Changes in Channel Roughness Following Large Sediment Inputs

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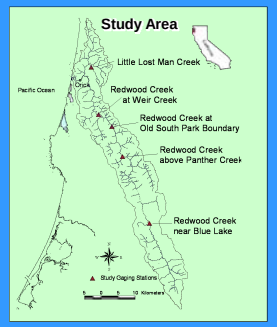
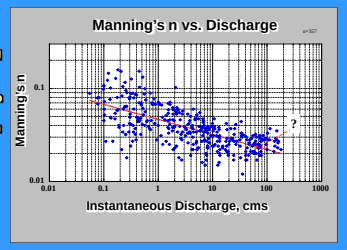
ABSTRACT

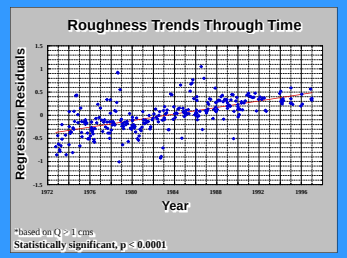
Large inputs of coarse sediment entering a river can change the flow resistance characteristics of the channel. Trends in channel roughness values at five gauging stations were examined for a 20-year period of record, using measurements of velocity and channel geometry. At four stations, the river had aggraded one to two meters during floods in the 1970's, and the streambed was relatively smooth. Since the mid-1970's the channel has downcut through the flood deposits, bed topography has become more variable, and bed relief has increased. Concomitantly, the value of Manning's roughness coefficient ('n') has significantly increased through time at these stations, after adjusting for discharge. During the same period, there was no statistically significant increase in channel roughness in the control stream, Little Lost Man Creek, which did not aggrade.

The control stream exhibited the typical pattern in gravel-bed rivers of decreasing flow resistance with increasing discharge. In contrast, however, the other four stations with high sediment supplies displayed a pattern of decreasing flow resistance with discharge only at low to moderate flows. At flows greater than a 1.1 year recurrence interval, values of Manning's n increase with increasing discharge. This may be due to high bedload transport rates and scour of the stream bed at higher flows, which leads to greater bed relief and turbulence, and consequently greater flow resistance.

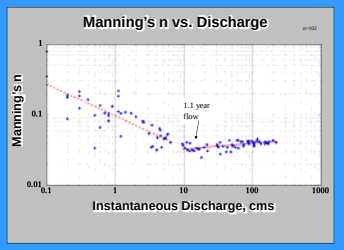


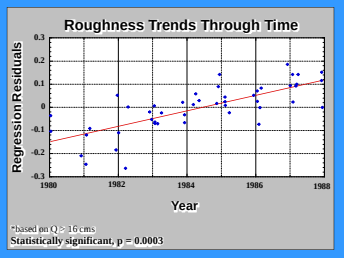
Redwood Creek near Blue Lake



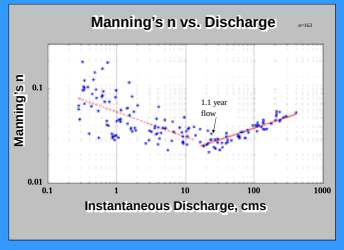


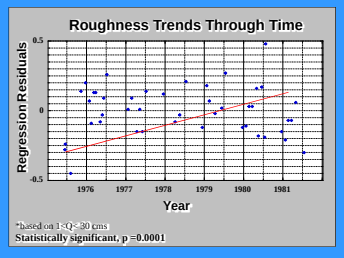
Redwood Creek above Panther Creek



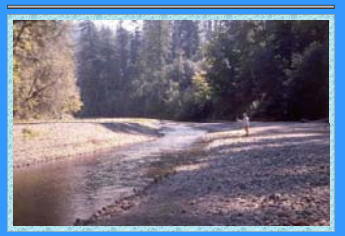


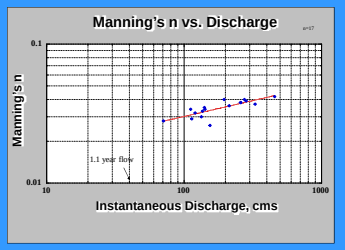
Redwood Creek at South Park Boundary

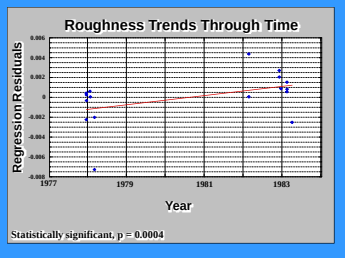




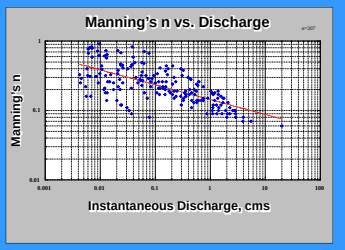
Redwood Creek at Weir Creek

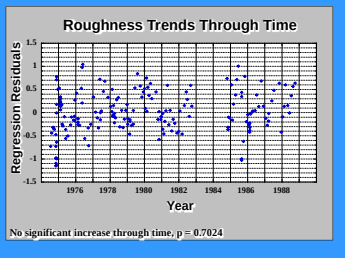






Little Lost Man Creek - Control Stream





COMPONENTS OF FLOW RESISTANCE

*Form Roughness: Bed relief increased through time and with discharge at most stations.

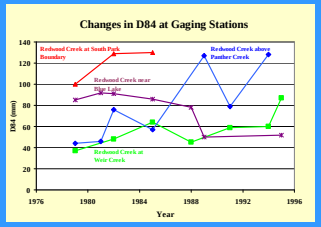
* Grain Roughness: The dominant particle size, D84, increased at some stations. Also, bedload transport rates decreased (see CD-rom).

--Vegetation: Riparian vegetation did not increase significantly at most stations, and width/depth ratios were > 20.

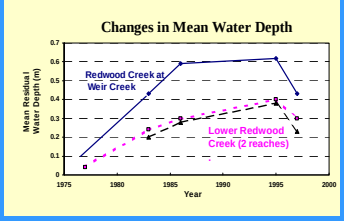
--Channel irregularities: All stations were located in straight reaches, with no bends.

--Overbank flow: No floodplains present at stations.

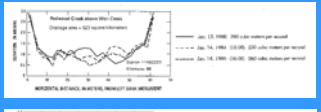
--Changes in channel gradient: Surveys of low flow channel bed showed no significant changes through time.

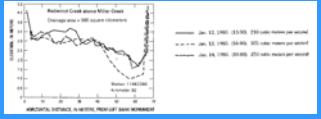


--D84 (determined by pebble counts) increased at three stations. Relative roughness (bankfull depth/D84) ranged from 25 to 70.



--Following a large flood and associated landsliding in 1975, water depths and bed relief were low, but increased through time. Additional landslides in 1997 caused depths to decrease (Madej, 1999).





Bed topography was measured by depth soundings at high flow. Considerable scour and fill occur during high flows, resulting in greater bed relief. However, the channel bed returned to its approximate pre-flood topography on the falling limb.

SUMMARY

Following large sediment inputs from a flood in 1975, the Redwood Creek channel was relatively flat and smooth. Channel roughness increased significantly through time at several gauging stations in Redwood Creek during the same period as mean water depth and bed relief were increasing. Bed particle size also increased somewhat, but the development of bed topography probably plays an important role in the observed increase in flow resistance in the channel.

At several stations, Manning's n increased with increasing discharge at flows greater than a 1.1 year recurrence interval.

Graphics and poster prepared by Brian Barr