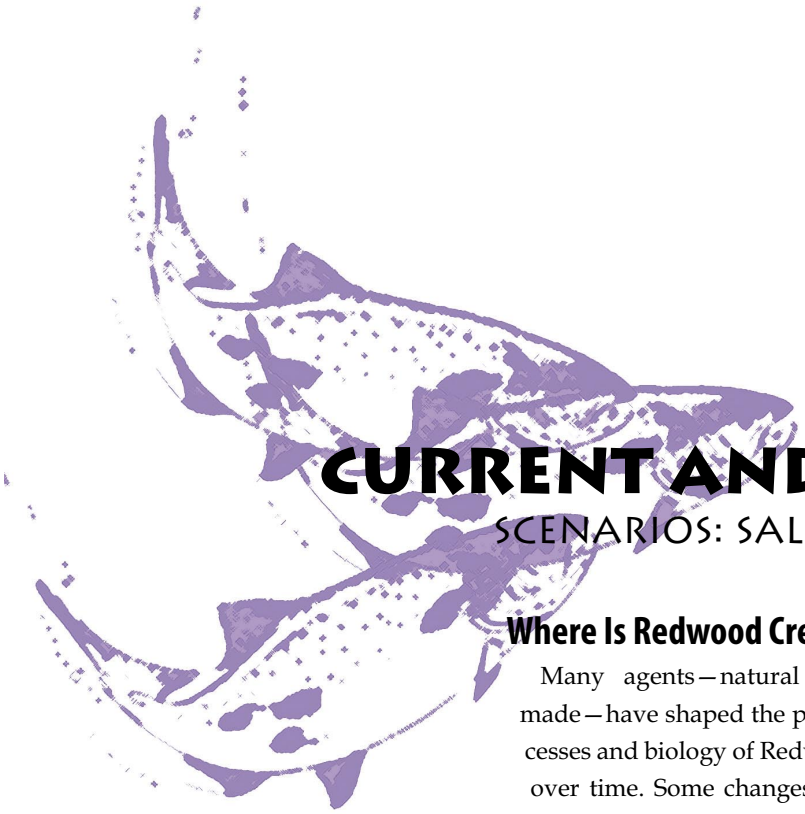


CURRENT AND FUTURE
SCENARIOS: SALMON IN REDWOOD CREEK

Where Is Redwood Creek Now?

Many agents—natural and man-made—have shaped the physical processes and biology of Redwood Creek over time. Some changes have been naturally occurring and uncontrollable; others have been influenced by controllable land uses. The biggest influences appear to have been major natural events. The changes in sediment conditions that Redwood Creek has experienced over the last 50 years are within the natural range of variability when compared with historical changes in channel morphology and sediment loading. Historical photographs of the shifting bedload leave little to imagination.

Linkages among the patterns of local annual rainfall, peak flows, sediment yield, and ocean salmon catch have been witnessed over time.

Over the decades, above-average rainfall has been associated with higher sediment yields and above-average salmon harvests. The relationship of these factors at Redwood Creek mirrors what has been found throughout the Pacific Northwest.[336,337]

Quantitative studies at Redwood Creek have found no lasting adverse effects on aquatic life as a result of measured increases in the levels of fine sediment. The number of juvenile salmonids present in Redwood Creek in the summer has not been correlated significantly with the volume of fine sediment in the streambed.[338] Furthermore, the later life stages of anadromous fish seem to show no discernible changes even though sediment levels affecting salmonid reproduction may vary.[339] These observed outcomes on aquatic life are not uncommon. At least two dozen field studies on the effects of sedimentation on salmonids throughout the Pacific Northwest have led experienced researchers to conclude:

"[a]lthough some studies indicate a localized reduction in emergence success or reduced biomass of rearing juveniles, with one exception, none of the studies demonstrated an overall reduction in seaward migrant anadromous salmonids because of sedimentation."[345]

Unfortunately, it is impossible to make definitive comparisons of the strength of today's salmon and steelhead populations with those of the past. The long-term records are incomplete, and a lack of documentation for adult salmon populations in the Pacific Northwest is, unfortunately, a common problem. However, it appears that the biggest obstacle to creating viable comparisons is the natural patterns of cyclical ecological change that are constantly occurring.

Some evidence suggests that the range of summertime juvenile salmon between 1945 to 1997—about one fish for every 1 to 5 feet of stream length—describes the range of natural variability, without a discernible trend.

From the few historical records available, we can conclude that the adult coho salmon runs of Redwood Creek have not changed since 1960. The adult chinook salmon population decreased from about 5,000 fish in 1960 to about 1,850 fish in 1979. Nothing can be concluded about the adult steelhead population, except that their abundance was estimated to be 10,000 fish in 1960.

Where Is Redwood Creek Going?

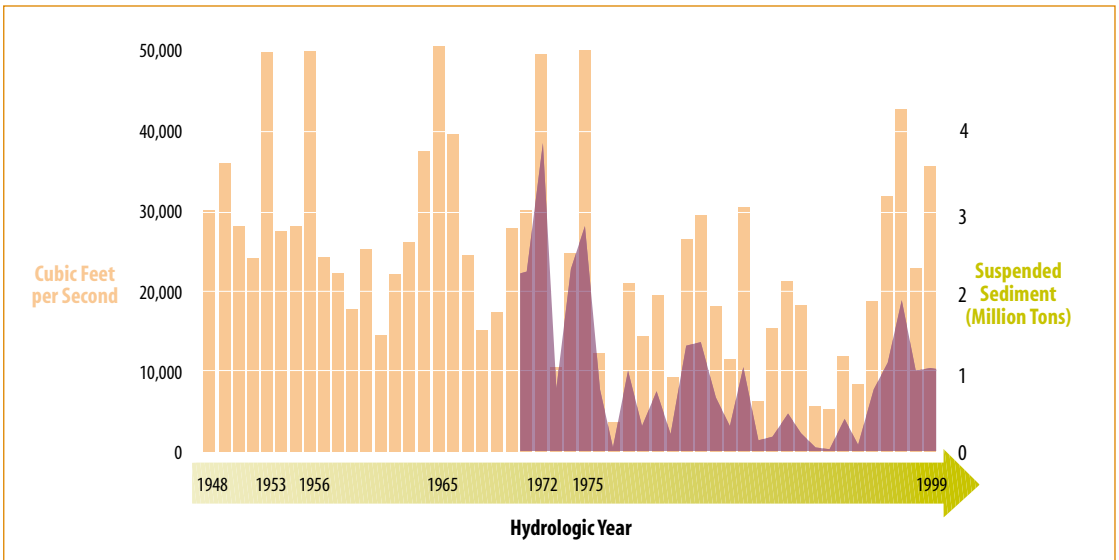
The essence of science is knowledge gained through observation—the greater the number of observations, the greater the accuracy in interpreting the observations. It is the process that incorporates all available information that provides the best resource stewardship.[340,341] The Redwood Creek story, beginning in the 1800s and continuing to the present, is perhaps more complete now than ever before, and the time is ripe for re-examination of salmonid ecology as it relates to the stream's habitats, sediment conditions, and compatible land uses.

We can expect the past patterns of change to continue into the future. Under a probable future scenario of fluctuating climate and ocean conditions, episodic natural disturbances, and regulated land uses, including forest practices, we should rethink the speculative conclusion that the salmonid productivity of Redwood Creek has been impaired by sediment in the past or that it will be in the future. There seems to be broad middle ground between what amount constitutes too much and too little sediment in salmonid habitats.

The data presented in this recapitulation indicates that man-made sediment is not adversely affecting salmon production in Redwood Creek. Regardless, it is possible to modify and enhance stream habitat through sound management practices.[342,343,344] Careful, improved erosion control of roads in the basin today has reduced the potential to contribute sediment to stream channels.

Perhaps a more holistic view of the role of sediment in stream ecosystems is necessary.[345] For better or worse, sediment loading and transport are constantly changing states of the stream. Healthy aquatic habitat depends on it.[346,347,348] If sediments were not being replenished to replace sediment transported out of the stream, there would eventually be no suitable spawning gravels.[349] Consequently, geomorphic changes, including rare dramatic events, must be recognized as inherently characteristic and should not necessarily be viewed as negative forces.[350,351]

Also, it is impossible to choose a spe-



Suspended sediment increases when peak flows occur.

Source: R. Klein. 1999. Redwood National Park.

cific sediment condition from any one time in the past and attempt to achieve that condition now or in the future. In the words of prominent scientists *"All ecosystems have flows of things—organisms, energy, water, air, nutrients—moving among them. And all ecosystems change over space and time. Therefore, it is not possible to draw a line around an ecosystem and mandate that it stay the same or stay in place for all time."*[352]

Our understanding of Redwood Creek's natural history has increased through observation and study, and investments in our understanding are continuing. For example, the *Redwood Creek Downstream Salmonid Migration Study*, undertaken by the Redwood Creek Landowner's Association, is underway and is already yielding valuable insights.[353] The study is a vehicle for addressing uncertainties and finding answers to questions about the presence, relative numbers, migration timing, and health of anadromous salmonids in the upper Redwood Creek basin.

If the identified salmonid population patterns continue, the low ocean survival rates of the early 1990s may represent a natural low point. Fortunately, rainfall patterns since 1994 resemble those associated with past periods of high salmon abundance.[354] Also, coastal upwelling along northern California in 1999 is among the highest in more than 50 years.[355] As a result, smolts that enjoy such favorable early-life growing conditions may produce higher adult salmon abundance over the next few years.[356]

Consequently, land management policies for Redwood Creek must take into consideration the cyclical agents of change when addressing issues related to salmon and trout populations and freshwater aquatic habitats. Managing ecosystems means working with the processes that cause them to vary and to change. And the regulatory climate must take into consideration natural histories and ecological potentials. Only with realistic expectations for sediment loading capacities and water quality can compatible land management activities be implemented with appropriate flexibility.

In nature, cyclical patterns of change are inevitable. With continued well-reasoned land management and the salmon's innate ability to adapt to a changing environment, we will continue to enjoy the benefits of wild salmon populations in Redwood Creek for generations to come.

Little Lost Man Creek is captured in a moment of time.

Photo courtesy of Barnum Timber Company