NATIONAL FOREST MANAGEMENT AND WATER YIELD IN THE SIERRA NEVADA

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CALIFORNIA'S NATIONAL FORESTS

- 18 National Forest units in the Pacific Southwest Region
- 21 million acres
- Headwaters of most major rivers
- About 50% of the runoff in the state

How do forests affect water yield in the Sierra Nevada?

- Transpiration
- Interception and snow accumulation
- Infiltration

TRANSPIRATION

(data from Rector and MacDonald, 1987)

- 73 million ac-ft/yr for all National Forest System lands in California
- Forest transpiration may increase rainfall downwind (Ellison and others, 2011)

INTERCEPTION AND SNOW ACCUMULATION

- Canopy interception losses in Coast Range forests are about 25% of total rainfall.
- Sublimation of intercepted snow can be 20 to 30% of total snowfall.
- Forest openings can increase snow accumulation but also increase snowmelt rates.

INFILTRATION

- Forest soils generally have much higher infiltration rates than agricultural fields and pastures
- Forest infiltration rates in the Sierra Nevada are generally higher than common rainfall intensities, therefore overland flow is limited
- Mechanical removal of vegetation tends to compact soils and reduce infiltration and increase runoff

EXPECTED EFFECTS OF FOREST THINNING:

- Reduced transpiration
- Reduced interception loss
- Increased snow accumulation
- Reduced infiltration (but not below common rainfall intensities)
- Increased soil moisture
- Increased streamflow or change in regimen
- Quantification is difficult with current information

REGIONAL ESTIMATES FROM PREVIOUS STUDIES

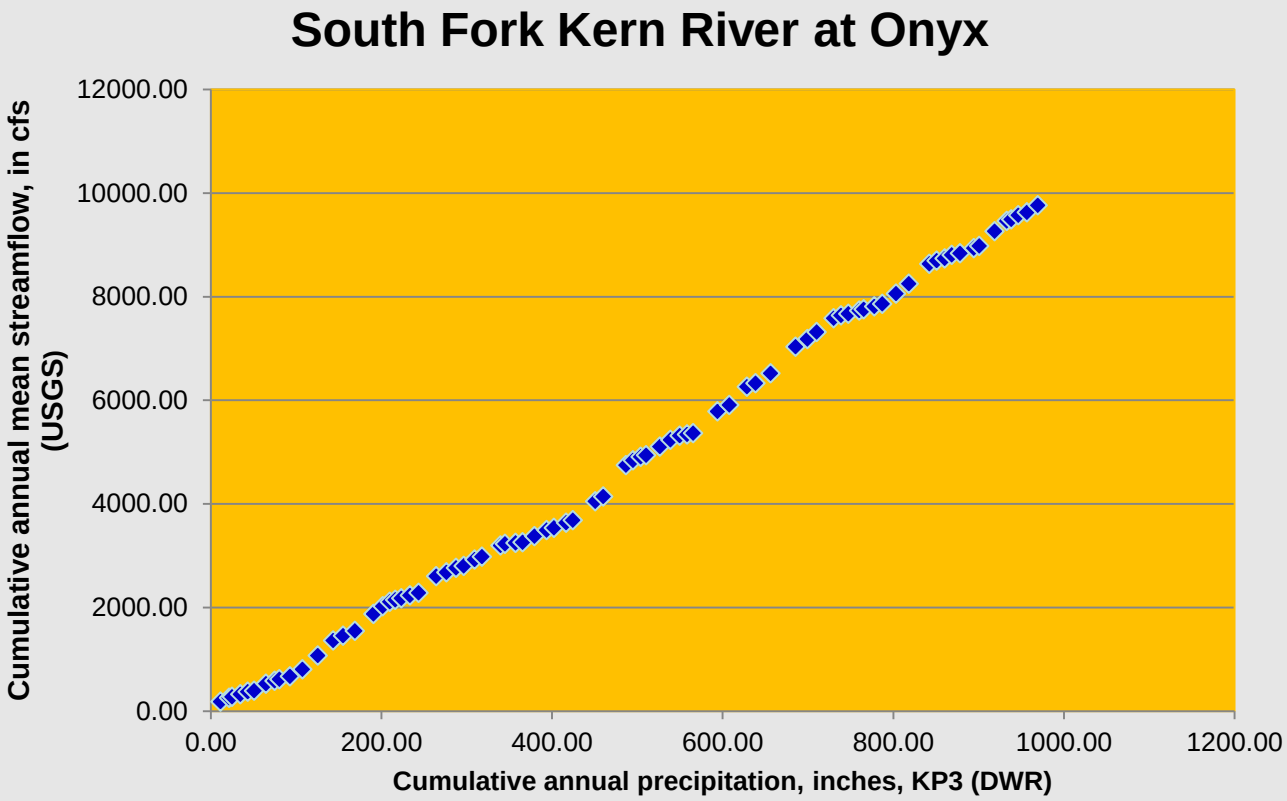
(data from Rector and MacDonald, 1987; Ziemer, 1987)

- **Maximum increase in water yield that could be realized through removal of vegetation estimated at 1.1 MAF/year.**
- **More realistic estimate is 0.35 MAF/year.**
- **Some of the increase would occur in winter and spring.**
- **Based on stand densities and ET rates in the 1980's.**

EXAMPLE: TROENDLE AND OTHERS, 2007, Northern Sierra Nevada

- 12 acres of thinning, 20% basal area reduction → 1 ac-ft/yr of water.
- Repeated every 15 years for continued effect.
- Effects may not be measurable (<5 to 10%).

ANOTHER EXAMPLE: STREAMFLOW TRENDS IN THE SOUTHERN SIERRA NEVADA, 1922 to present



POSTFIRE RUNOFF AND EROSION

- **Hillslope runoff increased 2 to 1,200 X above pre-fire flows**
- **Short-term increases in groundwater discharge and base flow**
- **Hillslope erosion increased up to 5 orders of magnitude above pre-fire rates**

REDUCING FIRE RISK ON NATIONAL FORESTS--THE FUELS CHALLENGE

- 400,000 acres/yr lost to wildfire
- USFS treats fuels on 200,000 ac/yr
- About 45% of NFS lands are high priorities for treatment
- Treatments need to be repeated every 20 yrs
- Need to treat at least 450,000 ac/yr to break even

CAN FUELS TREATMENTS IMPROVE WATER YIELD?

- 450,000 ac/yr (USFS goal)/12 acres per ac-ft = 37,500 ac-ft/yr based on Troendle and others, 2007
- About 1/10 of Rector and MacDonald estimate of likely increase from vegetation management
- As stand densities increase, effects of treatments on water yield are likely to increase

MEADOW RESTORATION: mitigation for lost snowpack storage in headwaters?

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PREVIOUS STUDIES AND RECENT MONITORING RESULTS:

- Restored meadows support higher flows in early to mid-summer than eroded meadows in most cases.
- Restored meadows support longer duration of flows in summer than eroded meadows.
- Restoration effects on late summer flows have been minimal.
- Meadow restoration may reduce winter and spring flood peaks.

SUMMARY

- National Forests are critically important for California's water resources, and their importance is likely to increase owing to climate change.
- Limited improvements in water delivery from forests are possible through forest and meadow management—more information is needed.
- Significant adverse impacts to water resources on forests can be expected if wildfire risk is not reduced.
- The Forest Service is working with stakeholders, tribes, researchers, and regulatory agencies to improve water quantity and quality on National Forests in California.


Thank you
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