Western Juniper's Growing Influence in Eastern Oregon

Estimated Acreage	1936	1988	2004
> 10 percent cover	420,000	2.2 million	
Total area with juniper		6 million	9 million (Azuma, 2004)

Volume of current stand -------- 467 million cubic feet

Private landowners own 58 percent of the area and 49 percent of the volume

BLM is the principle owner of public lands with juniper – 79 percent of publicly owned juniper forest

Over ½ of the present juniper forest became established between 1850 and 1900 (greatest increase came between (1879 and 1918).

Rate of Establishment

1650 – 1800	2900 acres/year
1800 – 1850	8200 acres/year
1850 – 1900	23,100 acres/year
1900 – 1940	6000 acres/year

52 percent of juniper grows in the 10 – 15 inch precipitation zone

41 percent of juniper grows between 4000 – 5000 ft. in elevation

Juniper transpires water year round compared to seasonal transpiration of other vegetation

Juniper roots can extend several times the crown diameter

Almost 50 percent of juniper forests have crown covers 10-20 percent

Juniper crown intercepts up to ½ of the annual precipitation

Juniper woodlands have 1 magnitude of order greater erosion rates compared to sagebrush – grass ecotypes (Buckhouse et. al.)

Average cubic volume of wood per acre in juniper forests is 200 cubic feet

Over half the area of juniper forests have fewer than 50 large trees per acre

Information from:

Gedney, D.R. et.al. (1999). Western Juniper in Eastern Oregon. USDA Forest Service. Pacific Northwest Research Station. General Technical Report, PNW-GTR-464, November 1999.

Buckhouse, J. et al. (1982). Potential Sediment Production within Vegetative Communities in Oregon's Blue Mountains. Journal of Soil and Water Conservation. Vol. 37, Number 2. Pgs. 120 – 122.

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Water use by Western Juniper:

The Camp Creek Paired Watershed Study was initiated back in 1993. It is still an active research sight and Dr. Carlos Ochoa is leading that effort. It is hard to believe that it has been almost 30 years.

Here are some water use (water impact) numbers that are the result of this project and others. The original water use research was started by Dr. Rick Miller (OSU Rangeland Professor) and Dr. Lee Eddleman (OSU Rangeland Professor) from the 1980's and early 1990's. Our work, the Paired Watershed, just took their work on individual tree use and water interception and put it on a landscape level.

Assumptions:

Dr. Rick Miller, retired Juniper researcher: **Individual tree use:** 12" dbh (diameter at breast height) can use up to **26 gallons of water per day** if soil moisture is available. Dr. Carlos Ochoa (OSU Rangeland Watershed researcher) measured water use in 17" juniper averaged 25 – 40 gallons per day (dry and wet years).

Dr. Lee Eddleman, retired juniper researcher statement: **Juniper tree water use: 9 - 13 large trees (greater than 12" dbh) can use all the water delivered in a 13" precip zone. 13" of annual precipitation is equal to 353,002 gallons per acre.**

From Dr. Eddleman's work: **Juniper tree interception** alone accounts for an equal percent loss per percent of crown cover (what precipitation the tree canopy captures and holds until it evaporates back into the atmosphere without touching the soil surface). Therefore a 20 percent canopy cover of juniper per acre results in a direct loss of 20 percent of the annual precipitation. **So in a 13" precip zone, canopy loss alone is equal to 2.6 inches of annual precipitation. That's 70,600 gallons per acre.**

From Dr. Rick Miller's work: Large juniper tree (>12" dbh) water use can be as high as 26 gallons per day if the soil moisture is available. Let's assume this water use model per tree for the year (my model):

26 gallons/day for 120 days = 3120 gallons
15 gallons/day for 100 days = 1500 gallons
5 gallons/day for 50 days = 250 gallons
0 gallons/day for 95 days = 0 gallons

total gallons = 4960 gallons per tree per year

Dr. Ochoa measured annual water use of large trees @ 4815 gallons per year. Juniper saplings (5 ft tall) evaluated used 70.7 gallons per tree per year.

Average tree density per acre = 13 (a conservative number of trees per acre)
Water consumption = 13 x 4960 = **64,480 gallons per acre per year** (doesn't include tree canopy interception and evaporation). Juniper sapling density of 250 trees/ac = **17,500 gallons per acre/year**.

From 1936 to 1999, Juniper acres in Crook County alone increased by 627,000 acres. 600,000 ac. x **80,000 gallon/acre (water consumption and interception)** (**important to see note below by Dr. Ochoa on small tree water use**) = 48,000,000,000 gallons per year

48,000,000,000 = 147,692 ac ft of water annually. (325,851 gallons = 1 ac.ft)

Since 1936, juniper acreage increase

County	Acres increased since 1936	Annual water equivalent
Crook County	627,000	145,000 ac ft
Deschutes County	28,000	6,500 ac ft
Jefferson County	441,000	102,000 ac ft
Wheeler County	459,000	106,000 ac ft
Lake County	625,000	144,000 ac ft
Klamath County	172,000	40,000 ac ft
Harney County	1,023,000	237,906 ac ft

Bowman Dam/Prineville reservoir capacity = 150,000 ac. ft.

1 cfs = 2 ac ft of storage
For the Crooked River,
145,000 ac ft / 2 = 72,500 cfs
72,500 cfs/365 days = 198 cfs/day year-round, a little more than twice the flow agreed to in the HCP for the Crooked River every day of the year. ☺

And these water calculations for the basin would be even higher if we accounted for our over dense national forest of pine and fir.

Here is the table those calculations come from so just removing what was established after 1936 still leaves lots of acres of juniper:

Estimated Juniper Acres by County

County		Total Acres		1936[a]		1999		Percent Increase
Crook		1,964		509		1,136		223
Deschutes		1,932		329		357		108
Jefferson		1,140		63		504		800
Klamath		3,804		106		278		262
Lake		5,207		222		847		381
Harney		6,486		189		1,212		641
Wheeler		1,097		50		509		1010
Grant		2,898		41		837		2041
Baker		1,964		20		418		2090

[a] Estimates of juniper based on 1936 vegetation map from Oregon Department of Forestry
Source: The Western Juniper Resource of Eastern Oregon, PNW-RB249, 2005

From Carlos Ochoa, Professor, Oregon State University who is now leading the research at the Camp Creek Paired Watershed:

Some clarifications, mostly derived from the conversions to acres from hectares:

The total gal/tree/year is 4815 for trees with an average diameter of 17.5 inches at sensor height, which is very close to dbh. This number is close to your calculations of 4960 gallons per tree per year. One thing you are not considering and that we can add from the study is the ***water uptake by saplings*** *(An average of ~ 5 ft tall, 1 inch diameter); our estimates indicate that there are 259 tree/acre at Mays WS and 255 tree/acre at Jensen WS. At Jensen WS, saplings account for 79% of the total number of trees (this, in my opinion, is the most significant issue as we move forward with the next phase of the study). Adult trees defined in our study as those with canopy cover > 5ft are 68 tree/acre (21%) at Jensen WS. Of course, this number (68 trees/acre) cannot be used along with the 4815 gallons per tree per year because the water uptake estimate was only based on larger trees. I hope this helps, please let me know if you have any questions. O****n average, the; that is about 18000 gallons per acre (~255 trees/acre)***

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