

# Final Project Report

## Scaling Juniper Markets:

*Sustainable Solutions for Rangelands and Rural Communities*

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## Outline

- Background
- Material sources
- Executive Summary
- Recommendations
- Discussion



## Background - Dramatic Expansion of Juniper Woodlands

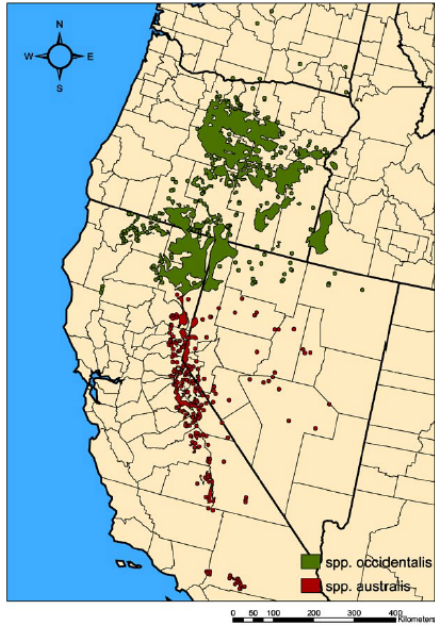
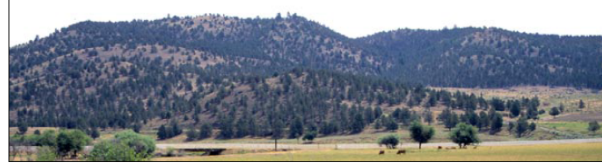


Photo taken near Prineville, Oregon circa 1890



Same location in 1989

In Oregon:  
1930 – 1.5 million acres  
2005 – 6.5 million acres

A screenshot of the Western Juniper website. The header includes the logo "WESTERN JUNIPER" and navigation links: PHOTOS, ABOUT, FIND/BUY, THE WJA, NEWS, GRADING RULES, CONTACT. The main content area is titled "WESTERN JUNIPER IN ACTION" and "THE HARDWORKING WOOD WITH OREGON VALUES". Below this, a paragraph states: "Western Juniper is the perfect outdoor wood for gardens, vineyards, orchards and farms. Its rustic beauty also appeals to architects, interior designers and fine furniture makers." The page features a grid of 12 images showcasing various uses of Western Juniper, including outdoor decks, pergolas, raised garden beds, dining tables, planters, and interior furniture.

Phase 1 – develop & publish design values (for solid wood)



Western Juniper

Western Juniper							
Grade	Extreme fiber in bending		Tension parallel to grain	Comp. parallel to grain	Comp. Perpen. to grain	Horiz. shear	Modulus of elasticity
	Fb (psi)		Ft (psi)	Fc (psi)	Fc <sup>⊥</sup> (psi)	Fv (psi)	E (psi)
	2" nom.	4" nom.					
<b>BASE VALUES</b>							
Select Structural	925		525	225	770	125	600,000
No. 1	800		425	200	770	125	600,000
No. 2	650		350	175	770	125	500,000
No. 3	375		200	100	770	125	500,000
Construction	750		400	200	770	125	500,000
Standard	425		225	175	770	125	500,000
Utility	200		100	100	770	125	400,000
Stud	500		275	100	770	125	500,000
<b>2x4 Size Adjusted Values</b>							
Select Structural	1,390	1,390	790	260	770	125	600,000
No. 1	1,200	1,200	640	230	770	125	600,000
No. 2	975	975	525	200	770	125	500,000
No. 3	565	565	300	115	770	125	500,000
Construction	750	750	400	200	770	125	500,000
Standard	425	425	225	175	770	125	500,000
Utility	200	200	100	100	770	125	400,000
Stud	550	550	305	105	770	125	500,000
<b>2x6 Size Adjusted Values</b>							
Select Structural	1,205	1,205	685	250	770	125	600,000
No. 1	1,040	1,040	555	220	770	125	600,000



Phase 2 – what to do with all the residues?





## Material sources



Explored in this project	Residue	Description	Current Market(s)
Yes	Slabs	From outer diameter of tree, predominantly sapwood with bark	Firewood
Yes	Edgings	Generated as boards with rough edges are trimmed to width; heartwood and sapwood, some bark	Often burned as fuel at sawmills
Yes	Peeler shavings – with bark	Sapwood, bark	Garden mulch
Yes	Peeler shavings – without bark	Produced by pole peeler, primarily sapwood	Can be sold to particleboard mills
Yes	Sawdust	Includes sapwood, heartwood, and some bark <i>Note: geometry of particles varies with the type of saw used</i>	None
No	Planer shavings	Sapwood, heartwood	Very limited production (from sec. mfrs. using juniper)
No	Limbs	Generally left in the forest when the trees are harvested	Firewood
Not directly	Foliage	Generally left in the forest when the trees are harvested	Essential oil

## Executive Summary

### Particleboard

Phase	Species & materials	Properties tested
1 'Pilot'	DF; juniper sawdust: bandsaw, circular saw (w/ & w/o bark), heartwood, sapwood	Particle size Density, MC, TS, WA
2 'Refining the recipe'	Same as 1 Differing levels of wax (0, 0.5, 1%) Particle screening (to mimic DF panels)	Density, TS, WA
3 'Blends'	DF, ponderosa pine Blended w/juniper (5,10,20%) sawdust (bandsaw, edger, circular saw)	Density, TS, WA, LE
4 'Mech. Props.' 3-layer panels	DF, juniper	Density, TS, WA, MOR/MOE, IB

- Juniper sawdust particles can be used to produce particleboard, mixed-species or 100% juniper panel
  - Juniper sapwood and edger dust: TS > than DF panels
  - Bandsaw & circular saw sawdust (mostly heartwood) - comparable moisture behavior to DF panels
  - Blends - no difference in thickness swell compared to control panels (i.e., 100% fir and pine panels) after 24-hour water soak
  - Acceptable to include small fractions of bark



## Executive Summary

### Strandboard

Phase	Species & materials	Properties tested
1 'vs. aspen'	Aspen; mixed juniper heart/sap	Density, IB, TS, WA, LE
2 'vs. pine'	SYP, juniper - sap, heart, mixed (w/o bark), mixed (w/bark)	Density (inc. x-ray profile), TS, WA, MOR/MOE, IB, screw withdrawal (face & edge)
3 'Durability'	SYP, juniper – sap, heart, mixed; Juniper sap: 1) panels from strands impregnated w/juniper leaf oil (pre-press) 2) panels impregnated post-press	Resistance to fungi (2 brown rot, 1 white rot)

Strands produced from juniper slabs & edgings using veneer slicer



- Heartwood & sapwood strands can be used to produce panels even w/approx. 10% bark
- Panel properties - equivalent or slightly better than SYP panels w/one exception –
  - bending stiffness higher for high-density SYP than all-heartwood juniper panels
- Durability – heartwood strandboard highly decay resistant
  - Decay resistance - impregnating sapwood (strands or finished panels) led to increased decay resistance to one of the two brown rot fungi tested but not other brown rot fungus or a white rot fungus.
  - IB strength - impregnating strands prior to pressing resulted in panels with reduced internal bond strength compared to panels impregnated after pressing; bond strength for all juniper panels (w/ & w/o essential oil) exceeded SYP panels



Strandboard:  
Heartwood only



Cross-section strands (surface); regular strands (core)



Strandboard:  
mixed heart/sap



## Recommendations

- Small residues (sawdust, shavings)
  - collect and segregate residues by process (e.g., primary breakdown saw vs. edger)
- Larger residues (slabs, edgings)
  - entrepreneurial venture needed to acquire materials, produce strands, and produce decorative panels from strands
- Future work
  - Test insect-resistance of panels (e.g., as closet liner)
  - Explore economic feasibility and supply:
    - Assess haul distance and value of alternative uses
    - Develop detailed estimates of potential supply of material by region



## Outputs

- Outreach
  - Two web-based meetings: 3/18/2020; 5/19/2021
  - Page on Oregon Wood Innovation Center website ([owic.oregonstate.edu/western-juniper-composites](http://owic.oregonstate.edu/western-juniper-composites))
- Conference Presentations
  - Society of Wood Science & Technology – [Utilization of western juniper residues for strandboard manufacturing](#) (July 2020)
  - 10<sup>th</sup> European Conference on Wood Modification – [Impregnation of strands with juniper essential oil for strandboard manufacturing](#) (postponed until Feb. 2022)
- Publications
  - [Properties of western juniper \(\*Juniperus occidentalis\*\) strandboard](#). 2021. *BioResources* 16(2): 2853-2860
  - [Utilization of western juniper \(\*Juniperus occidentalis\*\) in strandboard to improve decay resistance](#). 2021. *BioResources* (in-press)

Open Discussion