# PUBLIC PARTICIPATION AND SOCIAL CONSIDERATIONS: THE KEY TO RESTORATION AT THE WATERSHED SCALE

**Adina Merenlender and Matt Deitch**

*University of California, Berkleley, USA*

## Executive Summary

Our research has assessed some of the broader impacts that humans place on our fresh water systems, and how we can improve attempts to restore watersheds and dependent natural resources such as anadromous fisheries during a period of human population growth that is intensifying social demands on land and water. We are interested in transformative restoration through large-scale manipulations that address root causes to improve social, physical, and ecological processes that will increase ecological and community resilience. This approach is in contrast to the current practice of spending millions of dollars on small-scale restoration projects that focus on technical solutions to site-specific problems. We hypothesize that restoring stream flow during the dry season, when almost no rain falls in meditteranean-climate areas and when demand for water is at its peak, would provide transformative restoration and greatly improve chances for recovery of endangered salmonoids.

Like most wine-grape growing regions around the world, coastal California has a mediterreanean climate with most of the rainfall occurring in the winter months, followed by a dry period that can last six months. Not surprisingly, in many parts of the Russian River Basin for example, water rights records predict that demand for water during the spring and summer growing season exceeds supply; while rainfall during the wet season exceeds winter water removal estimates. Our monitoring of flow in upland tributaries of the Russian River reveals dramatic drops in stream flow during spring frost protection periods as well as decreases in flow during extreme hot temperatures. Comparisons between historical and present stream flow data also demonstrate that vineyard development has decreased spring stream flows. Such flow adjustments during the dry season may have consequences to native anadromous salmonids, including sudden drying of gravel bar habitat, higher water temperatures, and changes in the invertebrate prey base. Juvenile salmonids must survive one and sometimes two to three summers in these tributaries before they are large enough to migrate to the ocean, and we show that their survivorship through summer is greatly influenced by stream flow. Increasing winter storage may be one of the only solutions to meet the demand for wine grape production and reduce the impacts associated with the practice of pumping surface and subsurface stream waters during the dry season. However, hesitance to grant water rights and uncertainties over whether additional reservoirs will lead to cumulative effects on winter flow thresholds necessary to sustain salmonid migration has resulted in a backlog of over 200 requests for additional

appropriate rights, many to increase the storage of winter rainfall, since 1990 – creating expensive delays and uncertainty for wine grape growers.

In collaboration with the Salmon Coalition we are developing a new spatially explicit analysis tool that can help reveal where additional reservoirs for storing winter rainfall are not likely to impact adult salmon passage and evaluate the potential to relieve the observed agricultural impacts on spring and summer stream flows. These decision-support tools are essential to evaluate environmental and economic tradeoffs associated with different water management schemes widely implemented across coastal California, where water for agriculture is not provided by large centrally controlled reservoirs, but relies instead on small water projects.

In the Russian River basin the Salmon Coalition is exploring ways to provide incentives for altering the use of historic rights in order to improve stream flows in areas designated as critical for salmon recovery. These collaborative efforts are currently not seen as “restoration projects” per se and therefore have not received restoration dollars, yet they are critical for salmonid survival. In conclusion, real solutions will only be found when restoration looks beyond the stream to address the entire watershed as a combination of social and ecological forces that interact to produce watershed conditions. Bridging the disconnect between restoration goals and practices will require public participation and better coordination among agencies involved in restoration to focus on larger, watershed-scale concerns.

## Introduction

Our research has assessed some of the broader impacts that humans place on our fresh water systems, and how we can improve attempts to restore watersheds and dependent natural resources such as anadromous fisheries during a period of human population growth that is intensifying social demands on land and water. Restoration is a set of human activities based on existing social, biological, and physical models that determine where and how these activities occur and the resulting consequences. We distinguish three types of restoration that occur at three nested scales; 1) repair, 2) protection, and 3) transformation. Repairs are treatments at a specific site designed to solve a perceived problem arising from human occupation along rivers and streams, such as bank stabilization, planting riparian vegetation, and rock weirs. Protective restoration includes manipulations and land management designed to prevent stream degradation, usually in the uplands of individual watersheds. Restoring roads, maintaining stream protection zones, and planting cover crops to prevent sediment from reaching the stream are examples. Finally, manipulations that lead to changes in the system over a larger spatial and/or temporal scale we consider transformative. Removing a large dam, changing water policy, or transferring water from one basin to another would be considered transformative actions. These activities result in physical, biological, and social transformation that changes the contextual forces of the entire system.

Transformative restoration is relatively more important for restoring watersheds in a Mediterranean climate region as compared to the collective effect of individual repairs to the system, that may more easily produce the desired effect in a more homogeneous environment**.** In more general terms, there is a relationship between the degree of ecological variability, uncertainty of water supply, and scale(s) at which effective stabilization can be sought and achieved. Thus, while relatively homogeneous and well-watered conditions may respond to a strategy of site repairs, Mediterranean conditions present a much wider range of scale requirements to achieve similar effect. However, repairs can also satisfy a particular social need that communities have to act locally and might help develop a sense of place and greater awareness of nature.

We identified trends that shed light on both the ecological and political implications of restoration at a basin scale by examining a database of 787 restoration projects implemented in the Russian River basin since the early 1980s. Although a total of over $47 million has been spent on restoration in the basin alone, dominant forms of restoration are limited in scope to small scale projects that focus on technical solutions to site-specific problems. The majority of restoration efforts are devoted to road repair, riparian stabilization, and in-stream structures, accounting for 62% of all projects (**Figure 1**). These types of projects do not address the broader social drivers of watershed change such as land and water uses. We suggest that restoration can become more effective by addressing the entire watershed as a combination of social and ecological forces that interact to produce watershed conditions.

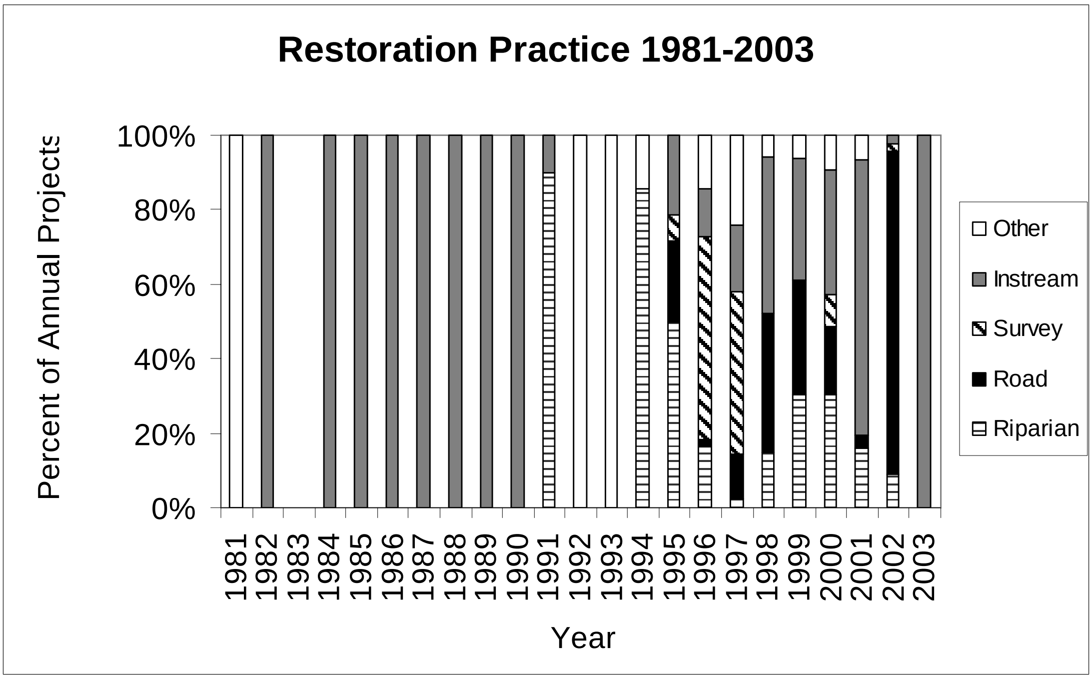


**Figure 1. Work types associated with restoration projects by year, 1981 - 2003**

Equally significant are those practices that are *not* well represented, which include education for the public and school children, land and water conservation projects to address harmful activities beyond the riparian zone that are focused on water usage, and upland projects that are focused on changing land use patterns or activities beyond the riparian zone. Therefore, while the goals of restoration are broad and address watershed-scale ecological processes and social issues, the actual practice of restoration is primarily restricted to repairing streams and rerouting sediment at specific sites. Why does this disconnect exist? How can it be bridged?

We suggest that the disconnect between restoration goals and practice is closely related to restoration efforts and the associated lack of attention to the larger drivers social, political, and economic drivers of watershed degradation. Water quantity and flow levels in the Russian River is an example of a larger, and critical, watershed issue that is currently not being addressed by the practice of restoration. This summer the State Water Board mandated reductions of water use by municipalities and agriculture in the Russian River basin. This request was made because there was not enough water in existing reservoirs to provide adequate flows for salmon migration and could result in a violation of the Endangered Species Act. Restoring stream flow during the dry season, when almost no rain falls in the basin and demand for water is at its peak, is critical for salmon recovery and requires that the practice of restoration address water quantity as listed in the agencies programmatic goals for their restoration programs. Water quantity in streams is currently not part of the restoration efforts in upland streams; with the exception of the recent efforts by the Mattole Restoration Council and Sanctuary Forest in Humboldt County, California. There, restorationists are tackling the issue of water quantity by working with water attorneys to draft "forbearance" agreements where riparian water rights holders forebear their summer water rights in exchange for off-stream reservoirs.

Like most wine-grape growing regions around the world, coastal California has a mediterreanean-climate with most of the rainfall occurring in the winter months, followed by a dry period that can last six months. The separation between the time and location of water availability and the demand from agriculture and other human uses, necessitates large scale manipulations of water. These manipulations have in large part resulted in the decline of California's coastal salmon runs. Now with several of these fish species listed under the Endangered Species Act, the State has basically refused all requests for additional water storage over the past 10 years and private-land owners are increasingly concerned they may be sited for altering habitat critical to salmon recovery. The result of stopping water storage projects has been increased sub-surface pumping near streams which, as we documented, can impact surface flow during the dry season. Juvenile salmon mortality is related to stream flow during the dry season and we hypothesize that the cumulative effect of increased pumping is leading to high levels of juvenile salmon mortality.

Our research and education program is focused on increasing our understanding of the coupled human and natural system of the coastal Russian River basin in order to better balance the demand for water by agriculture and improve salmon restoration efforts. Existing models of watershed behavior and policies that guide management and restoration do not account for the social, biological, and physical variability inherent in California's Mediterranean watersheds. Hence, when the prevailing models are applied they produce weaker explanations and less effective actions in Mediterranean California than is observed in non-Mediterranean systems. As a result, scientists have not been able to adequately recommend protection and restoration methods to sustain watershed function and process in these regions. This can result in development of policies that support ineffectual if not counterproductive actions. Here we emphasize the need to recognize the local environmental conditions and develop uniquely adapted solutions to improve restoration practice.

## California's Mediterranean-Climate Coastal Watersheds

Mediterranean-type climates are characterized by cool, wet winters (8-12° C) and dry, hot summers (18-30° C) (Aschmann 1973) and occur on almost all continents. In the Pacific coast of North America, this climate type extends from southern Oregon to northern Baja California. Although the seasonal pattern of rainfall is predictable (approximately 70% of the precipitation falls in winter months), temporal and spatial variability can be quite high (**Figure 2**). Deviations in mean annual flow of 30% or more from long-term annual averages are common, leading to continual uncertainty about water supply.

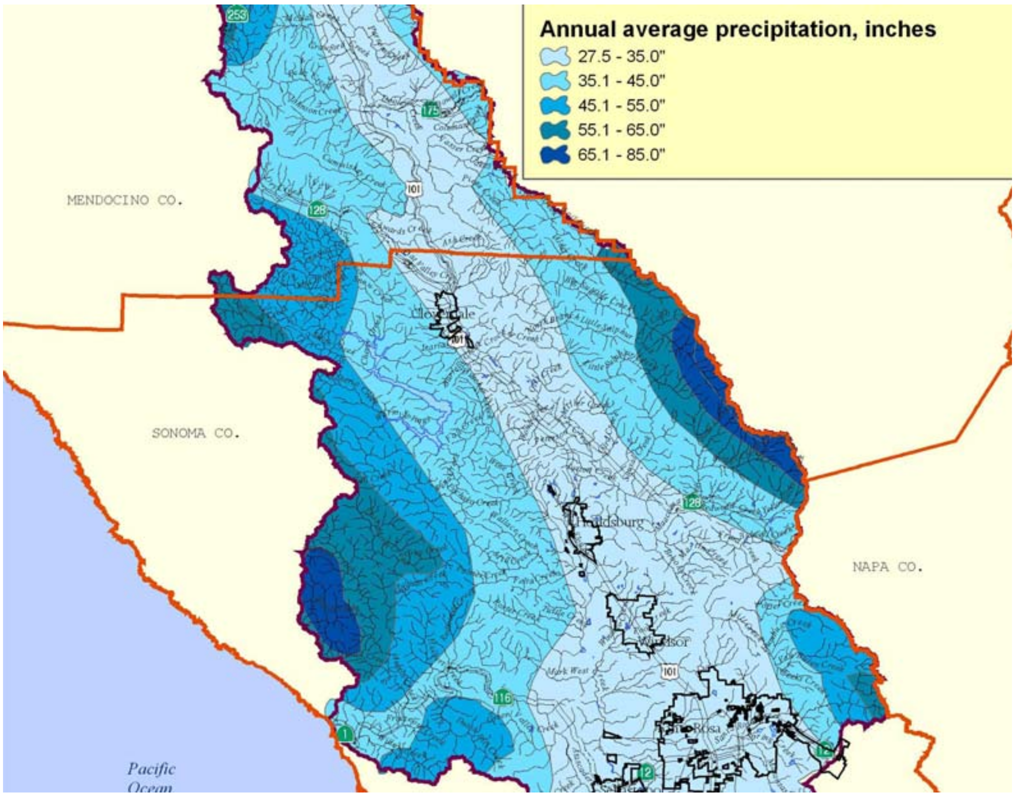


**Figure 2. High spatial variability in rainfall.**

Like rainfall, most streamflow occurs during winter and early spring, and winter and spring flows are followed by gradual recession to base flow for several months. Streamflow varies enormously over the year, as illustrated by the Eel River measured at Scotia, California (drainage area 8060 $km^2$), where flow has ranged from 0.3 $m^3/s$ to 22,000 $m^3/s$ (12 to 858,000 cfs) (Friebel et al. 1996). Compared to streams in other regions in the U.S. with similar catchment size, storm peak flows are greater in Mediterranean California streams; because precipitation is concentrated over a few months, Mediterranean climate streams also produce greater annual and seasonal discharge. High variability in precipitation results in high inter-annual flow variability as well. The coefficient of variation for mean annual flow ($SD_{MAF}/MAF$) in unregulated Mediterranean California streams (e.g. 0.68; n=6) is more than double that in many comparable regions (e.g. 0.32 for Colorado, 0.25 for Massachusetts, 0.32 for Michigan; n=5 for each) (**Figure 3 and 4**).

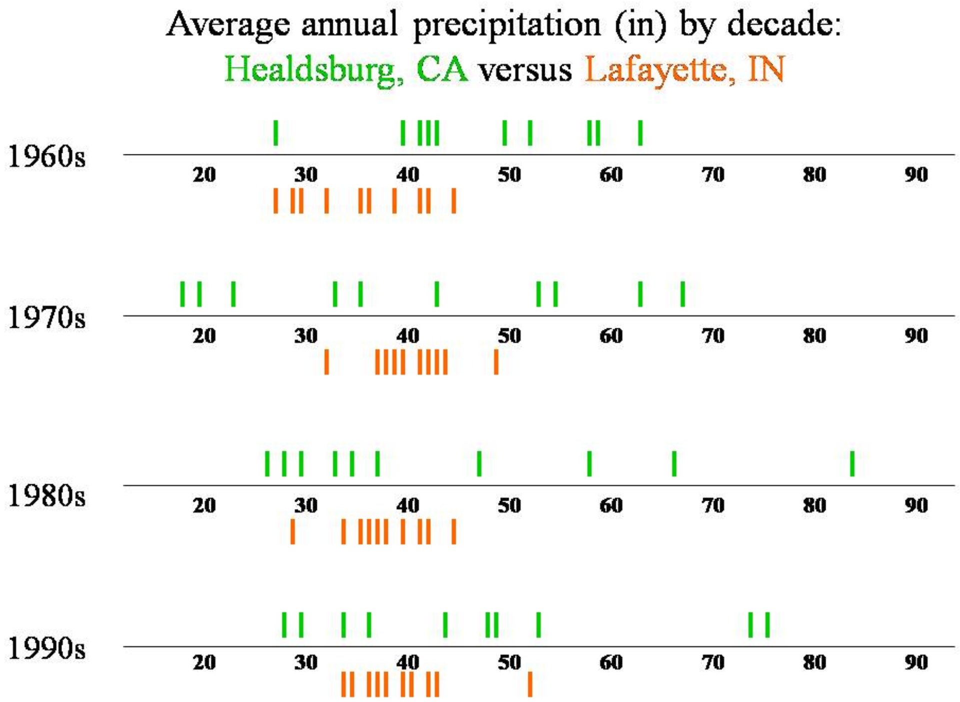


**Figure 3. California Mediterranean climate has more year to year variability – increases uncertainty.**

**Figure 4. High flow in winter and low flow in summer at same site.**

Although annual precipitation is unpredictable and little rain falls from late spring to fall, greater annual water availability compared to other arid and semi-arid regions makes Mediterranean regions suitable for agriculture and human settlement. But due to the seasonality and unpredictability of rainfall, intensive water management has been required to support continued development. In northern Mediterranean California, developed regions such as the Russian River basin receive ample water for agriculture (approximately 1000 mm/yr), but water availability (winter) is out-of-phase with demand (summer), so agriculture must rely on groundwater pumping or storage in artificial reservoirs. Despite large scale water projects, competition for water resources still exists especially during years of low rainfall when the increased water deficit results in even greater abstraction of water for human use (Woodward and Romm 2002).

Two anadromous fish species once plentiful in California, steelhead trout (*Oncorhynchus mykiss*) and coho salmon (*O. kisutch*), are now listed as threatened and endangered, respectively, in the Russian River basin. Therefore the watersheds in the Russian River were declared critical habitat for salmonids and this designation has increased the concern among landowners about violating the endangered species act – adding another level of uncertainty for private land-owners.

*Distributed water control*

Wine grape production is vital for the local and State economy in California as it not only results in a highly valued product but attracts tourists to the area and other associated activities that are vital for the region. California's premium wine grape industry relies on fresh water resources (ecosystem service) from coastal watersheds (**Figure 5**). We have focused our attention on how small instream diversions throughout the region may impair streamflow; and in one particular region, how they actually do impair streamflow. This is of great importance to water management throughout the wine country of northern California: electronic records maintained by the State Water Resources Control Board illustrate that almost 1800 requests for water rights have been submitted since 1918 in the Russian River watershed (**Figure 6**), and approximately 50 percent of all water rights requests throughout all of California from 2000 to 2005 describe abstraction from streams in either Napa, Sonoma, or Mendocino County. This increase in demand for fresh water resources is a result of the increase in the popularity of California's premium wine. Depending on how these diversions operate, they may threaten flows necessary to support anadromous salmonids in the region.

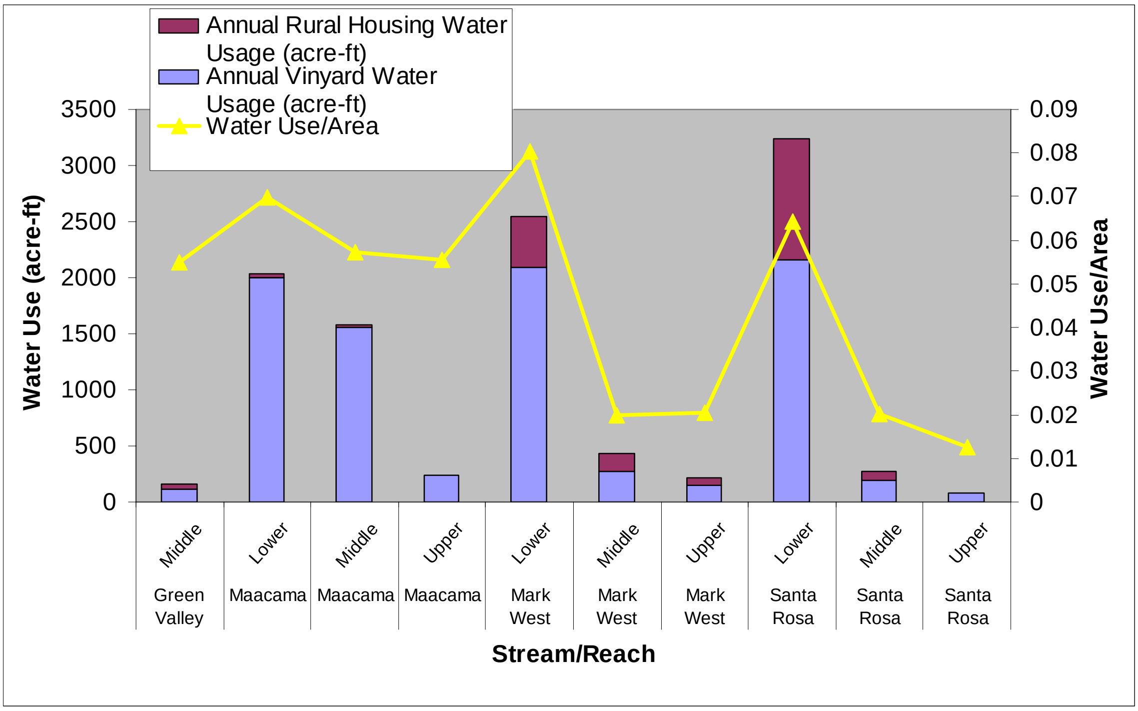


**Figure 5. GIS analysis of land use types and estimated water demand in the study watersheds.**

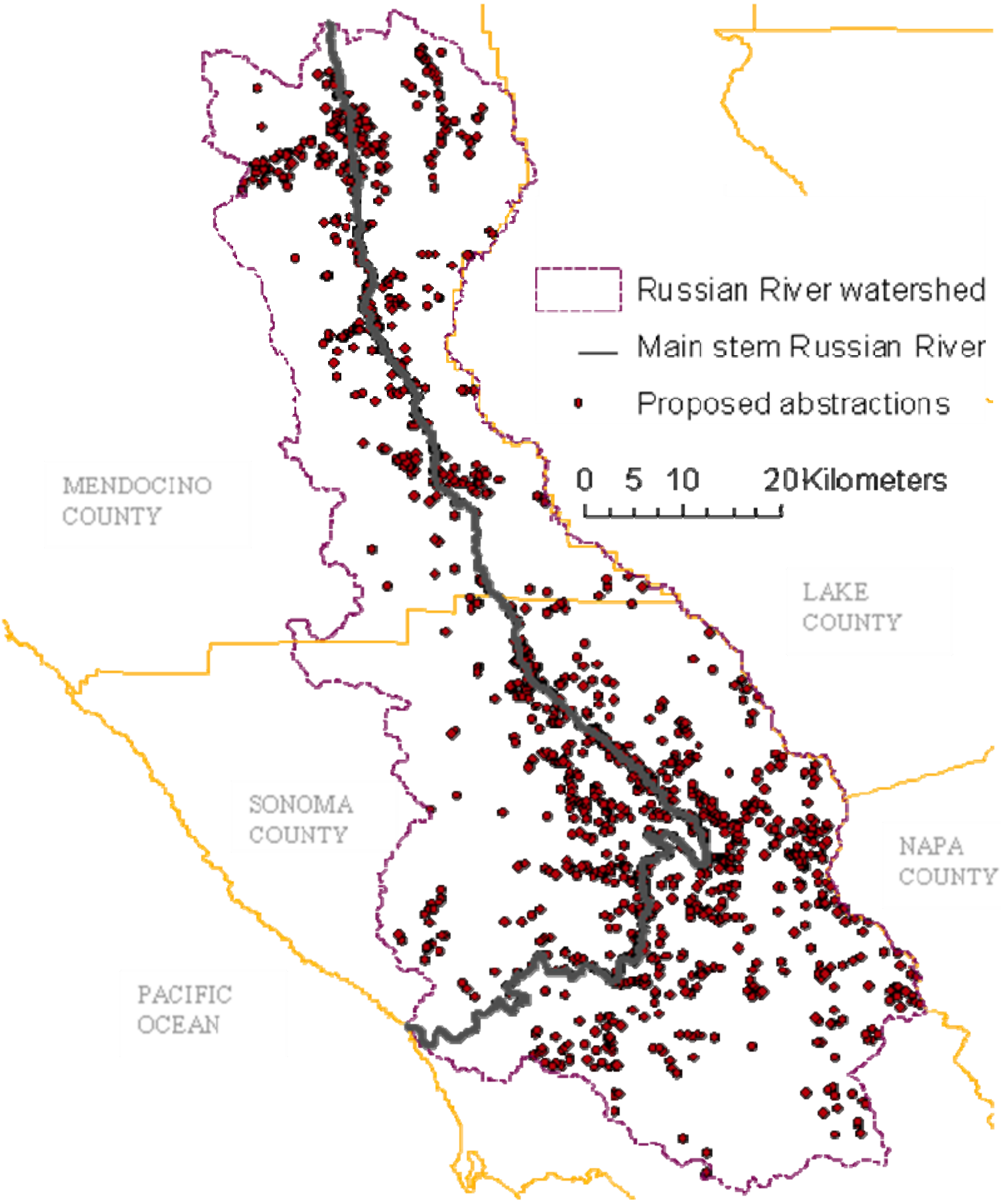


**Figure 6. Proposed points of abstraction in the Russian River basin (appropriative and riparian rights), based on the SWRCB WRIMS database. (Note: this only contains 1500 PODs because the WRIMS GIS has not been updated since 2001.)**

## Effects on stream flow and aquatic biota

Not surprisingly, in many parts of the Russian River Basin for example, water rights records predict that demand for water during the spring and summer growing season exceeds supply; while rainfall during the wet season exceeds winter water removal estimates (**Figure 7**). Our monitoring of flow in upland tributaries of the Russian River reveals dramatic drops in stream flow during spring frost protection periods as well as decreases in flow during extreme hot temperatures. Comparisons between historical and present stream flow data also demonstrate that vineyard development has decreased spring stream flows. Such flow adjustments during the dry season may have consequences to native anadromous salmonids, including sudden drying of gravel bar habitat, higher water temperatures, and changes in the invertebrate prey base (**Figure 8**). Juvenile salmonids must survive one and sometimes two to three summers in these tributaries before they are large enough to swim to the ocean, and our retrospective analysis of existing survivorship data shows that juvenile salmonid survivorship through summer is greatly influenced by stream flow and estimated demand for water by vineyards in the uplands.

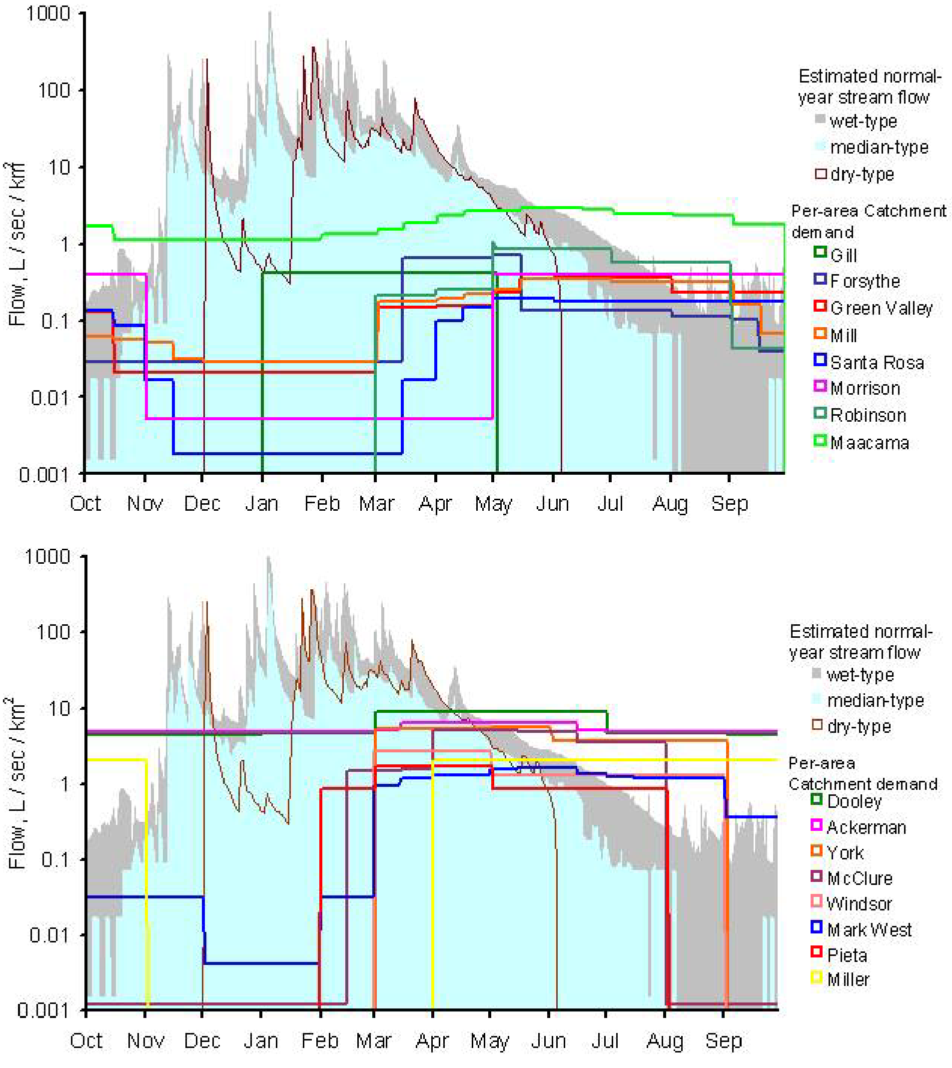


**Figure 7. Sum of approved watershed diversions in ungauged Russian River tributaries, and estimated normal-year streamflow based on historical USGS records (expressing a wet-type, median-type and dry-type flow regime). Data suggest that total demand from each watershed likely exceeds watershed discharge at some time in a normal year.**

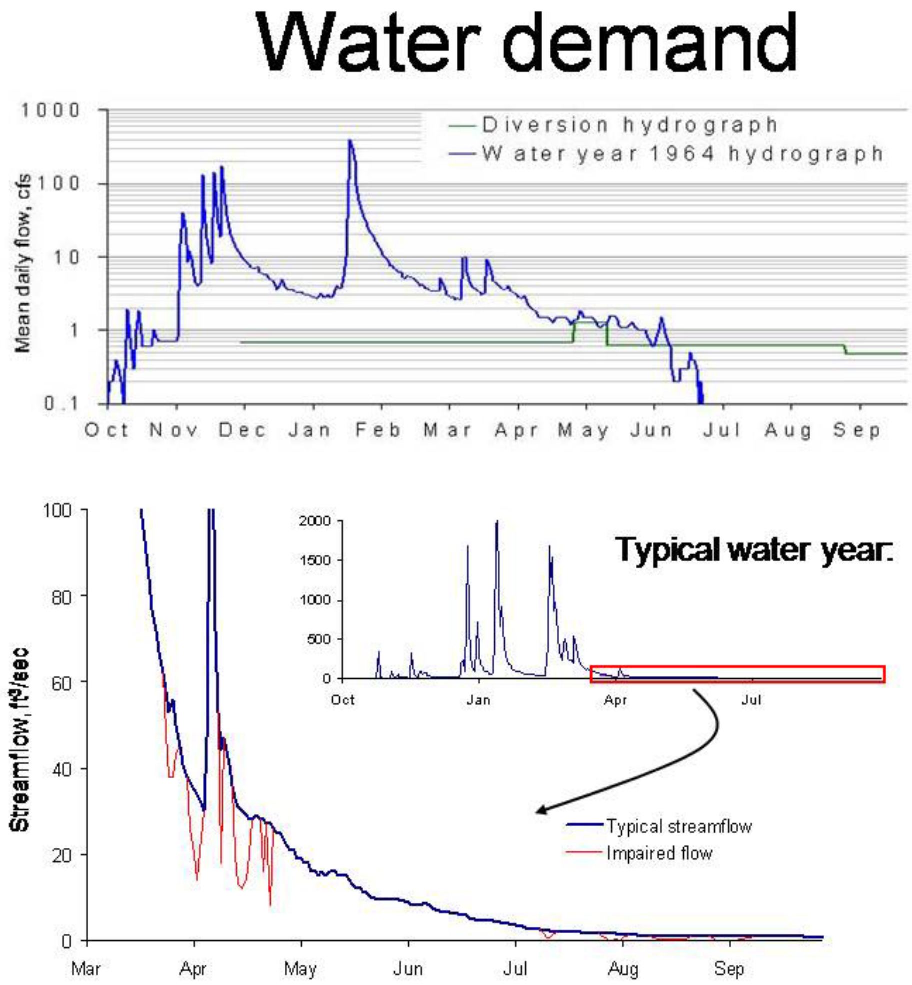


**Figure 8. Water demand can be met with the amount of winter rainfall. Pumping during the spring and summer can have result in cumulative impact on stream flow.**

## Collaborative Conservation

In the end, land and water conservation in places such as coastal California, which is almost entirely comprised of private land, cannot occur without landowner participation. Therefore, we are engaged in the collaborative conservation processes, with a public interest group called the Salmon Coalition, to facilitate public participation in transformative restoration. This coalition represents a growing demand for a more adaptive local approach to resource management through collaborative conservation. This approach can often result in increased environmental and social benefits across a variety of complex situations

The Salmon Coalition is a stakeholder group that was recently formed to increase communication among private land owners of Dry Creek and Alexander Valleys (northern Sonoma County), resource agency staff (NOAA and Calif. Dept. of Fish and Game), and the Sonoma County Water Agency and their urban clients (9 water districts serving cities and towns in Sonoma and Marin Counties). The goal of the Salmon Coalition is to set restoration priorities for salmon recovery while protecting and hopefully improving water security for rural and urban uses and lessening the burden on private land owners posed by the Endangered Species Act. The Salmon Coalition is a good example of a policy-based initiative which involves stakeholder participation to design plans that are intended to protect habitat as compensation for future takings of endangered species in the United States (Cestero 1999).

This type of collaborative conservation is increasing in popularity as decision-authority about how to implement species recovery devolves from government resource agencies to public stake-holders. The outcomes generally remain untested. In an attempt to define a common language for this approach to decision-making and to share lessons learned from case studies, the Sonoran Institute published a very useful report titled "Beyond the Hundredth Meeting: A Field Guide to Collaborative Conservation on the West's Public Lands (Cestero 1999). Although focused on public land issues, this investigation offers helpful guidelines to improving the success of public processes that are a necessary part of planning most corridor projects. Efforts that are place or community-based are distinguished from those that address a specific policy or interest-based initiative as is the case for the Salmon Coaltion.

Cestero (1999) also reports that place-based efforts work best if they are led by local participants rather than by government representatives, and take place in an open and inclusive process that can accommodate a full range of perspectives, including government representatives. It is also better if participants do not try to represent a larger interest group, because confusion can arise when individuals are held accountable for a large diverse interest group, some of whom will feel their interests were not well-represented. In addition to completing the desired projects, collaborative conservation can lead to increased capacity of community residents to respond to external and internal stresses that will inevitably arise. This capacity can help avoid future problems from becoming crises.

One clear conclusion from those who have studied examples of collaborative conservation is that groups focused on smaller areas are more likely to succeed (Cestero 1999). This is because those involved can relate to the landscape in question, and regular participation from people spread across a large geographic area is not required. The Quincy Library Group in northern California is an example of where a group of approximately 30 people developed a plan for 2.5 million acres of public forestland that in the end did not adequately attend to the diverse interests represented in this large and relatively populated area (Duane 1997). Such larger scale conservation projects are better addressed through a network of local efforts (Cestero 1999). In our case, the Salmon Coalition is primarily focused on only two sub-watersheds within the Russian River which will help the restoration planning process.

Equally important, the Coalition has agreed to a participatory research effort that will greatly increase our understanding of the various ways that water is managed across private lands. Having a group begin by collecting and evaluating existing information that will increase their understanding of the system is one way to empower a group early on (Cestero 1999). This group has offered their assistance in collecting information from wine grape growers on water management practices and for access to private lands required for further stream flow monitoring. Without this cooperation, we would not be able to collect local information and would continue to have to rely on coarse assumptions about the system and management models that are ill-suited for such a complex issue. The data describing hydrology and water management that we are collecting with the help of the Salmon Coalition will enhance our understanding of human-ecosystem interactions – a necessary step to better inform future water management and policy decision-making.

Together we are working toward solutions that better balance environmental and social outcomes through collaboration among local experts, resource agency professionals, and landowners. These efforts will help the State Water Resources Control Board and local stakeholders resolve problems over additional requests for appropriative rights to store more water during the rainy season. Our data analysis and models will also be used by Sonoma County Water Agency to improve their estimates of available flows for ecological processes (thus enhancing salmonid recovery efforts) and municipal uses.

**Planning for recovering stream flow as a means of transformative restoration**

Increasing storage of winter rainfall and runoff using small off stream reservoirs may be one of the only solutions to meet the demand for wine grape production and reduce the impacts associated with the practice of pumping surface and subsurface stream waters during the dry season. However, the State has been unwilling to grant water rights in part because of uncertainties over whether additional reservoirs will lead to cumulative effects on winter flow thresholds necessary to sustain salmonid migration. This inaction has resulted in a backlog of over 200 requests for additional appropriate rights, many to increase the storage of winter rainfall, since 1990 **–** creating expensive delays and uncertainty for wine grape growers.

To address this problem, we are developing a spatially explicit analysis tool that can help reveal where additional reservoirs for storing winter rainfall are not likely to impact adult salmon passage and evaluate the potential to relieve the observed agricultural impacts on spring and summer stream flows (**Figure 9**). These decision-support tools are essential to evaluate environmental and economic tradeoffs associated with different water management schemes widely implemented across coastal California, where water for agriculture is not provided by large centrally controlled reservoirs, but relies instead on small water projects.

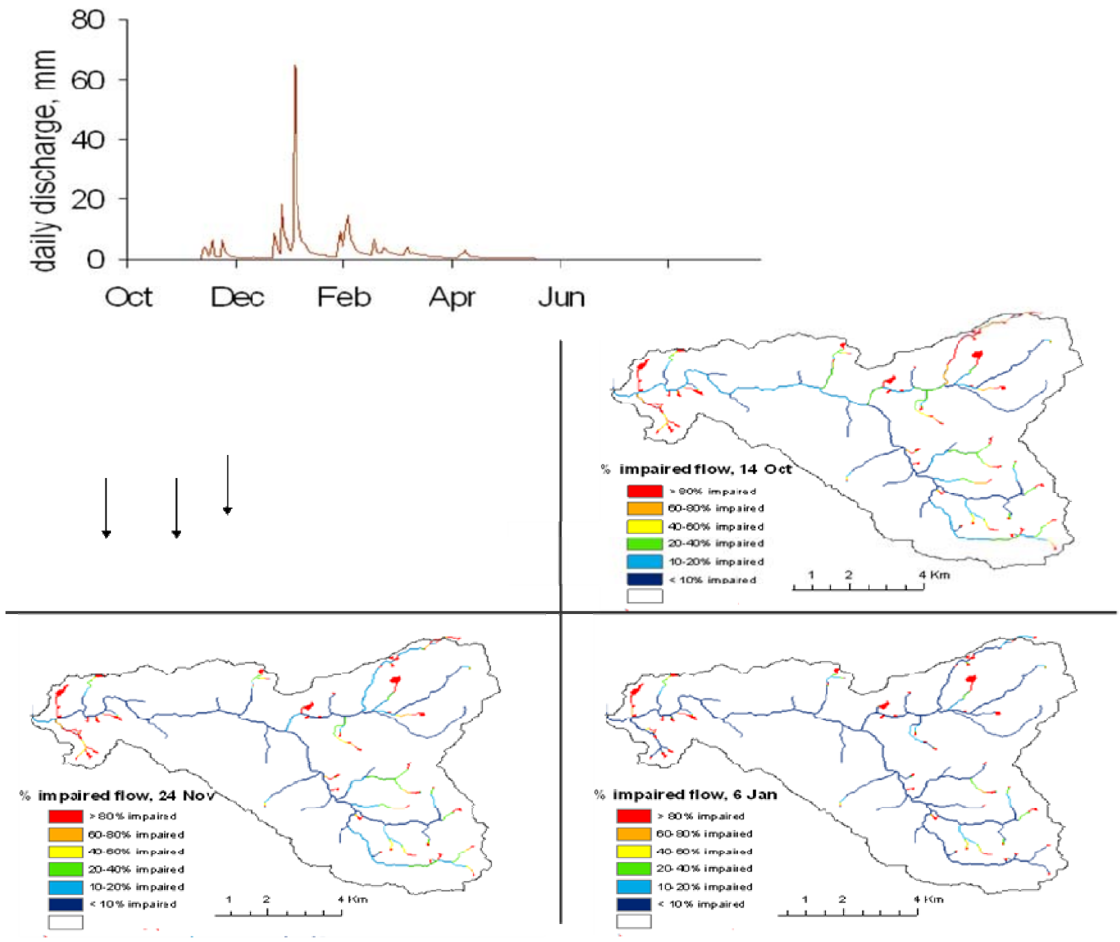


**Figure 9. Impacts on winter flows of reservoirs throughout the Franz Creek drainage network at three different intervals, relative to median-flow year 1965. The model can be replicated and expanded to apply to streams throughout the Russian River watershed.**

Providing additional storage of winter rainfall and runoff would greatly increase certainty for wine grape growers both by providing a more reliable water supply during the growing season for frost protection and irrigation and by establishing more secure water rights. Current debate has arisen over the need for an appropriative right to pump subsurface stream flows, which in California is generally referred to as "ground water" and therefore not regulated or monitored by the State or local government. Even the threat of declaring thousands of land owners who rely on wells adjacent to streams without appropriative rights out of compliance is unnerving to say the least. However, given the costs associated with environmental cumulative impact studies ($300,000 and up) required for an appropriative right and the extremely low likelihood of being granted an appropriative right by the State, many private sector interests are faced with an uncertain future when it comes to water availability. Establishment costs for vineyards are extremely high (40,000-75,000 acre) and this investment requires reliable water delivery especially in the early years of establishment and during frost periods.

In summary, the progress we have made to date, with help from the Salmon Coalition, has established a better framework for water allocation decision-making. This framework uses models that will quantify the tradeoffs for both the wine grape growers and salmonid recovery efforts between storing more water in the winter and pumping on demand year round to meet agricultural and residential water needs. These tools point to areas where potential solutions can be found for ecological and economic interests in the region, and help prevent future regional crises that can arise around salmon and other endangered species recovery programs.

## Acknowledgements

This research was funded in part by US EPA (STAR grant G4K10732), the University of California Water Center, and the Integrated Hardwood Range Management Program. Our colleagues at Berkeley have been instrumental in developing some of these ideas: G. Matt Kondolf, Vince Resh, Juliet Christian-Smith, David Newburn, and Ruth Langridge.

## Literature Cited

Aschmann, H. 1973. Distribution and peculiarity of Mediterranean ecosystems. In diCastri, F, and H.A. Mooney (eds). Mediterranean-Type Ecosystems: Origin and Structure. Springer-Verlag, New York, pp. 11-20.

Cestero 1999 Sonoran Institute published a very useful report titled "Beyond the Hundredth Meeting: A Field Guide to Collaborative Conservation on the West's Public Lands.

Woodward, and J.R.Romm. 2002. A Policy Assessment of the 2001 Klamath Reclamation Project Water Allocation Decisions. In press.