Dieback and mortality of ponderosa pine along Highway 20 associated with herbicide applications near Sisters, Oregon –

Spring 2018 Update

Brent Oblinger

Plant Pathologist, USDA Forest Service, Forest Health Protection, Central OR Forest Insect & Disease Service Area

Since compiling a report in June of 2015 on mortality and dieback of ponderosa pine associated with herbicide applications along Highway 20 northwest of the town of Sisters, the severity of damage along the Highway has increased substantially. Large- and small-diameter trees have been affected. The damage confined to the right-of-way along the road still appears associated with herbicide applications (Perspective® containing aminocyclopyrachlor in particular). This report provides an update on the condition of trees (nearly all ponderosa pine) adjacent to the Highway as of spring 2018 within the proposed Highway 20 Corridor Public Safety Project to mitigate danger trees along the highway.

Several photo points were re-created in early-May of 2018 where photos were taken in 2015 approximately three years previously. Both the number of trees with dieback and the number of dead ponderosa pines have increased in the last three years (Figures 1-2) and damage continued to be concentrated along the Highway.

Figure 1a. Crown dieback and mortality in ponderosa pine along Highway 20 - taken southeast of the intersection between Highway 20 and the Tollgate Rd on April 28, 2015 (Oregon Department of Agriculture). Arrow for reference in Figure 1b.

Figure 1b. Increased damage in ponderosa pine along Highway 20 three years later– taken at the same location as the photo in Figure 1a on May 3, 2018. Arrow for reference in Figure 1a.

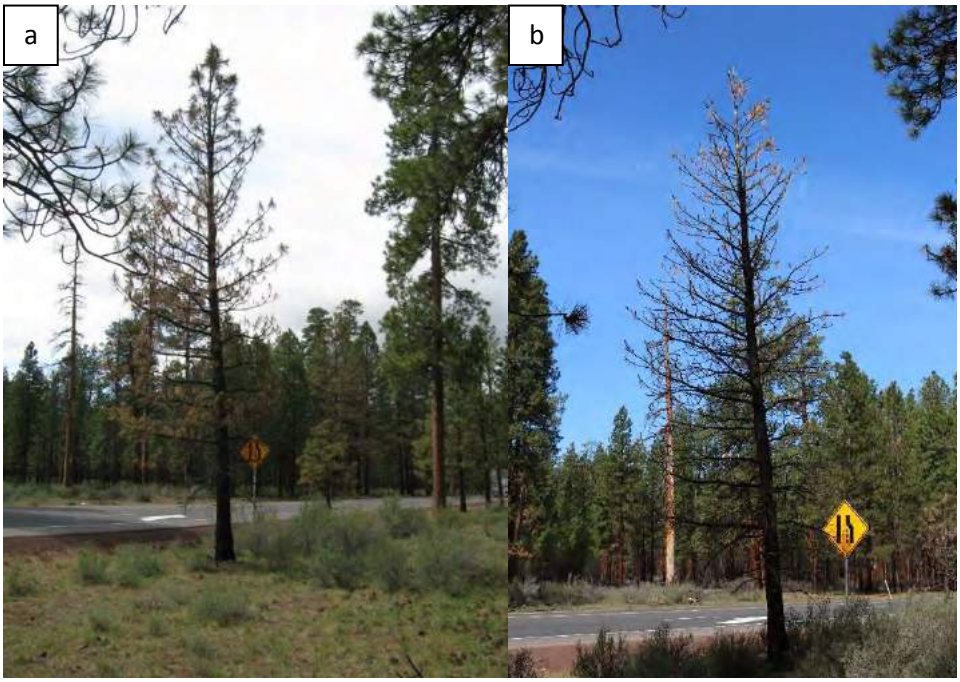
Figure 2a. Crown dieback and mortality in ponderosa pine along Highway 20 - taken near the same photos in Figures 1a-b on April 28, 2015 (photo: Oregon Department of Agriculture).

Figure 2b. Increased damage in ponderosa pine along Highway 20 three years later– taken at the same location as the photo in Figure 2a on May 3, 2018. These photos were taken near those shown in Figures 1a-b.

The mature, live tree in 2015 on the left-hand side of Figures 1a-b (left of the roadside refelector) is now dead in 2018 (left of roadside reflector) in Figures 2a-b, along with others that were still living in 2015 in these figures.

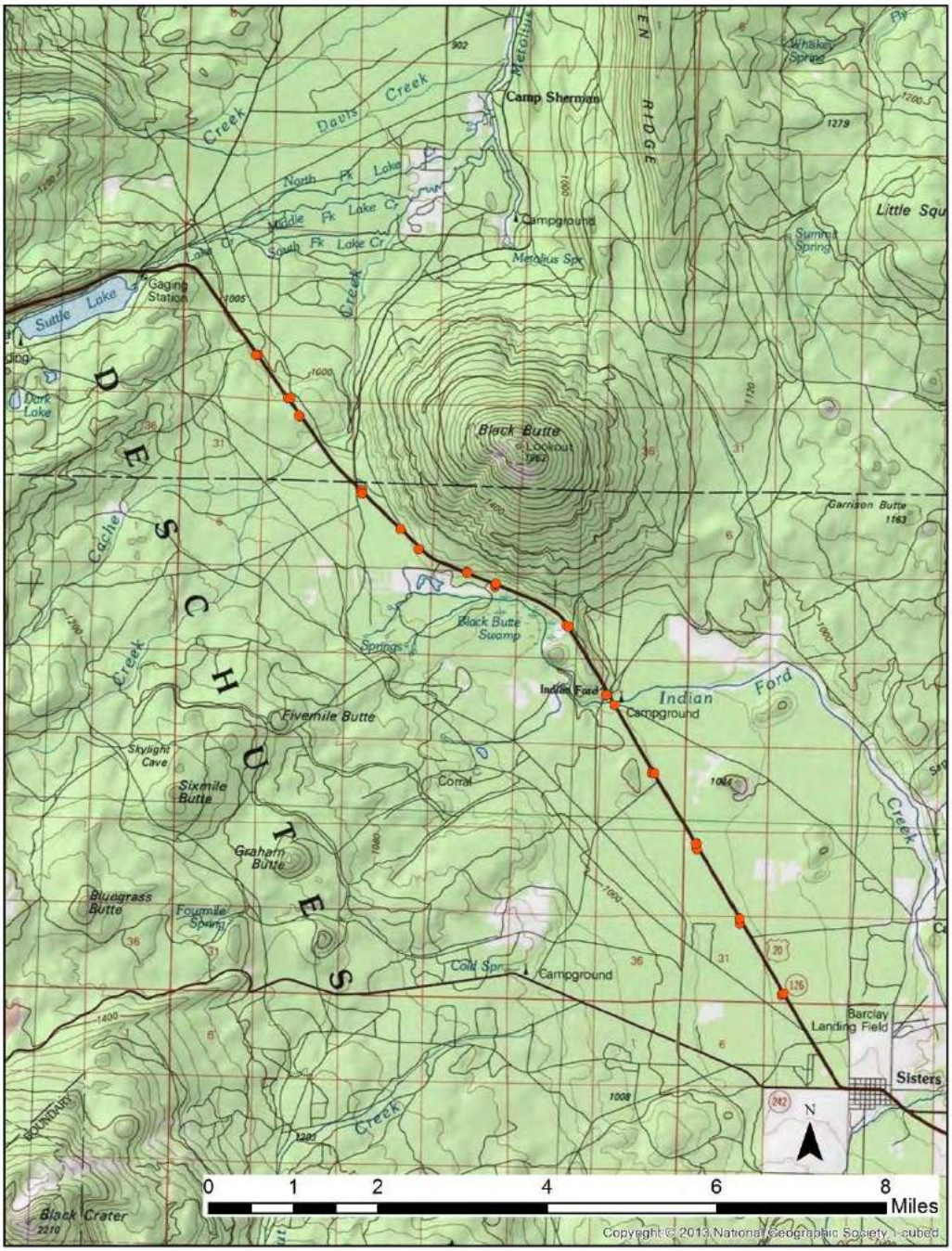
Trees with moderate to severe crown symptoms (no live foliage, chlorosis and killed stems of shoots and meristems) did not appear to recover along the highway and the number of symptomatic trees appeared to increase overall based on field observations (Figures 3a-b).

Figure 3. Live ponderosa pines along Highway 20 with severe crown dieback associated with herbicide injury in 2015 near the intersection of Highway 20 and forest road 500 in April 2015 (a) & (b) the same tree now dead in May 2018. Note the smaller pine to the right of the road sign in both a-b that died as well.



To confirm diagnostic symptoms of herbicide injury in the crowns of trees still living in 2018 along Highway 20, branch samples were collected from symptomatic and asymptomatic ponderosa pines by Forest Health Protection staff. At approximately every mile in the proposed Highway 20 Corridor Public Safety Project area northwest of Sisters, a live tree with crown symptoms (e.g., abnormal swelling in stems of shoots, killed meristems in shoots, chlorotic foliage) was arbitrarily selected along the highway and the nearest live tree without crown symptoms was selected for sample collection (Figure 4). A total of 46 trees were sampled and the spatial coordinates of all trees were recorded via GPS unit (Appendix A). Diameter at breast height (DBH; 4.5 ft) was measured on all trees and photos were taken of all trees sampled in the field on May 9, 2018 (Appendix B). For symptomatic trees, the percentage of the crown with symptoms of herbicide injury was visually determined to the nearest 5%. One symptomatic or asymptomatic lateral branch was collected within reach via pole pruners from each symptomatic or asymptomatic tree on May 3-4, 2018. Branch samples containing shoots were brought back to the lab for examination and photos were taken of samples (Appendix B).

Figure 4. Locations (orange points) of trees sampled on May 3-4, 2018 to examine branches for the presence of symptoms of herbicide injury in live ponderosa pine along Highway 20.



Stems of shoots were dissected in branches and the meristematic tissue in shoots was examined for healthy-appearing tissue. Branches collected from all live trees with crown symptoms had evidence of diagnostic symptoms of herbicide injury while branches from all live trees without crown symptoms had no evidence of herbicide injury. For example, Figure 5 shows a live tree with crown symptoms and Figure 7 shows a live tree without crown symptoms, and their branches examined.

Figure 5. Live ponderosa pine (E99S in Appendices A-B) with crown symptoms associated with herbicide injury (abnormal swellings in stems of shoots, killed shoots, chlorosis) along the eastside of Highway 20 flagged in orange from which a symptomatic branch sample was collected.

Figure 6a. Branch from ponderosa pine in Figure 5 exhibiting symptoms of herbicide injury with abnormal swelling in stem and killed stems in shoot to the right of foliage. Adventitious buds are present surrounding the killed portion of the shoot.

Figure 6b. Dissected branch with necrotic meristematic tissue on the right associated with herbicide injury in the same sample shown in Figure 6a.

Figure 7. Live ponderosa pine (E99A in Appendix A) without crown symptoms along the eastside of Highway 20 flagged in orange from which an asymptomatic branch sample was collected.

Figure 8a. Branch from tree in Figure 7 without symptoms of herbicide injury and healthy-appearing shoot.

Figure 8b. Dissected branch showing healthy-appearing shoot and healthy-appearing meristematic tissue on the right without symptoms of herbicide injury from the same shown in Figure 8b.

Based on branch samples collected in the field, live ponderosa pine with crown symptoms characteristic of growth regulator herbicide injury (Freucht 1988) were confirmed throughout the proposed Highway 20 Corridor Public Safety Project area, and live ponderosa pine without crown damage can be differentiated in the field. Branches from live, symptomatic pines had chlorotic foliage, abnormal growth (swellings) and killed meristematic tissue in stems of shoots (Appendix B). This is characteristic of growth regulator herbicide injury where damage is often found in meristems. Adventitious buds that form on shoots with herbicide injury have not maintained new healthy shoots and new stems have died after bud formation based on samples from live trees examined over the last three years. Branches from live, asymptomatic pines had normal growth and healthy meristematic tissue in stems of shoots (Appendix B). There were 16 of 23 symptomatic, live pines with 90-100% crown damage. The overall mean percentage of crown damage in symptomatic, live pines was 85% (range 40-100%). Field observations from 2015 to 2018 have shown an increase in the incidence and severity of crown symptoms associated with herbicide applications and an increase in mortality of ponderosa pine immediately adjacent to Highway 20. Trees with moderate to severe crown symptoms have not recovered and have died, which is consistent with other reports of damage in trees associated with a similar herbicide containing aminocyclopyrachlor (Patton et al. 2013). Patton et al. (2013) noted, "…Symptoms included shoot dieback and brown and twisted shoots, leaves and needles that were most noticeable in tree tops and most severe on new growth (Figure 1). Trees with moderate to severe damage did not recover and in most cases symptoms worsened (Patton et al. 2012a) with trees dying." Therefore, live trees with significant crown symptoms associated with herbicide injury immediately adjacent to Highway 20 are expected to die in the next several years.

References

Freucht, J. 1988. Herbicide injury in trees – Symptoms and solutions. Journal of Arboriculture 14: 215-219.

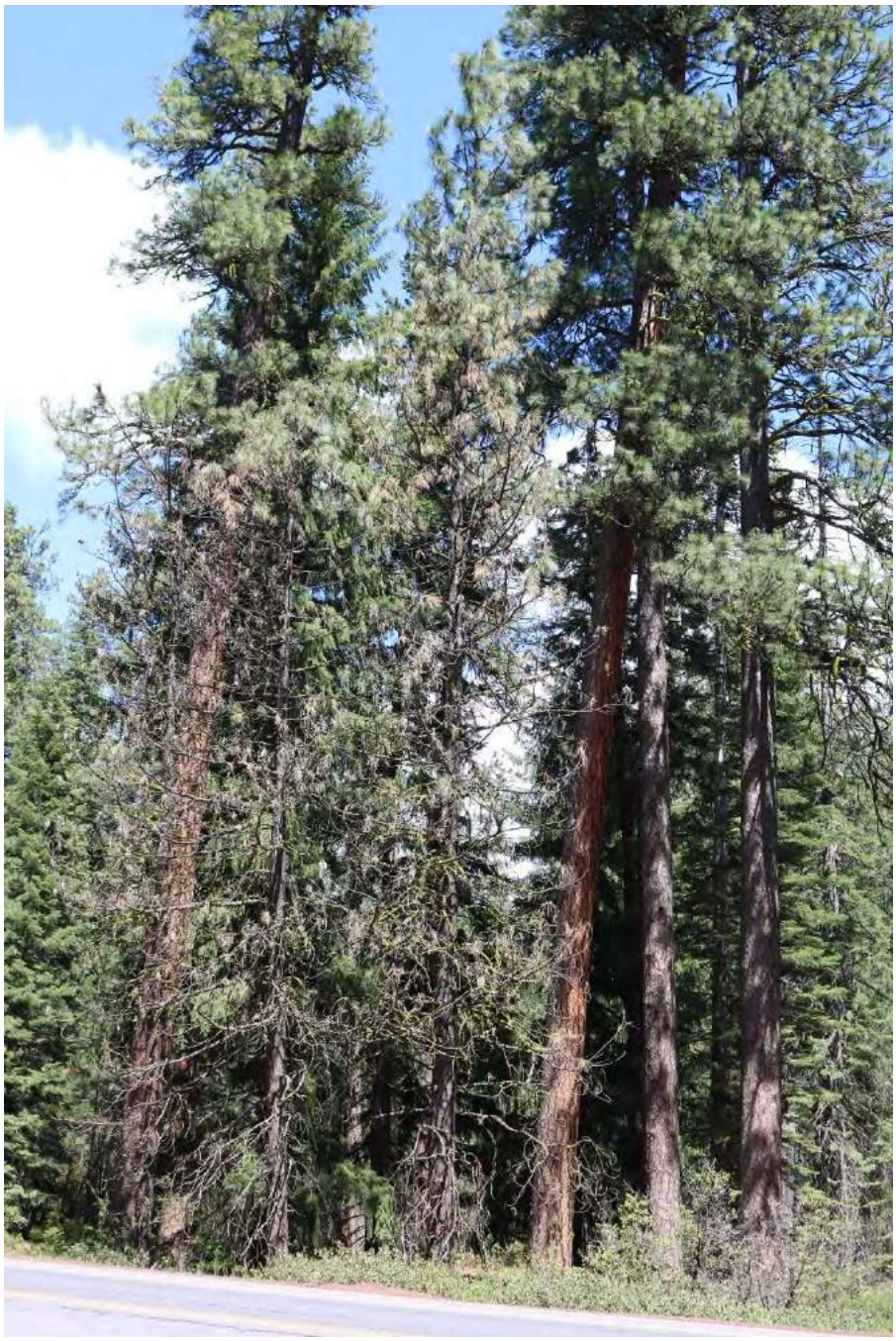
Patton, A.J.; Ruhl, G.E.; Creswell, T.C.; Wan, P.; Scott, D.E.; Becovitz, J.D.; and Weisenberger, D.V. 2013. Potential damage to sensitive landscape plants from wood chips of aminocyclopyrachlor damaged trees. Weed Technology 27: 803-809

Appendix A. Spatial coordinates (Datum: NAD83) of all symptomatic and asymptomatic ponderosa pines sampled on May 3-4, 2018 in the proposed Highway 20 Corridor Public Safety Project area. In the Tree ID field, "E" represents trees sampled on the eastside of the Highway and "W" represents trees sampled on the westside of the Highway. An "S" represents symptomatic live trees and an "A" represents asymptomatic live trees sampled.

Tree ID	Latitude	Longitude
W99S	44.30703800	-121.56936500
W99A	44.30692500	-121.56964400
E99S	44.30718600	-121.56934000
E99A	44.30724100	-121.56898800
W98S	44.31913900	-121.57978700
W98A	44.31905200	-121.57989500
E98S	44.31979600	-121.57992900
E98A	44.31990000	-121.57995000
W97S	44.33163500	-121.59043200
W97A	44.33157800	-121.59040500
E97A	44.33258000	-121.59043200
W96S	44.34455100	-121.60142700
W96A	44.34445800	-121.60161300
E96S	44.34436400	-121.60099500
E96A	44.34438900	-121.60085000
W95S	44.35765200	-121.61264400
W95A	44.35758300	-121.61266400
E95S	44.35592200	-121.61082400
E95A	44.35598500	-121.61086000
W94S	44.36932200	-121.62257100
W94A	44.36933200	-121.62269900
E94S	44.36916500	-121.62211600
E94A	44.36918200	-121.62208300
E97S	44.33251800	-121.59073700
W93A	44.37565600	-121.63980800
W93S	44.37596100	-121.63964400
E93S	44.37625200	-121.63978600
E93A	44.37632200	-121.63971000
W92S	44.38192800	-121.65821500
W92A	44.38187700	-121.65827500
E92S	44.38524800	-121.66271100
E92S	44.38523400	-121.66270600
E91S	44.39170400	-121.67235600
E91A	44.39180800	-121.67217900
W91S	44.39135100	-121.67204400
W91A	44.39121300	-121.67210500
W90S	44.40417300	-121.68729600
W90A	44.40429900	-121.68758000
E90S	44.40722600	-121.69022100
E90A	44.40727900	-121.68968600
E89S	44.41460600	-121.69762700
E89A	44.41453600	-121.69746000
W89S	44.41449200	-121.69794600
W89A	44.41445100	-121.69817500
E93AB	44.37819300	-121.64664300
E93SB	44.37805600	-121.64656500

Appendix B. Photos of symptomatic (“S”) and asymptomatic (“A”) ponderosa pines sampled in early-May of 2018 for the presence of crown damage associated with growth regulator herbicide injury. *Photos of branch samples examined in the lab for symptoms of herbicide injury in shoots and meristems.*

E89S




WESTCOTT
RULER
E 89S


RULER
E 89S

E89A


RULER
E89A


RULER
E89A

E90S


WESTCOTT
RULER
E90S


WESTCOTT
RULER
E90S

E90A


WESTCOTT
RULER
E90A


WESTCOTT
RULER
E90A

E91S


WESTCOTT
RULER
E91S


WESTCOTT
RULER
E91S

E91A


E91A


E91A

E92S


WESTCOTT
RULER
E92S

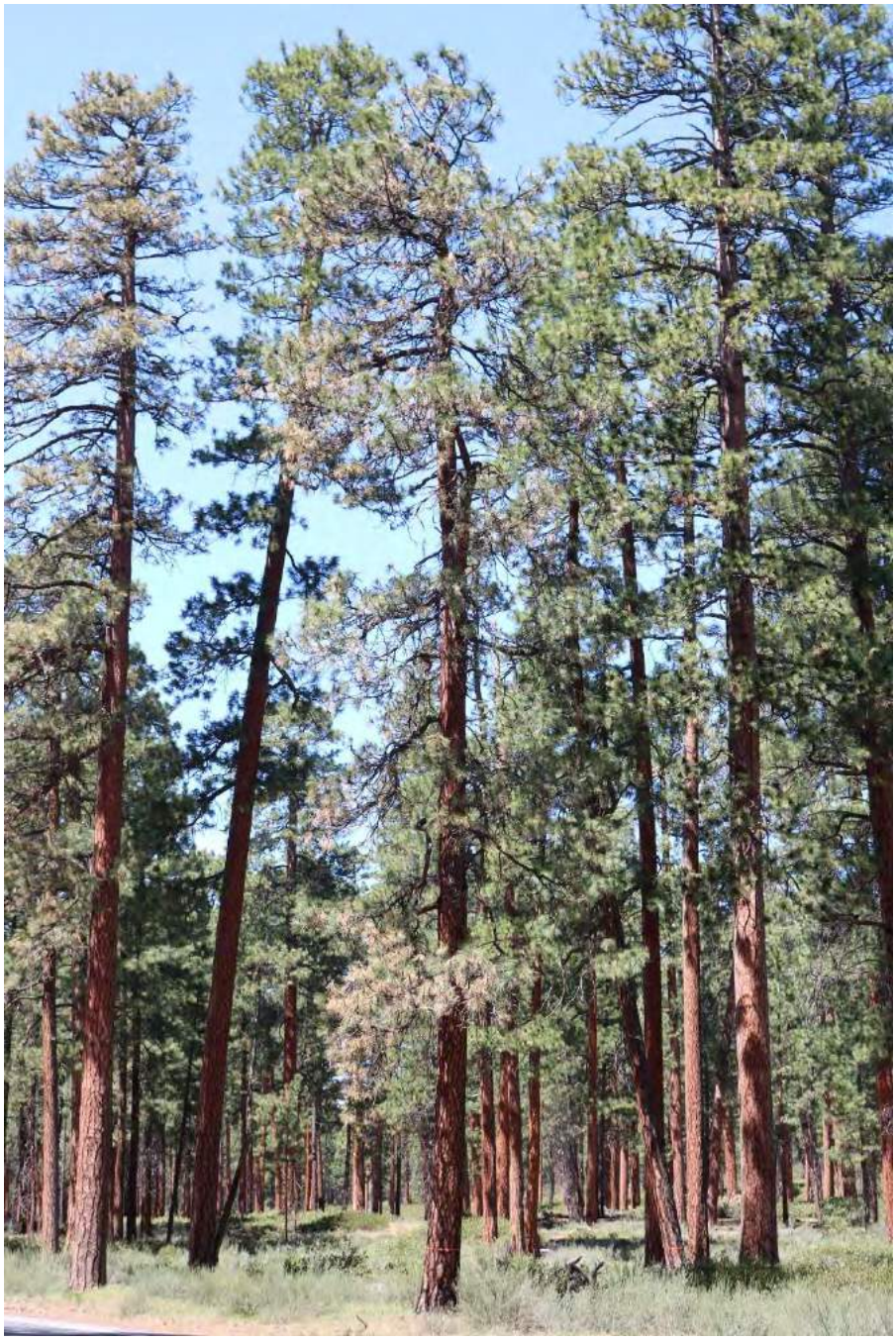

WESTCOTT
RULER
E92S

E92A


WESTCOTT
RULER
E92A


WESTCOTT
RULER
E92A

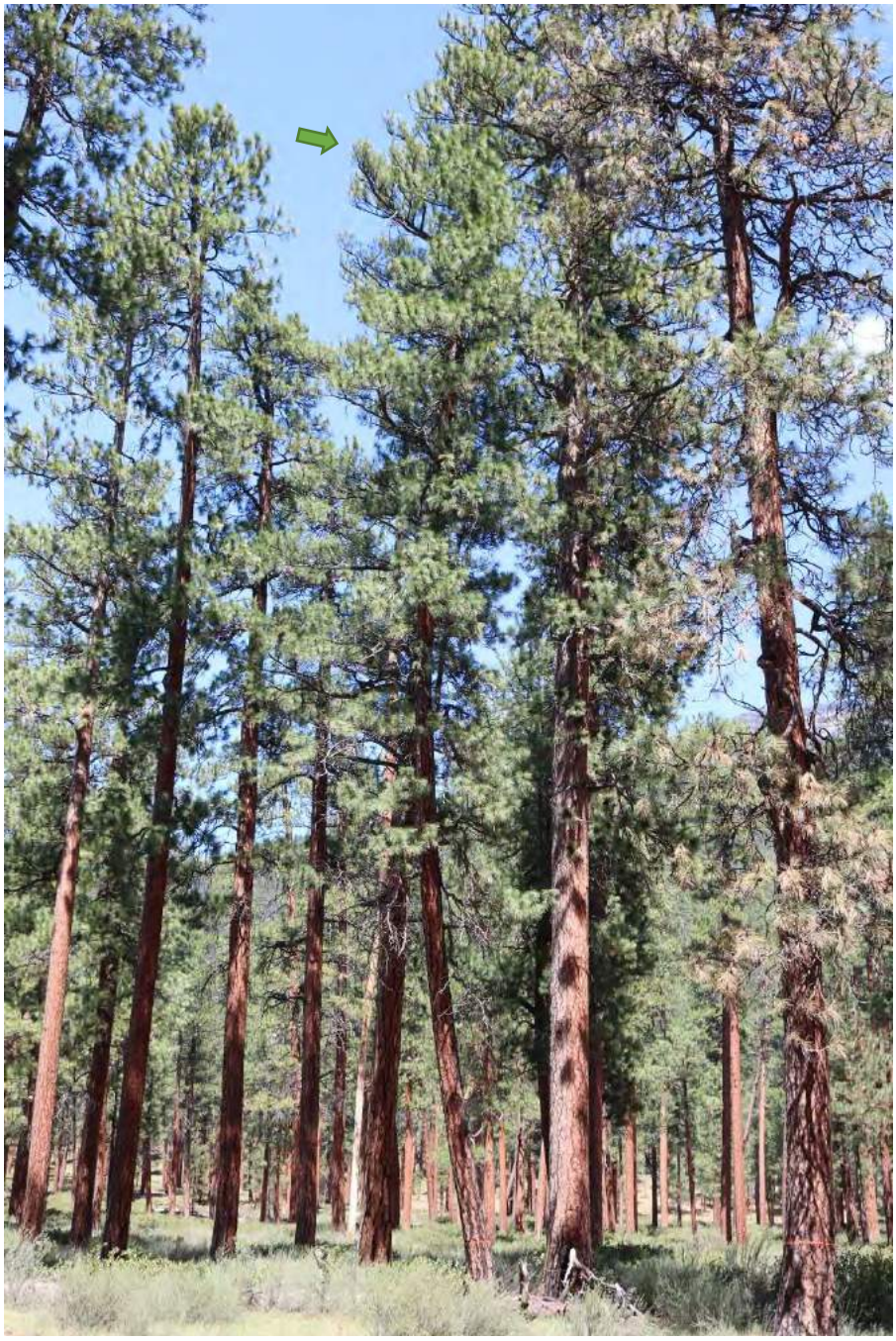
E93SB




WESTCOTT
RULER
E93S


WESTCOTT
RULER
E93S

E93AB




E93A


E93A

E93S


WESTCOTT
RULER
E93S


WESTCOTT
RULER
E93S

E93A


MADE IN U.S.A.
WESTCOTT
RULER
E93A

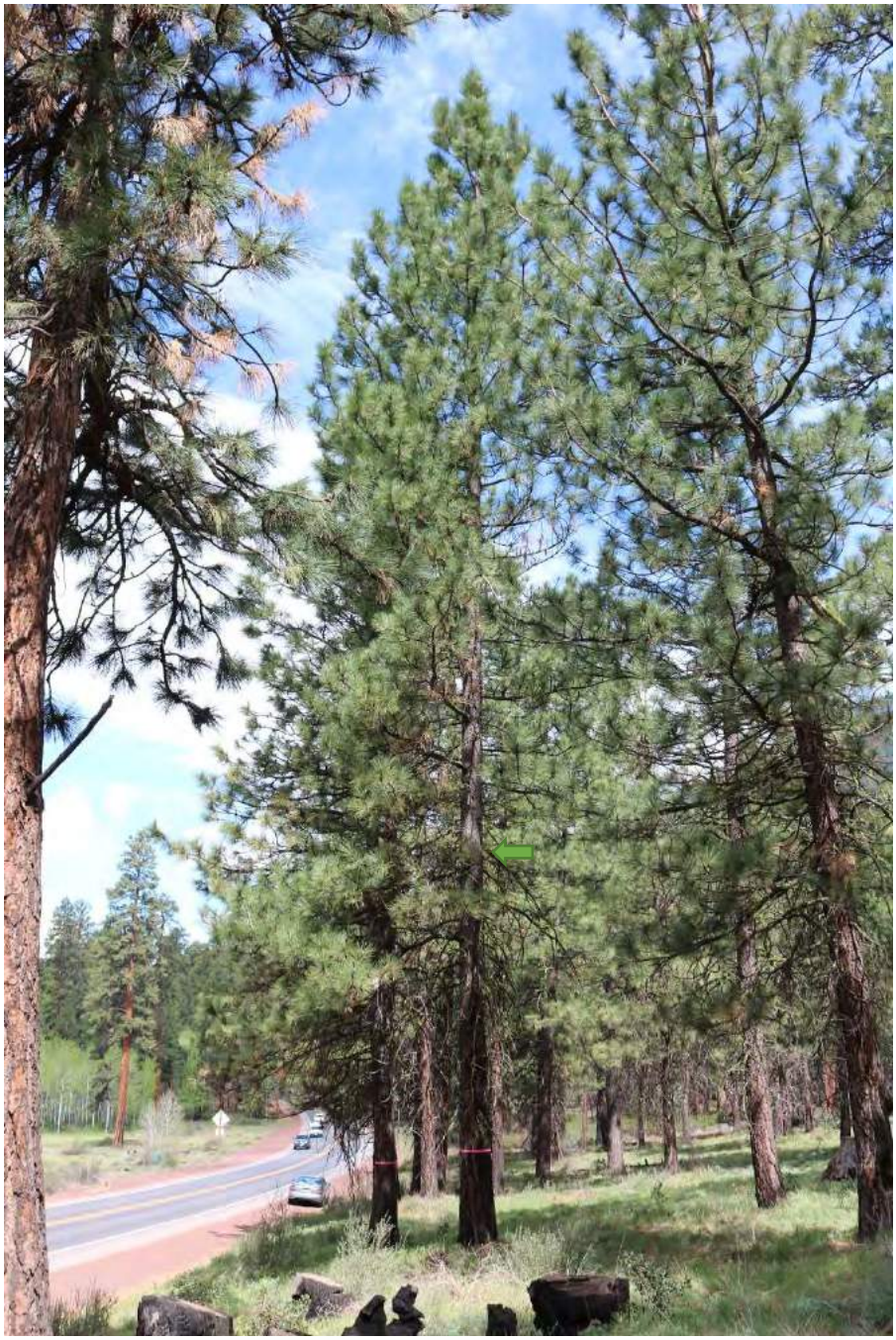

RULER
E93A

E94S


WESTCOTT
RULER
E94S


WESTCOTT
RULER
E94S

E94A




WESTCOTT
RULER
E94A

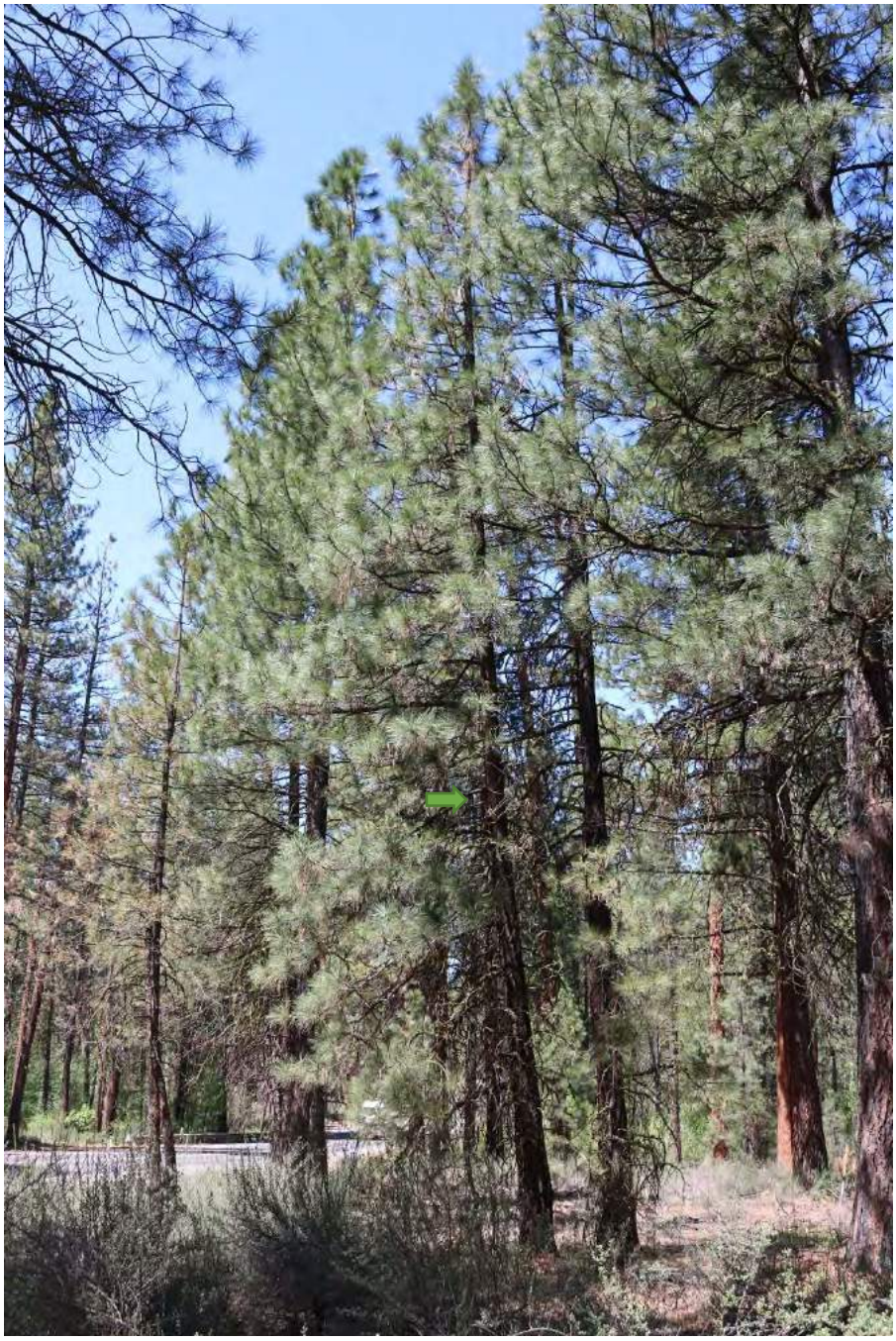

WESTCOTT
RULER
E94A

E95S


WESTCOTT
RULER
E95S


WESTCOTT
RULER
E95S

E95A




WESTCOTT
RULER
E95A

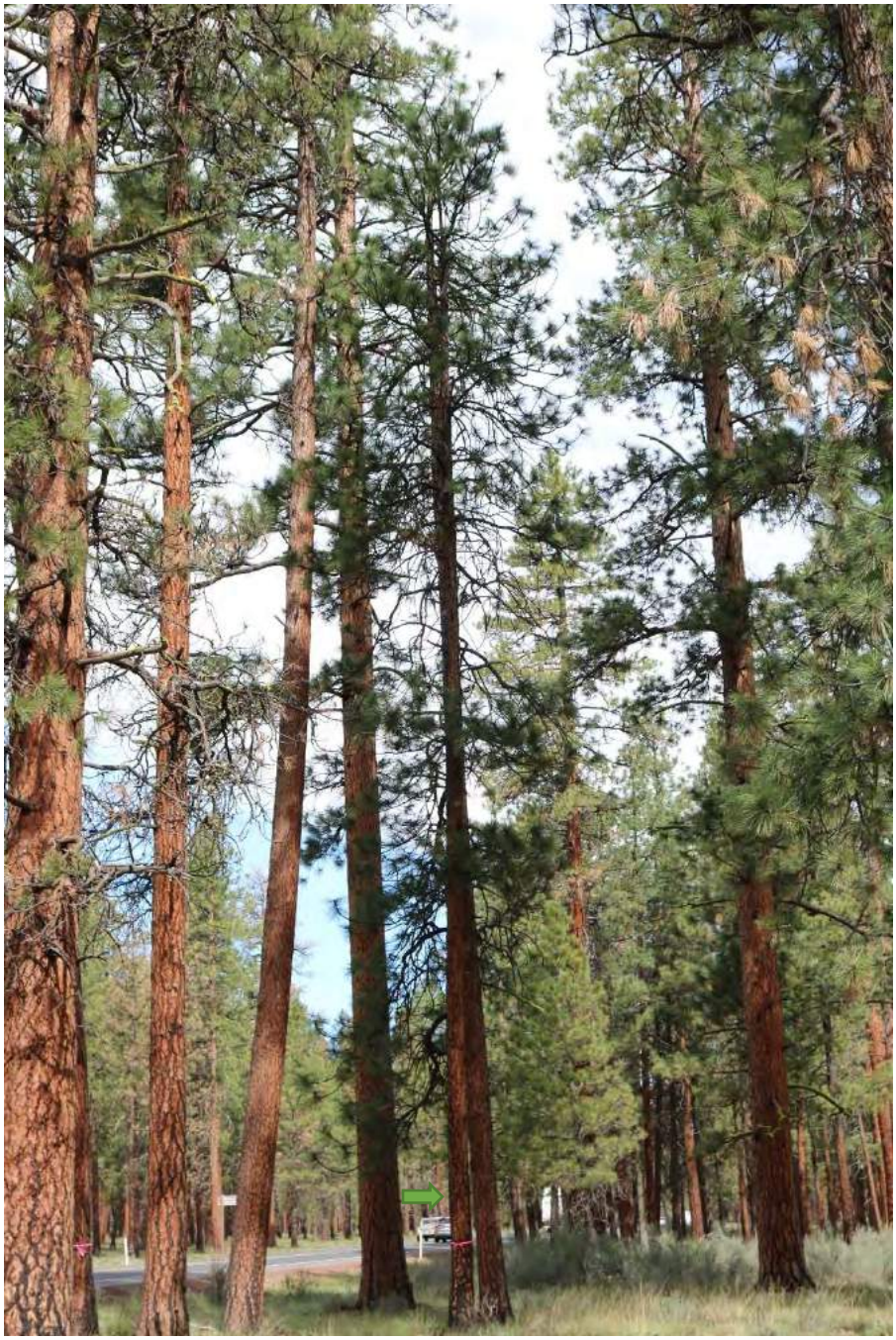

WESTCOTT
RULER
E95A

E96S


WESTCOTT
RULER
E96S


WESTCOTT
RULER
E96S

E96A




RULER
E96A


RULER
E96A

E97S


MADE IN USA
WESTCOTT
RULER
E97S


MADE IN USA
WESTCOTT
RULER
E97S

E97A


MADE IN U.S.A.
WESTCOTT
RULER
E97A


MADE IN U.S.A.
WESTCOTT
RULER
E97A

E98S


WESTCOTT
RULER
E98S


WESTCOTT
RULER
E98S

E98A


WESTCOTT
RULER
E98A


WESTCOTT
RULER
E98A

E99S


E99S


E99S

E99A


MADE IN U.S.A.
WESTCOTT
RULER
E99A


WESTCOTT
RULER
E99A

W89S


WESTCOTT
RULER
W895


WESTCOTT
RULER
W895

W89A


WESTCOTT
RULER
W89A


WESTCOTT
RULER
W89A

W90S


WESTCOTT RULER
W90S


WESTCOTT RULER
W90S

W90A


W90A

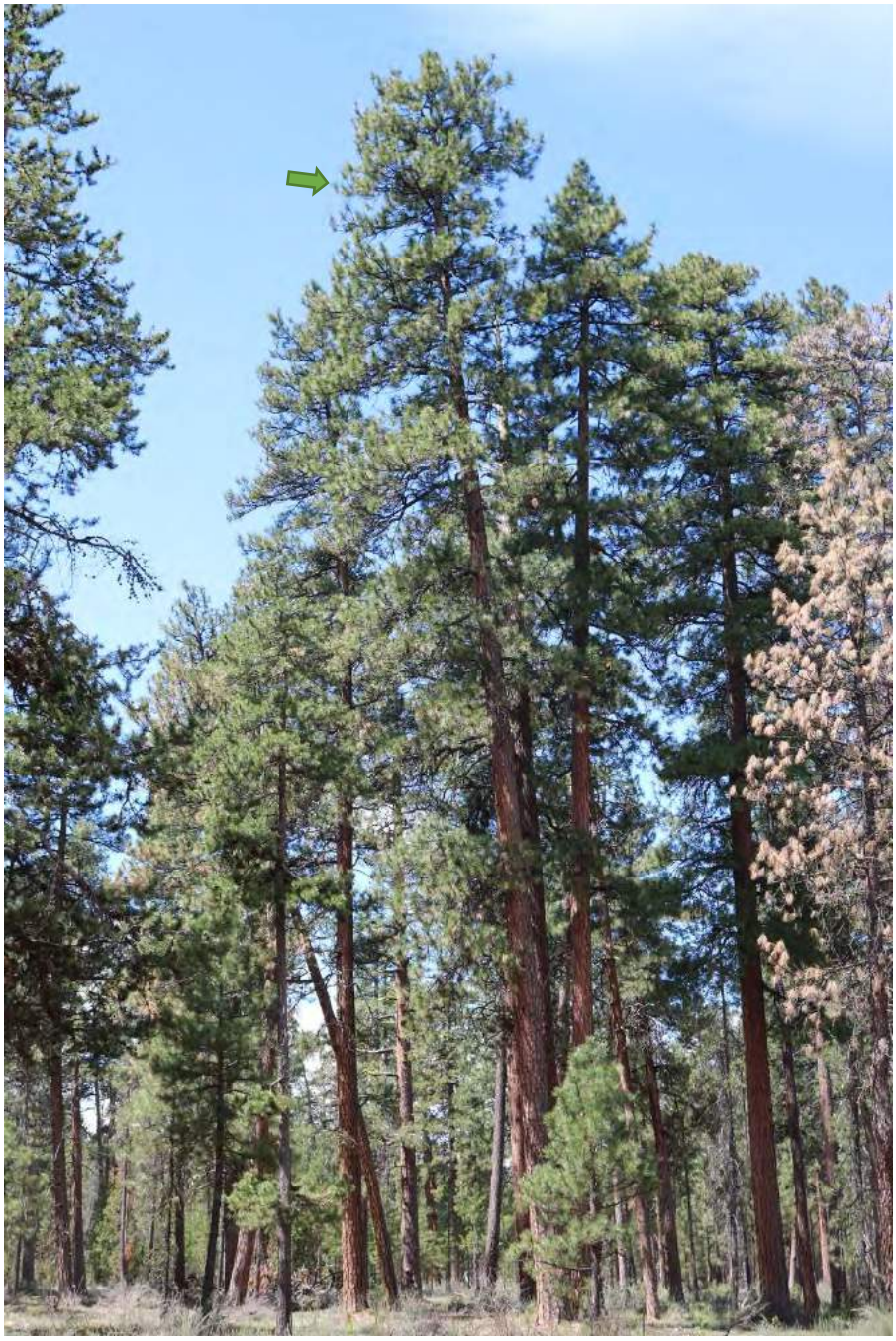

W90A

W91S


WESTCOTT
RULER
W91S


WESTCOTT
RULER

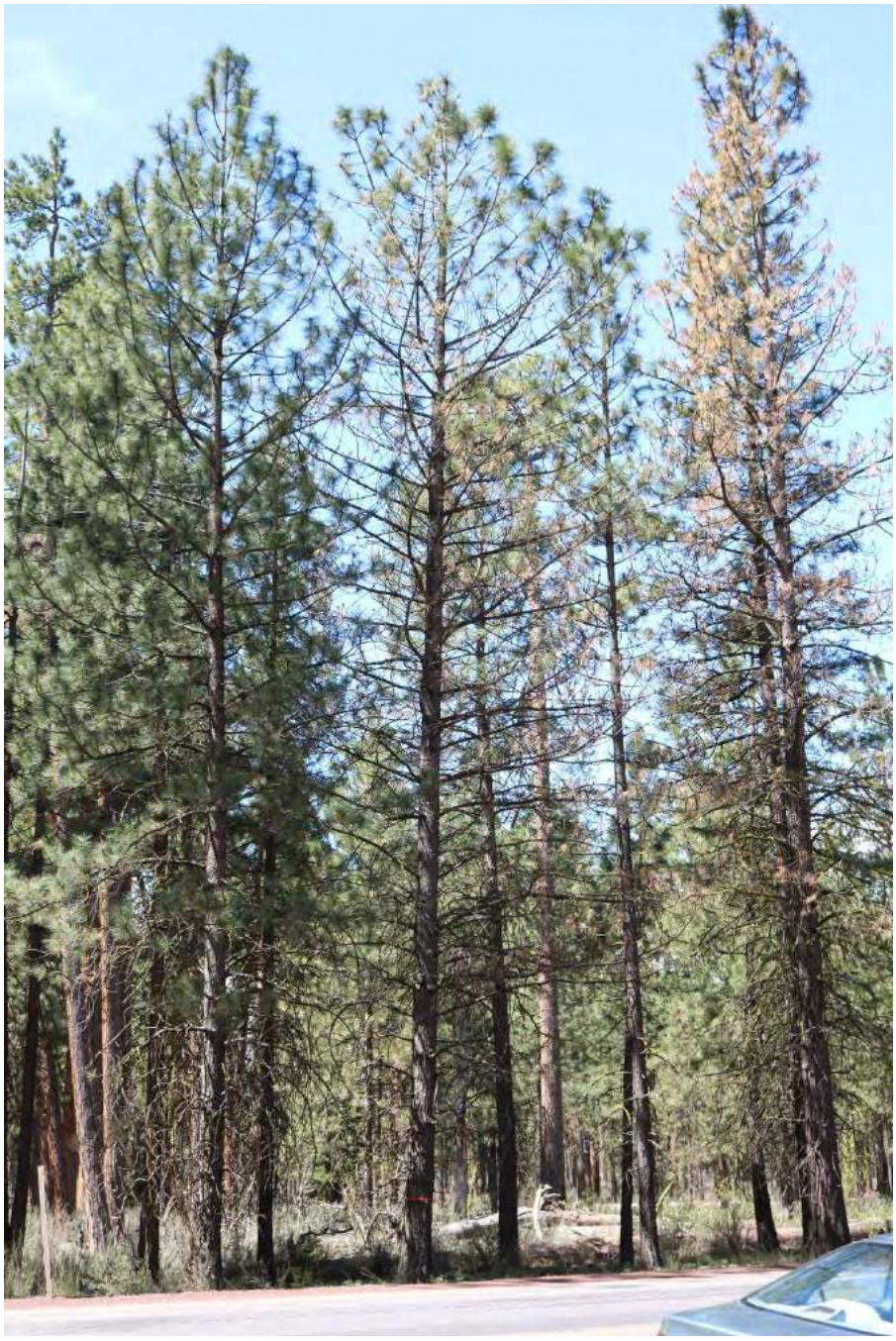
W91A




WESTCOTT
RULER
W91A


WESTCOTT
RULER
W91A

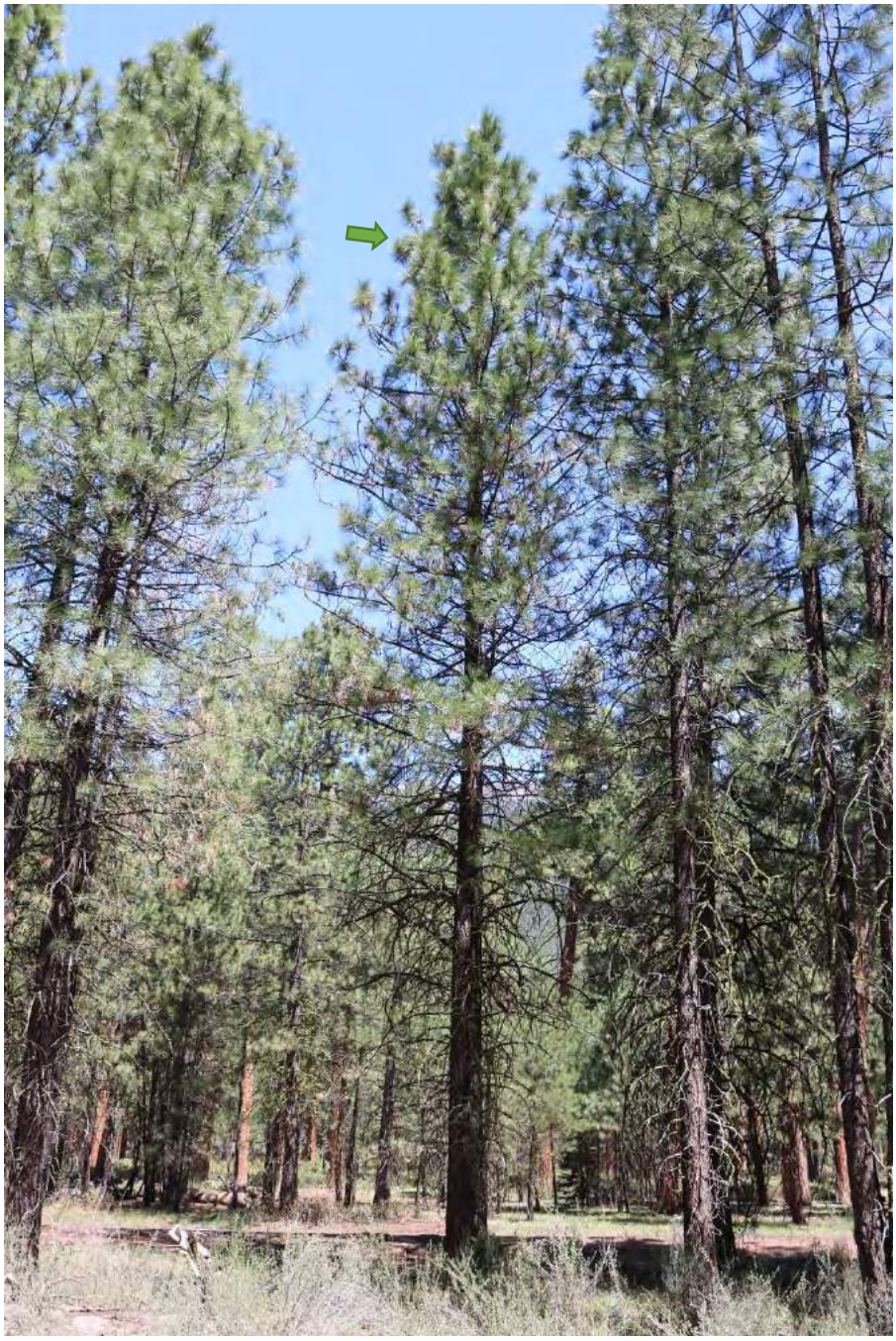
W92S




WESTCOTT
RULER
W92S


WESTCOTT
RULER
W92S

W92A




W92A


W92A

W93S


W93S


W93S

W93A


WESTCOTT
W93A


WESTCOTT
RULER
W93A

W94S


WESTCOTT
RULER
W94S


WESTCOTT
RULER
W94S

W94A


MADE IN U.S.A.
NO. R 301-12
WESTCOTT
RULER
W94A


MADE IN U.S.A.
NO. R 301-12
WESTCOTT
RULER
W94A

W95S


WESTCOTT
RULER
W95S


WESTCOTT
RULER
W95S

W95A


W95A


W95A

W96S


WESTCOTT
RULER
W96S


WESTCOTT
RULER
W96S

W96A


WESTCOTT
RULER
W96A

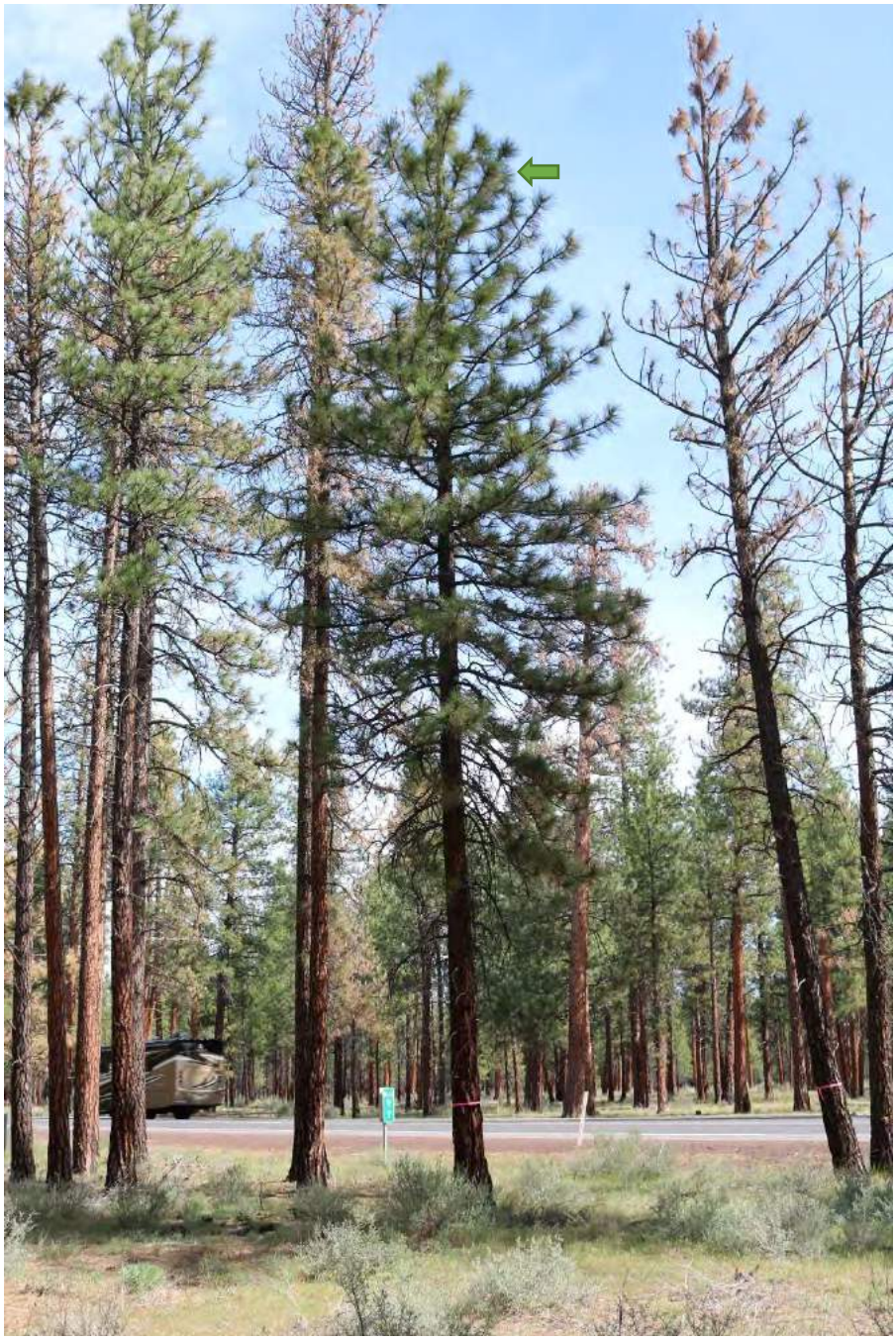

WESTCOTT
RULER
W96A

W97S


W97S


W97S

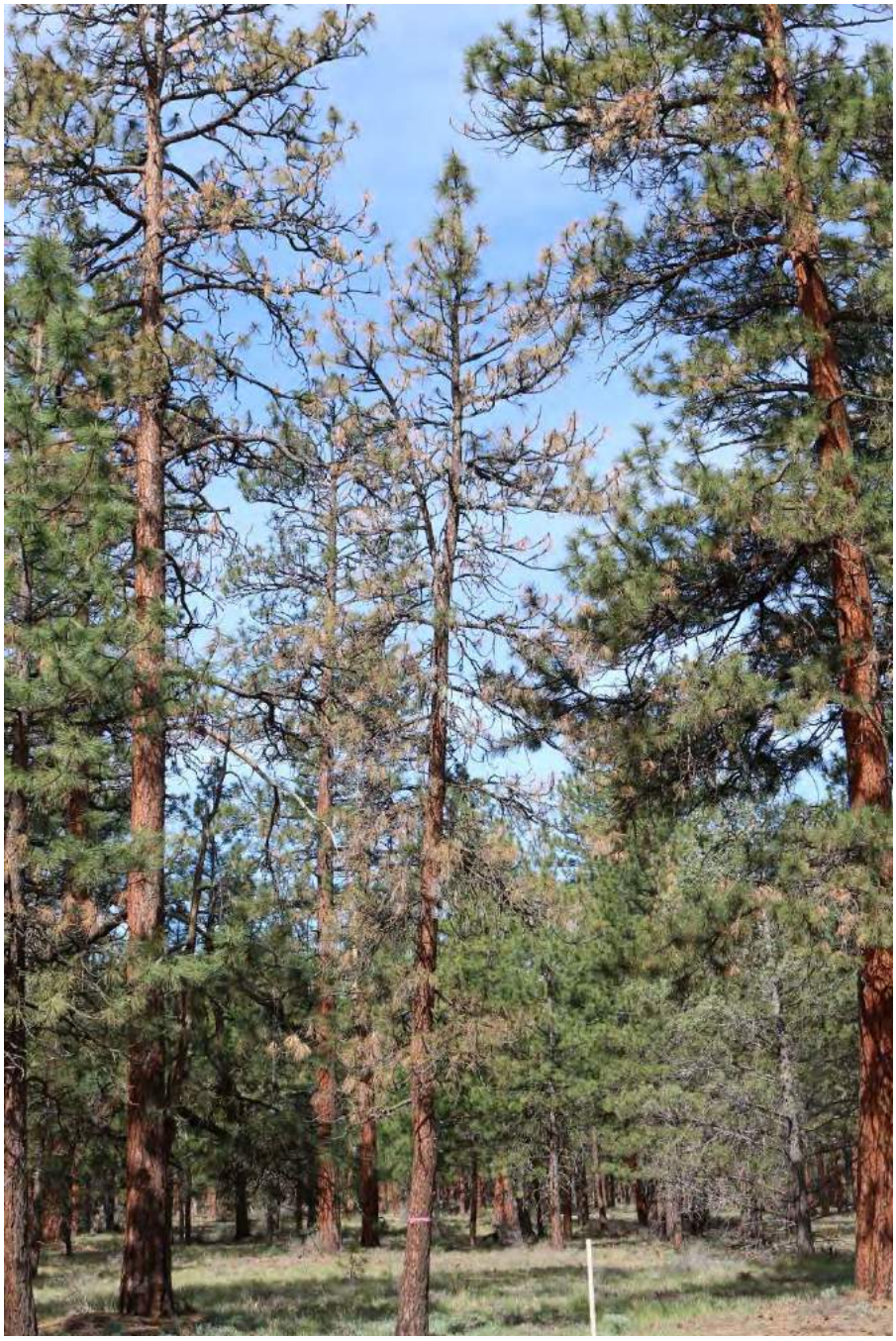
W97A




WESTCOTT
RULER
W97A


WESTCOTT
RULER
W97A

W98S




WESTCOTT
RULER
W98S


WESTCOTT
RULER
W98S

W98A


WESTCOTT
RULER
W98A


WESTCOTT
RULER
W98A

W99S


WESTCOTT
RULER
W99S


WESTCOTT
RULER
W99S

W99A


W99A


W99A