Why is elevation an issue in Utah?

Mean Elevation

1st: 6,800'
2nd: 6,700'
3rd: 6,100'
4th: 5,700'
5th: 5,500'
6th: 5,000'
7th: 3,400'
8th: 3,300'
9th: 1,700'
10th: 2,900'

Elevation

3rd: 5,500'
5,000'
4,100'
5,700'

2nd: 6,700'
6,100'
6,800'

1st: 6,800'
6,100'
5,700'

Mean Elevation

6,100'
Why is elevation an issue in Utah?

- Summit County 2nd highest (8,388’) in U.S. outside Colorado
- Wasatch County 5th highest (7,919’)
- Piute County 7th highest (7,739’)
- Duchesne County 8th highest (7,714’)
- Sevier County 13th highest (7,517’)
• Non-green areas are above about 6,000 feet
How much of an issue is growing landscape trees at high elevations in Utah?

- Proportional to how many people live at, and grow cultivated landscapes at high elevations
- Now fairly few people at high elevations
- More will be in the future; Summit County one of fastest growing in the state; Wasatch also growing
- Edges of cities moving up onto benches
Population density

Population per Square Mile (2000)

- 5,000-28,000
- 500-5,000
- 80-500
- 30-80
- 5-30
- 1-5
- <1
How high elevation affects trees

• Most native forest in Utah is at high elevation (above about 6,000’), so it must be good for trees overall.
Higher elevation means (almost always):

- Lower low temperatures (winter) (- tree effect)
- Lower high temperatures (summer) (+ -)
- Shorter growing season (later, earlier frosts) (-)
- Snow lasts longer, soils dry out slower (- +)
- Increased precipitation (summer and total) (+)
- Decreased ET (lower summer temp, higher humidity) (+)
- Increased climate fluctuations (〜)
• 5°F decrease per 1,000’ (adiabatic cooling)
  – From SLC at 4,200’ to Park City at 9,000’ can get a 24°F temperature drop
• 1°F decrease per degree latitude north
  – From Bluff at about 37 latitude to Logan at about 42 latitude can get a 5°F temperature drop (same elevation)
• So, Utah gets cooler as you go up in elevation and as you go farther north
Mean Annual Temperature

(source www.nr.usu.edu/Geography-Department/utgeog/climate.html)
Cooler minimum temperatures

-43.6°F  -11.2°F
-40.0°F  -7.6°F
-36.4°F  -4.0°F
-32.8°F  -0.4°F
-29.2°F  +3.2°F
-25.6°F  +6.8°F
-22.0°F  +10.4°F
-18.4°F  +14.0°F
-14.8°F  +17.6°F

30 Year Mean Minimum Temp
(source [www.nr.usu.edu/Geography-Department/utgeog/climate.html](http://www.nr.usu.edu/Geography-Department/utgeog/climate.html))
Shorter growing season (frost-free)

Average frost free season (days)

(source www.engineering.usu.edu/uwrl/atlas/ch2/ch2freezetemp.html)
Snow lasts longer

Average snowfall (inches)
(source www.engineering.usu.edu/uwrl/atlas/ch2/ch2avannsnow.html)
Increased precipitation

Mean Annual Precip 1961-1990
Decreased ET

Average PET (inches)
(source www.engineering.usu.edu/uwr1/atlas/ch3/ch3potevapot.html)
Higher elevation in Utah often means:

- Increased relief, so greater effect of aspect (~)
- Less uniformity across the landscape (climatic, soils, vegetation, etc.) (~)
- Decreased (more acidic) soil pH (below 7) (+)
- Rockier, thinner soils (highly variable) (-)
Relief/aspect
Poorer soils (arability)

(source www.engineering.usu.edu/uwr1/atlas/ch3/ch3arable.html)
So, what is a “higher elevation”?

- High enough that factors affect trees
- High enough for some detrimental effects
- Trees naturally grow above about 15” precip
- Trees grow naturally above about 6,000’ and below about 11,000’ in Utah
- Could use 7,000’ as a cutoff, but really anywhere where elevation has an effect
So, what is a “higher elevation”? 

- Everything not shown in green
Site and tree assessment is crucial

- Increased importance of microsite
  - Elevation, slope steepness, aspect, soils, rockiness, frost free period, moisture, temperature (summer & winter), windiness
- Look at USDA Hardiness zone of site and tree
  - Look in *Trees of Utah* book for table
- There are natives (unlike at low elevations), so use natives where possible
## USDA Hardiness Zones
### Summit & Wasatch Counties

<table>
<thead>
<tr>
<th>Station</th>
<th>Elevation (feet)</th>
<th>Zone (Ave., Min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summit Coalville</td>
<td>5550</td>
<td>5, 3</td>
</tr>
<tr>
<td>Summit Echo</td>
<td>5470</td>
<td>4, 3</td>
</tr>
<tr>
<td>Summit Kamas 3 NW</td>
<td>6480</td>
<td>5, 3</td>
</tr>
<tr>
<td>Summit Wanship</td>
<td>5940</td>
<td>4, 3</td>
</tr>
<tr>
<td>Wasatch Deer Creek</td>
<td>5270</td>
<td>5, 3</td>
</tr>
<tr>
<td>Wasatch Heber</td>
<td>5630</td>
<td>5, 3</td>
</tr>
<tr>
<td>Wasatch Snake Creek</td>
<td>6010</td>
<td>5, 3</td>
</tr>
</tbody>
</table>
Hardiness zones

- USDA Plant Hardiness Zones
- Meant for cold hardiness indication, not heat
Calculated hardiness zones

30 year average minimum temp (degrees F) (zone)
(source www.nr.usu.edu/Geography-Department/utgeog/climate.html)

-43.6F (2b) -11.2F (5b)
-40.0F (2b) -7.6F (6a)
-36.4F (3a) -4.0F (6b)
-32.8F (3b) -0.4F (6b)
-29.2F (4a) +3.2F (7a)
-25.6F (4a) +6.8F (7b)
-22.0F (4b) +10.4F (8a)
-18.4F (5a) +14.0F (8a)
-14.8F (5b) +17.6F (8b)
Selecting better trees (for any elevation)

- Moderate to slow growth rate; no fast growers
- Longevity
- Native *where appropriate*; well adapted to site is most important
- Better cultivars
- Mix sizes
- Interesting characteristics
Selection criteria

- Tolerance of low temperatures in winter
- Tolerance of frost on fringes of growing season
  - Occasional very late/early frosts are problems with almost any species, even natives
- USDA Zone 4b or lower (generally)
- Quality tree (few I/D problems, medium/slow growth, strong, good form)
- USU Tree Browser shows 137 species Zone 4 or colder with medium to slow growth rate; 26 natives
Some trees to avoid

Avoid
- *Any willow (Salix species)*
- Almost any poplar/cottonwood (*Populus species)*
- Russian-olive (*Elaeagnus angustifolia*)
- Norway maple (*Acer platanoides*)

Normally avoid, but may work on high, cool sites
- European white birch (*Betula pendula*)
- Blue spruce in hot locations (*Picea pungens*)
- Quaking aspen (*Populus tremuloides*)

*May be OK in native settings*
Selected broadleaves (15 in UTB)
- canyon maple (*Acer grandidentatum*)
- water or river birch (*Betula occidentalis*)
- curlleaf mountain-mahogany (*Cercocarpus ledifolius*)
- quaking aspen (*Populus tremuloides*)
- common chokecherry (*Prunus virginiana*)
- Gambel oak (*Quercus gambelii*)
- Greene mountain-ash (*Sorbus scopulina*)
Trees for high elevations in Utah – Natives

- Conifers (11 in UTB)
  - Douglas-fir (*Pseudotsuga menziesii*)
  - fir – white, subalpine (*Abies concolor, lasiocarpa*)
  - juniper – Rocky Mountain, Utah (*Juniperus scopulorum, osteosperma*)
  - pine – limber, lodgepole, ponderosa, pinyons (*Pinus flexilis, contorta, ponderosa, edulis, monophylla*)
  - spruce – blue, Engelmann (*Picea pungens, engelmannii*)
Trees for high elevations in Utah – Zone 2

- Amur maple (*Acer ginnala*)
- birch – European white, paper (*Betula pendula, papyrifera*)
- bur oak (*Quercus macrocarpa*)
- American basswood/linden (*Tilia americana*)
- pine – Scots, mugo (*Pinus sylvestris, mugo*)
- spruce – Norway, white (*Picea abies, glauca*)
- northern white-cedar (*Thuja occidentalis*)
Trees for high elevations in Utah – Zone 3

- maple – Norway, red, Tatarian (*Acer platanoides, rubrum, tataricum*)
- horsechestnut, Ohio buckeye (*Aesculus hippocastanum, glabra*)
- American hornbeam (*Carpinus caroliniana*)
- eastern redbud (*Cercis canadensis*)
- fringetree (*Chionanthus virginicus*)
- pagoda dogwood (*Cornus alternifolia*)
- hawthorn – cockspur and Washington (*Crataegus crusgalli, phaenopyrum*)
Trees for high elevations in Utah – Zone 3

- white ash (*Fraxinus americana*)
- ginkgo (*Ginkgo biloba*)
- Kentucky coffeetree (*Gymnocladus dioicus*)
- magnolia – cucumbertree, Kobus, Loebner (*Magnolia acuminata, kobus, x loebneri*)
- Apple, crabapple (*Malus pumila*, etc.)
- Amur corktree (*Phellodendron amurense*)
- cherry – sweet, sour (*Prunus avium, cerasus*)
- Amur chokecherry (*Prunus maackii*)
- European birdcherry (*Prunus padus*)
Trees for high elevations in Utah – Zone 3

- Ussurian pear (*Pyrus ussuriensis*)
- oaks – white, swamp white (*Quercus alba, bicolor*)
- locust – black, Idaho flowering (*Robinia pseudoacacia, x ambigua*)
- mountain-ash – Korean, American, European (*Sorbus alnifolia, americana, aucuparia*)
- Japanese tree lilac (*Syringa reticulata*)
- linden – littleleaf, Crimean (*Tilia cordata, x euchlora*)
- Chinese juniper (*Juniperus chinensis*)
- Japanese red pine (*Pinus densiflora*)
Trees for high elevations in Utah – Zone 4

- maple – hedge, paperbark, sycamore, purpleblow (*Acer campestre, griseum, pseudoplatanus, truncatum*)
- red horsechestnut – (*Aesculus x carnea*)
- downy serviceberry – (*Amelanchier arborea*)
- European hornbeam (*Carpinus betulus*)
- Chinese chestnut (*Castanea mollissima*)
- katsuratree – (*Cercidiphyllum japonicum*)
- yellowwood – (*Cladrastis kentuckea*)
- dogwood – Kousa, corneliancherry (*Cornus kousa, mas*)
Trees for high elevations in Utah – Zone 4

- filbert, hazelnut (*Corylus* species, esp. *colurna*)
- smoketree (*Cotinus* spp.)
- hawthorn – English, green, Lavalle (*Crataegus laevigata, viridis, x lavallei*)
- European beech (*Fagus sylvatica*)
- Osage-orange (*Maclura pomifera*)
- Magnolia – lily, star, saucer (*Magnolia liliflora, stellata, x soulangiana*)
- apricot (*Prunus armeniaca*)
- cherry – Sargent, Higan (*Prunus sargentii, subhirtella*)
Trees for high elevations in Utah – Zone 4

- oaks – shingle, chinkapin, English, northern red (*Quercus imbricaria, muehlenbergii, robur, rubra*)
- Japanese pagodatree (*Sophora japonica*)
- silver linden (*Tilia tomentosa*)
- lacebark elm (*Ulmus parvifolia*)
- baldcypress (*Taxodium distichum*)
- pine – Austrian, J. white, lacebark (*Pinus nigra, parviflora, bungeana*)
- Serbian spruce (*Picea omorika*)
Trees for high elevations in Utah – Faster growing

- hackberry (*Celtis occidentalis*)
- honeylocust (*Gleditsia triacanthos*)
- yellow-poplar (*Liriodendron tulipifera*)
- London planetree (*Platanus x acerifolia*)
- larch – European, Japanese (*Larix decidua*, *kaempferi*)
canyon maple (*Acer grandidentatum*; Zone 4)* (native)
paperbark maple (*Acer griseum*; Zone 4)
Tatarian maple (*Acer tataricum*; Zone 3)
European hornbeam (*Carpinus betulus*; Zone 4)
curlleaf mountain-mahogany (*Cercocarpus ledifolius*; Zone 3)*
fringetree (*Chionanthus virginicus*; Zone 3); picture is *C. retusus*; Zone 5)
Washington hawthorn (*Crataegus phaenopyrum*; Zone 3)
European beech (*Fagus sylvatica*; Zone 4)
ginkgo (Ginkgo biloba; Zone 3)
Kentucky coffeetree (*Gymnocladus dioicus*; Zone 3)
yellow-poplar (*Liriodendron tulipifera*; Zone 4)
Loebner magnolia (*Magnolia x loebneri* ‘Leonard Messel’; Zone 3)
star magnolia (*Magnolia stellata*; Zone 4)
Amur chokecherry (*Prunus maackii*; Zone 3)
white oak (*Quercus alba*; Zone 3)
bur oak (*Quercus macrocarpa*; Zone 2)
English oak (*Quercus robur*; Zone 4)
Greene mountain-ash (Sorbus scopulina; Zone 2)*
Japanese tree lilac (*Syringa reticulata*; Zone 3)
white fir (*Abies concolor*; Zone 2)*
white fir (*Abies concolor*) foliage*
Rocky Mountain juniper (Juniperus scopulorum; Zone 3)*
European larch (*Larix decidua*; Zone 4)
Blackhills (white) spruce (*Picea glauca* ‘Densata’; Zone 2)
Serbian spruce (*Picea omorika*; Zone 4)
lacebark pine (*Pinus bungeana*; Zone 4)
Japanese red pine (*Pinus densiflora*; Zone 3)
limber pine (*Pinus flexilis*; Zone 4)*

Vanderwolf’s Pyramid cv.
ponderosa pine (*Pinus ponderosa*; Zone 3)*
Utah Tree Browser

- Includes 241 trees
- Select 21 characteristics
- 1,000+ photos
- Fact sheets
- Select and save favorites
- www.treebrowser.org
References

• Books
  – Dirr, Manual of Woody Landscape Plants
  – Kuhns, Trees of Utah and the Intermountain West

• Web sites
  – forestry.usu.edu
  – www.treebrowser.org