the river ecosystem may not manifest themselves for decades, and then they may be hard to disentangle from the other variables that comprise the biology and hydrology of the river. Or they may not materialize at all, being compromised by economic demands such as a harvest elsewhere in the system.

At best, a management strategy based on balanced use gives resource managers ambiguous and conflicting signals, placing them in unwinnable conflicts between conservationists and economic interests. While some parties prosper in such circumstances, leveraging ambiguity with political or economic muscle, most people—ranchers and farmers, environmentalists, forest managers, hydroelectric engineers—are simply frustrated. Frustration fuels emotional debate, exaggerated argumentation, or demonizing of one's opposition. In the absence of cooperation and conscience, the river suffers.

The greatest weakness of ecosystem science—its imprecision—ultimately may be its greatest strength.

Growing acceptance of the lessons of ecosystem science has undermined the development model. Water quantity and quality standards that condition new water withdrawal rights are increasingly linked to a stream's biological health. Impacts on stream ecology may be employed to condition riparian and upslope land uses. Protecting species means protecting habitat, and a species' habitat may mean more than the adjacent field or even the feeding territory. Protecting steelhead trout habitat may mean intervening to reduce stream temperatures miles upstream of the steelhead's spawning beds. Protecting estuarine habitat may entail flow releases from dams hundreds of miles away. Federal and state protections are not so comprehensive as this today, but such comprehensiveness is implicit in public policy's tentative embrace of the new science.

The greatest weakness of ecosystem science—its imprecision—ultimately may be its greatest strength if it forces us to confront the question of burden of proof. Presently, that burden is carried by those who challenge an economic use of a river, to prove conclusively that an unacceptable injury will be inflicted on aquatic species. Ecosystem science is rarely able to be so definitive or precise; the variables are too many and the time frames are too long, rather like meteorology and climatology. For that reason, and if the objective is to protect the minimum threshold conditions that support a species—or, better, a river ecosystem—the burden of proof will have to be shifted to those proposing economic uses. If the evidence is inconclusive, a margin of error is needed to protect the species. The more difficult the proof, the greater the margin of error must be.

The Best Available Science

There are two prevailing patterns for integrating science into policymaking, neither of them entirely satisfactory. The first comes through the interaction of competing views of biology and hydrology in the public forum of ideas. Sometimes these differences are expressed in disciplined and

structured ways, through journal publication and critique. No less often, selective views or partial findings are advanced by those whose interests are served by a kind of advocacy science. This abuse of science flourishes particularly where the available evidence can support probabilities but not certainties and where time horizons tend to be most spacious. Climate change is one such area; ecosystem health is another.

The second approach relies on the principles of adaptive management. In the presence of scientific uncertainty, a hypothesis is stated and management strategies are rearranged to test the hypothesis. Results may lead to policy changes or to a refined hypothesis and further testing.

Adaptive management has been a useful but limited tool in rationalizing river basin management practices. Fragmented authority has meant that agreement either on a hypothesis or the protocols for testing it has been difficult to achieve. Responsible agencies may be reluctant to modify practices necessary to carry out the test. Where an outcome is the product of multiple ecosystem forces, isolating one variable and holding other factors constant is often not possible. Where effects may become apparent only over decades, agency commitments often erode. And where testing hypotheses may have large financial or political costs, such as decommissioning a dam to test migration at natural river levels, the tenets of adaptive management meet a resistance quite as immovable as the dams themselves.

Without abandoning the scientific method of hypothesis testing, are there other roles that science can profitably fill? There are, but they depend on scientists conquering their impulse to also become policymakers. Watershed science in service to public policy goals is most useful when it is independent of interests advocating one goal over another. Scientists must be truth-sayers and truth-testers, affirming or critiquing the evidence and interpretations without regard for interests affected, costs, or societal consequences, the latter of which are the province of policymakers.

Science that carefully preserves its independence becomes a sort of common ground to which parties of differing views but good faith can repair.

A second role for science is to describe the conceptual framework within which public policy must operate. Science must describe how hydrological and biological systems functioned in a pre-modern world, how these systems have been modified, and what the consequences have been. Scientists must then tell policymakers, within explicit probability limits, the likely consequences of proposed remedies.

A third and perhaps most critical role for science is that of intermediation. Science that carefully preserves its independence becomes a sort of common ground to which parties of differing views but good faith can repair. The more informed these parties become in what the science can and cannot tell them, the more they will find themselves curiously captive to that understanding, less free to engage in the polemical excesses of the uninformed. They will find themselves searching together for solutions within science's conceptual framework, and finding them.

Incremental Steps

Notwithstanding the entrenched resistance to governance changes and the preference for narrow solutions to immediate problems, there is still value to forcing the governance debate. Incremental changes will occur as a conscious effort to improve cooperation, deflect regulation, or grab control. Such changes are also the unintended consequence of technical fixes.

One of the reasons institutional change can be painfully slow is the fear of unilateral concessions that are neither matched nor returned. When adversarial parties are seeking the slightest advantage in legal and political leverage, it seems foolhardy to make gratuitous gestures and count on the other party not to take advantage. Yet in smaller watersheds where the interests are individuals—sometimes neighbors across a table—these gestures are being made and answered. Where expectations can be personalized instead of conveyed by lawyers and public relations consultants, it's harder to take advantage of someone and still show up for coffee at the corner grill the next morning.

Especially when people can use watershed science as a kind of referee and independent interpreter of the rules, they may discover common ground that leads to home-grown solutions. Pride of place also becomes a basis for trust and confidence-building.

It is far harder for large western water basins to build on personal relationships. Elections, changes in administrations, professional mobility, the impersonal nature of large institutions, and the law as an abstraction all interpose between people. But the use of science, and the success of unilateral small steps taken and repeated, should encourage parties to search out low-risk ways to emulate their colleagues in small watersheds across the West.

Bridging the Gap

So the best and final counsel is...to inch along? Incremental gains are the only practical gains? That's not a very satisfactory conclusion. The threats to the hydrological and biological sustainability of western waters are real and immediate. Change must come fast enough to rescue distressed food webs and disappearing species.

But change comes about at its own pace and in its own season. Evidence accumulates that old institutions and practices are no longer serving us well, either to explain events or shape outcomes. Harvest management rules aren't delivering the expected volumes of trees, or fish, or healthy forests and streams; water allocation rules can't keep groundwater levels from falling or aquifers from collapsing.

Individuals discern these patterns sooner than do institutions such as government agencies or economic interests invested in the status quo. Small communities in sparsely populated watersheds have the advantage over more ponderous institutions like the Corps of Engineers.

Only in the late innings do most institutions recognize the growing body of evidence and respond. If there is an entrenched minority with a stake in the way things are, the pace of change can be slowed or even arrested for a time. Ultimately, institutions that resist become irrelevant and are left behind.

But neither we nor the many species most immediately at risk can afford this kind of sullen dallying. If we are persuaded that there is a fundamental mismatch between existing institutions of river governance and the ecology of watersheds, then we are bound to offer a plausible alternative, and we are bound to promote it vigorously.

This may have the welcome effect of accelerating the pace of incremental change. But it can also prepare us for the eventful moment, the window that opens from time to time as personalities and political forces briefly align and allow momentous change to take place. In such a moment, the national park system was created; in another, the Endangered Species Act was adopted. At those moments, the opportunities are greatest for those who are prepared.■

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NOTES

1. One "animal unit month" is the amount of forage a 1,000-pound cow consumes in a month. The units are used by the U.S. Forest Service and the Bureau of Land Management for allocating grazing rights on federal lands.

2. See Gary Weatherford, *From Basin to Hydrocommons: Integrated Water Management without Regional Governance*, Natural Resources Law Center Discussion Paper Series (Boulder, CO: Natural Resources Law Center, January 1990).

3. This article is adapted from chapter six of *A Survey of Columbia River Basin Water Law Institutions and Policies*, 2 (Portland, OR: Northwestern School of Law of Lewis and Clark College, June, 1997), submitted by the Northwest Water Law and Policy Project to the President's Western Water Policy Review Advisory Commission.