

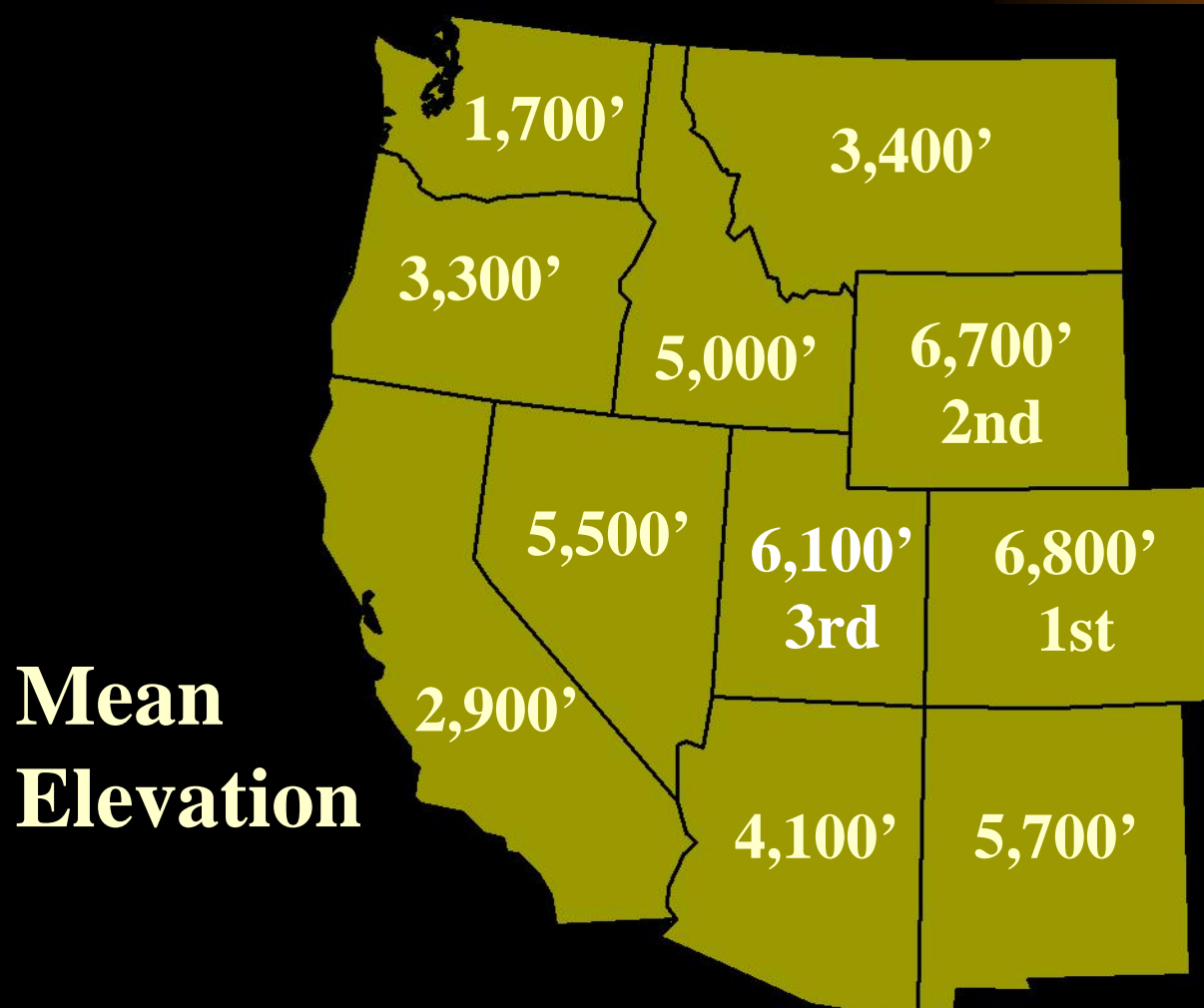
Tree Selection for Higher Elevations



Dr. Mike Kuhns

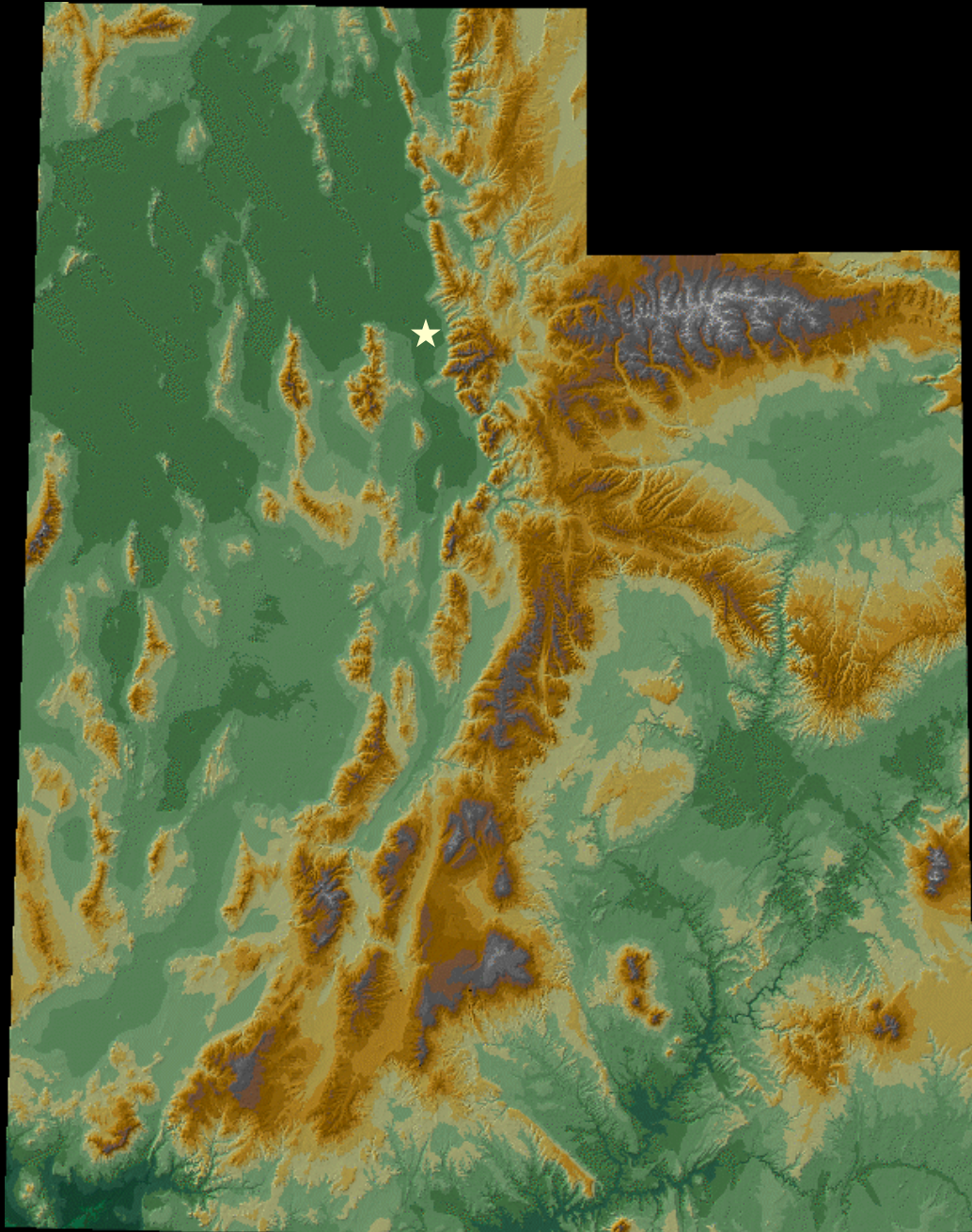
USU Extension Forester

Why is elevation an issue in Utah?



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')



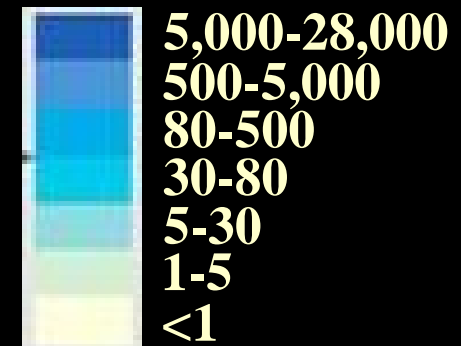
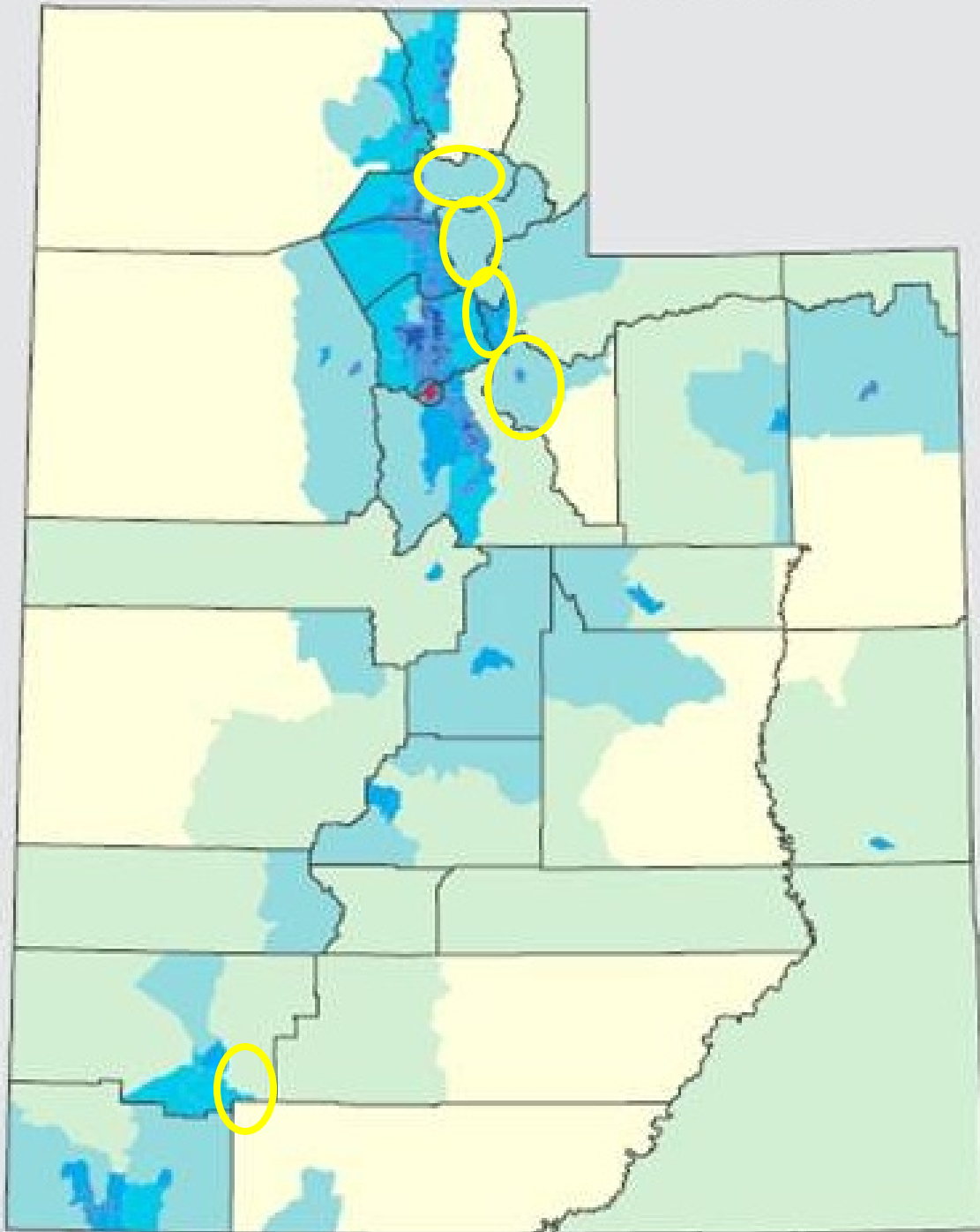
Elevation

- 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)**



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):

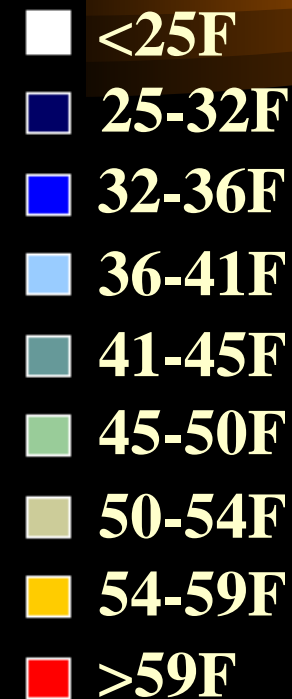
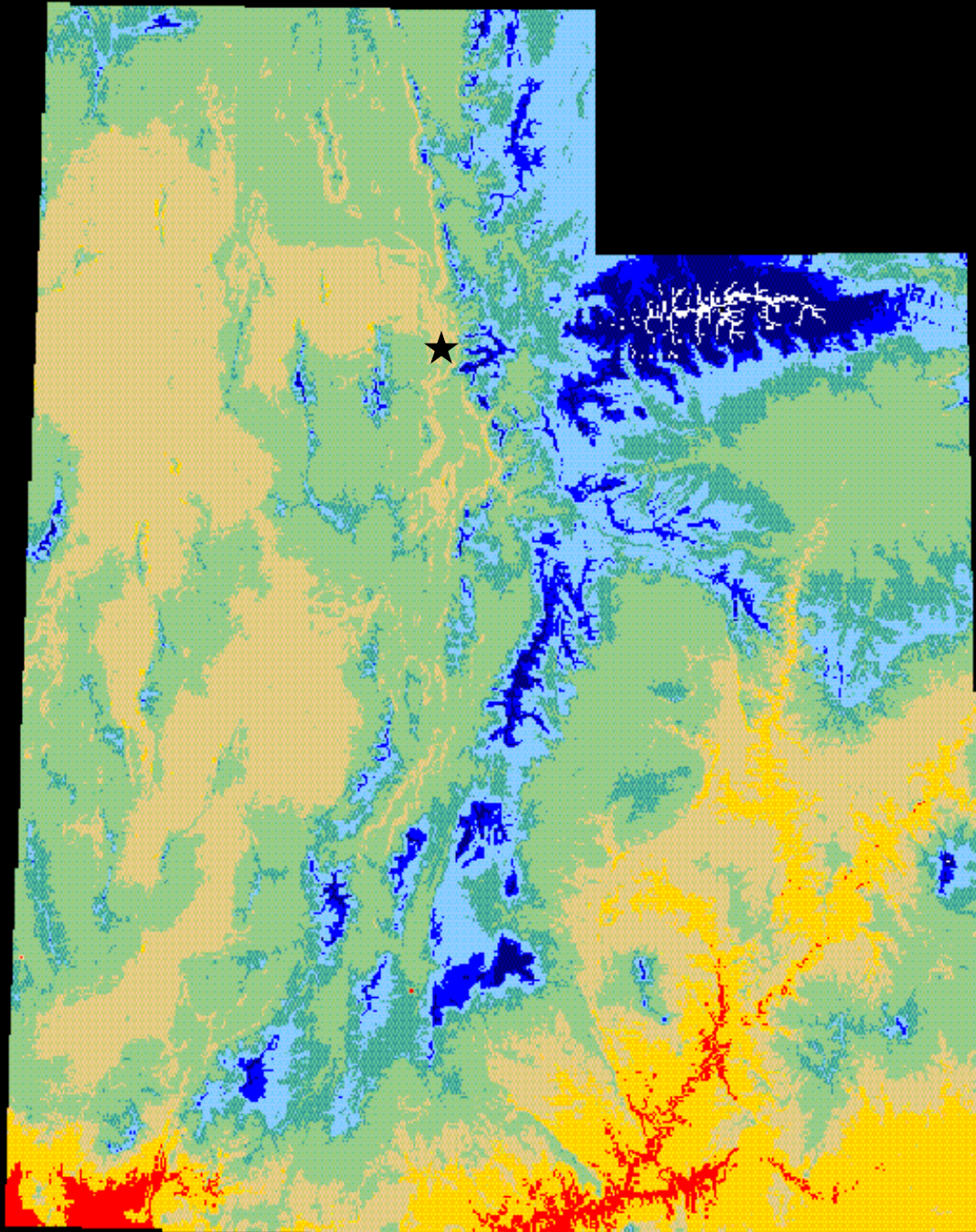
- Lower low temperatures (winter) (- tree effect)
- Lower high temperatures (summer) (+ -)
- Shorter growing season (later, earlier frosts) (-)
- Snow lasts longer, soils dry out slower (- +)
- Increased precipitation (summer and total) (+)
- Decreased ET (lower summer temp, higher humidity) (+)
- Increased climate fluctuations (~)

Temperature



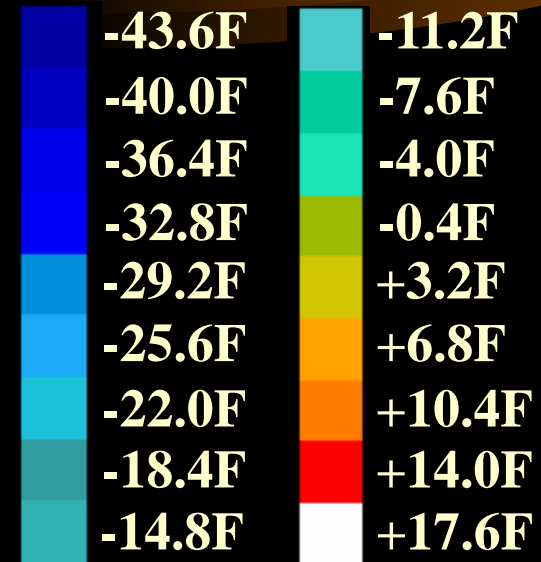
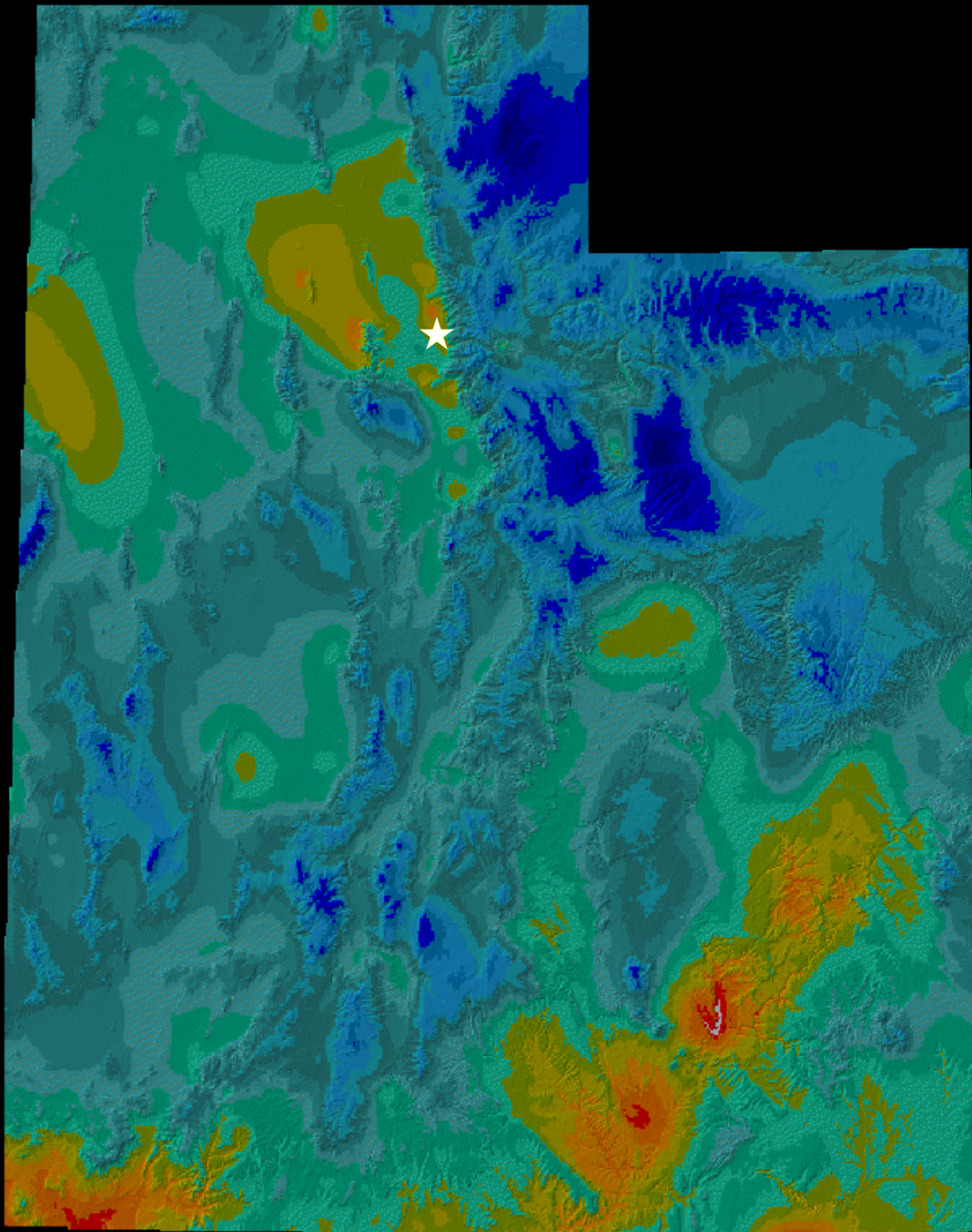
- 5F decrease per 1,000' (adiabatic cooling)
 - From SLC at 4,200' to Park City at 9,000' can get a 24F temperature drop
- 1F decrease per degree latitude north
 - From Bluff at about 37 latitude to Logan at about 42 latitude can get a 5F temperature drop (same elevation)
- So, Utah gets cooler as you go up in elevation and as you go farther north

Cooler temperatures



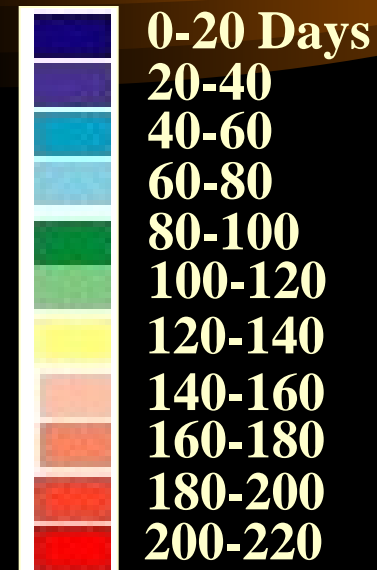
Mean Annual Temperature
(source [www.nr.usu.edu/
Geography-Department/
utgeog/climate.html](http://www.nr.usu.edu/Geography-Department/utgeog/climate.html))

Cooler minimum temperatures

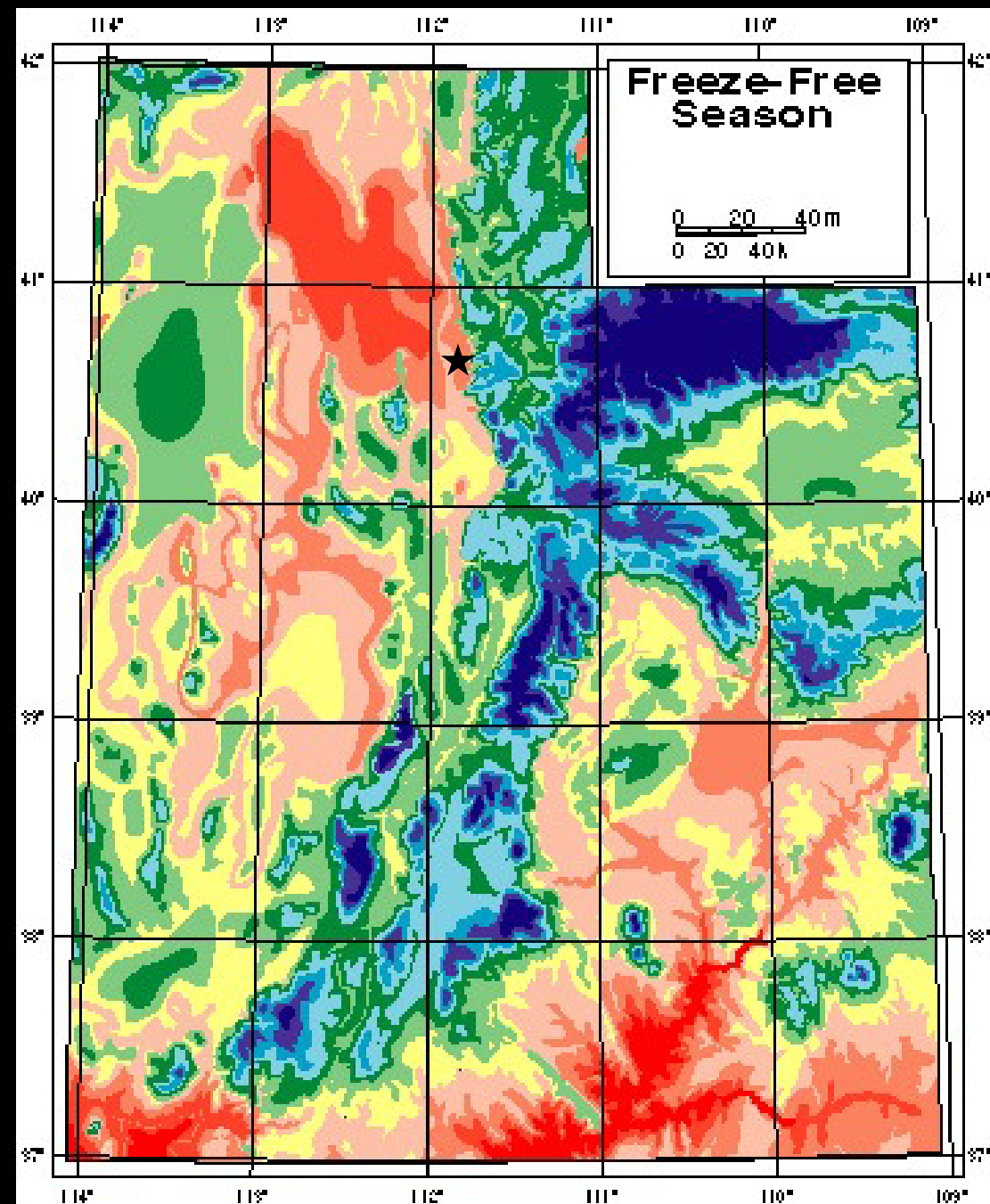


30 Year Mean Minimum Temp
(source [www.nr.usu.edu/
Geography-Department/
utgeog/climate.html](http://www.nr.usu.edu/Geography-Department/utgeog/climate.html))

Shorter growing season (frost-free)

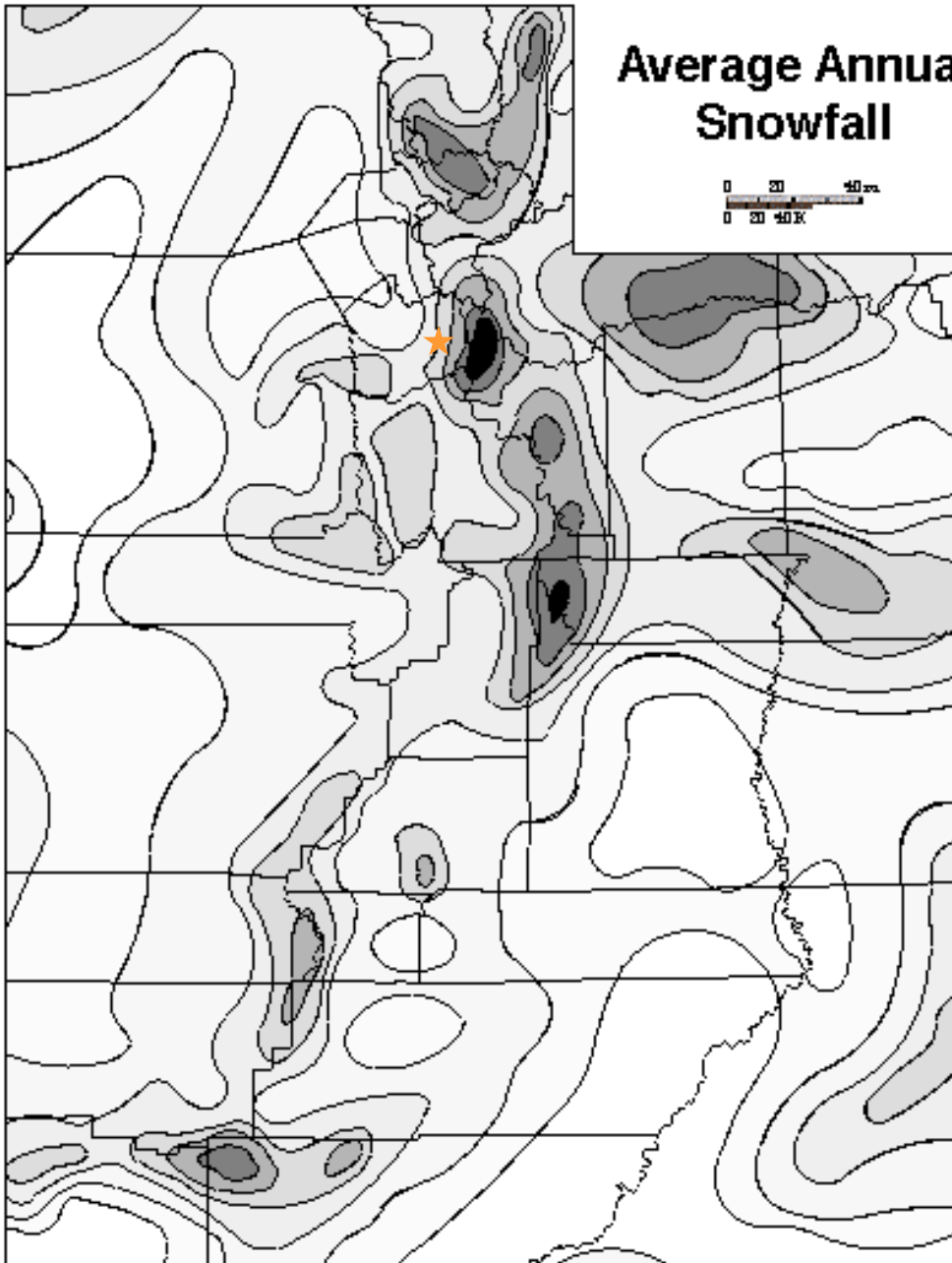


Average frost free season (days)
(source www.engineering.usu.edu/uwrl/atlas/ch2/ch2freezetemp.html)



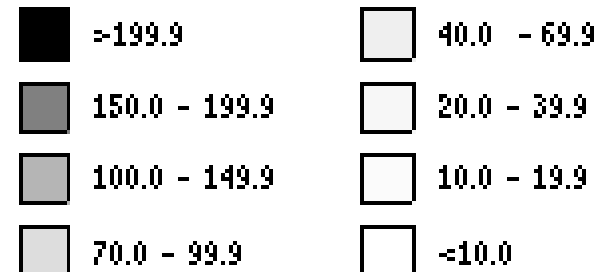
*Snow lasts
longer*

**Average Annual
Snowfall**



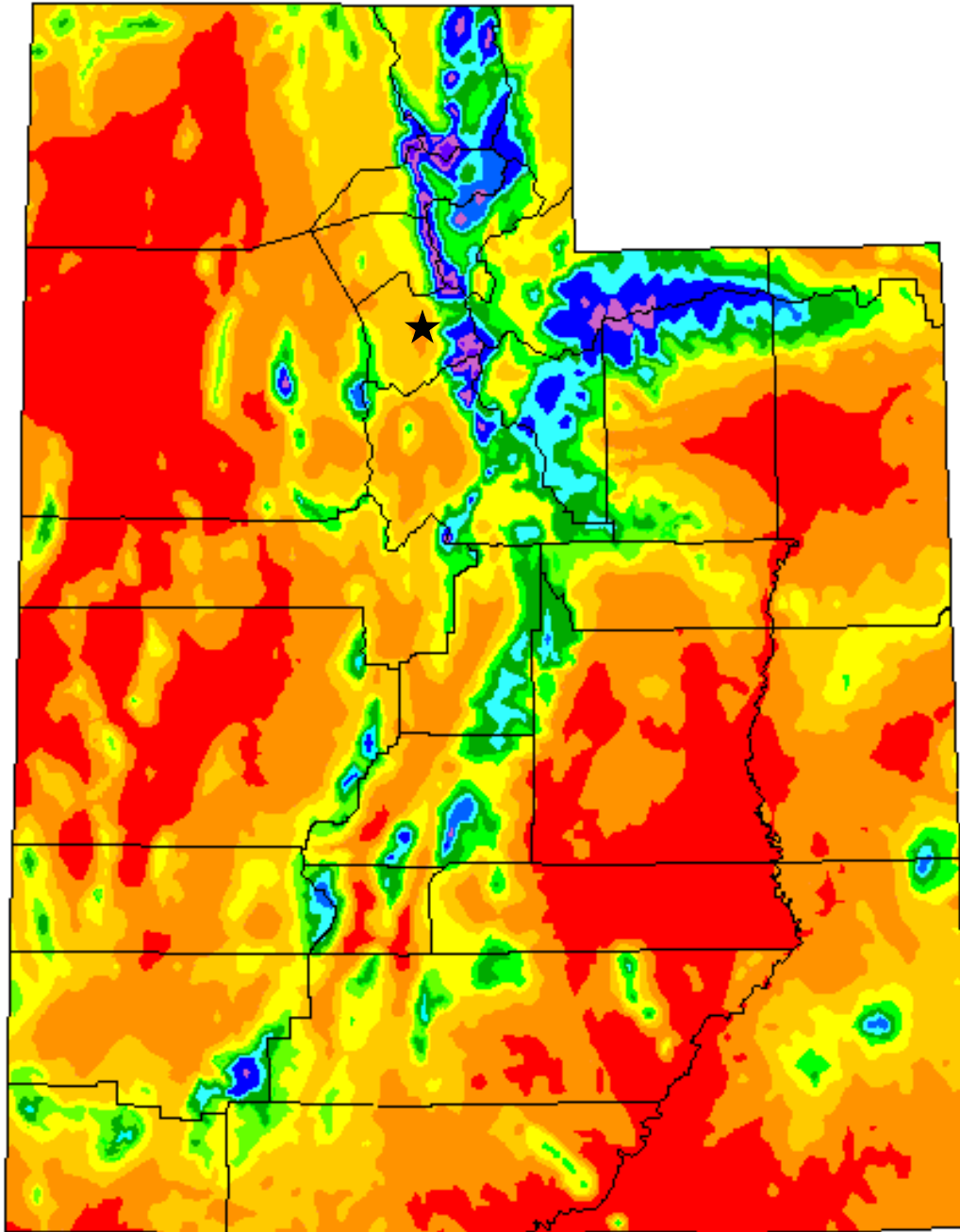
Legend

Snowfall in inches













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

Increased precipitation



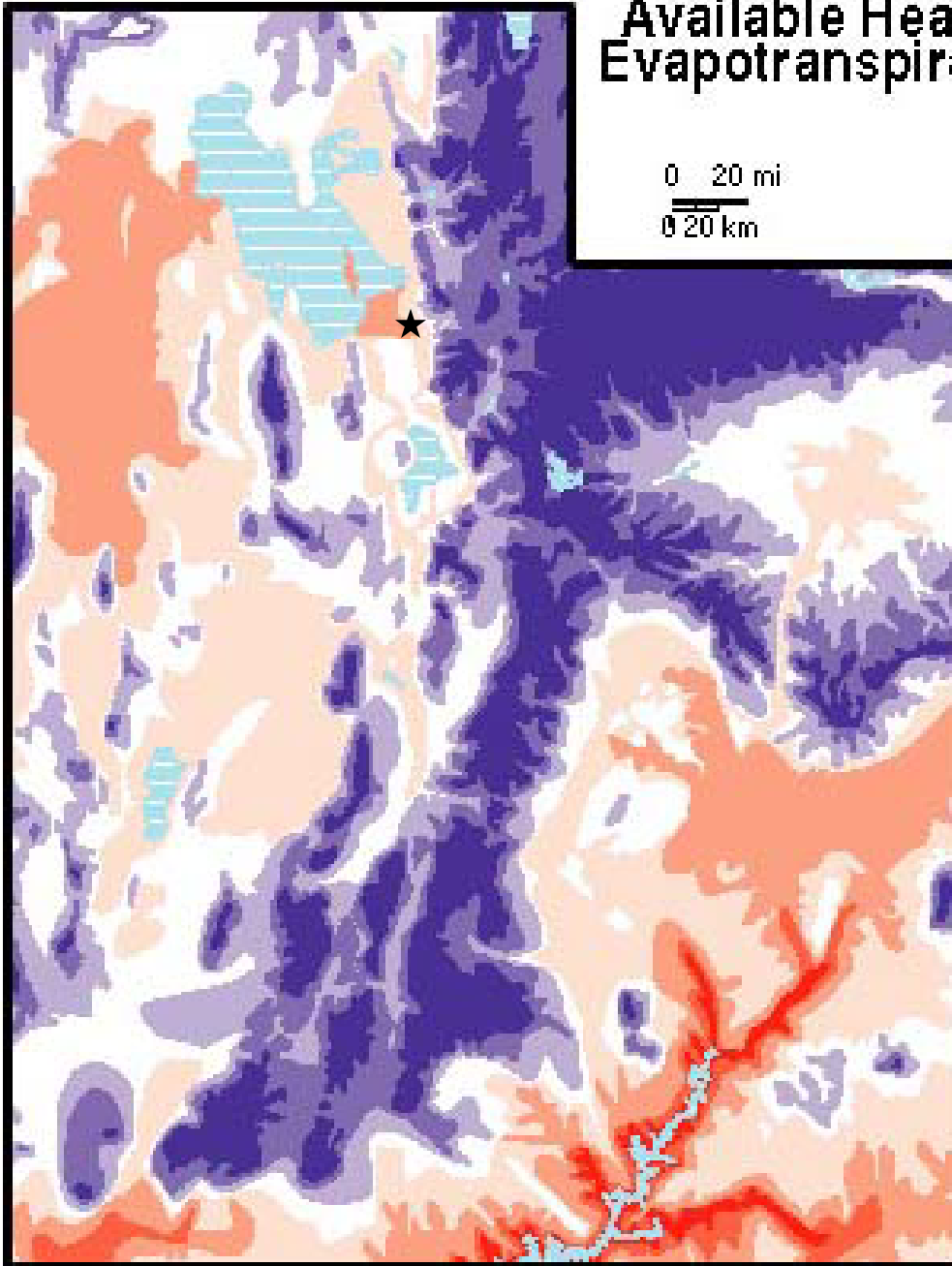
Legend (inches per year)

	Less than 8		24 to 28
	8 to 12		28 to 32
	12 to 16		32 to 40
	16 to 20		40 to 50
	20 to 24		More than 50

**Mean Annual Precip
1961-1990**

Available Heat & Potential Evapotranspiration Indexes

0 20 mi
0 20 km



*Decreased
ET*

Legend

Frost Free Period Heat Units	Annual Potential Evapotranspiration
Below - 2,000	Below - 18 in
2,000 - 3,000	18 - 21
3,000 - 4,000	21 - 24
4,000 - 5,000	24 - 27
5,000 - 6,000	27 - 30
6,000 - 7,000	30 - 33
7,000 - 8,000	33 - 36
8,000 - Above	36 - Above

Average PET (inches)
(source www.engineering.usu.edu/uwrl/atlas/ch3/ch3potevapot.html)

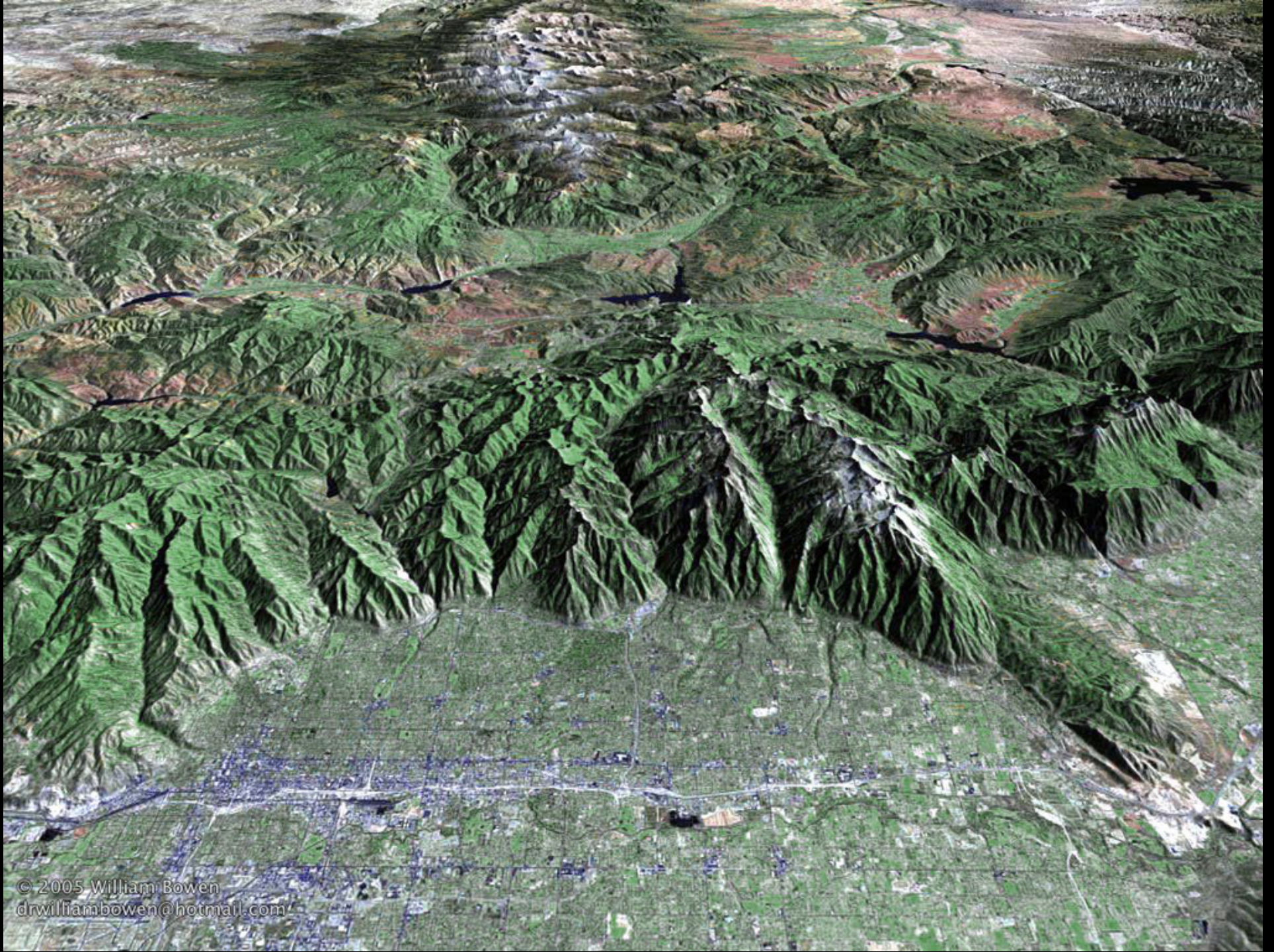
Higher elevation in Utah often means:

- 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) (-)

A topographic map of Salt Lake City, Utah, and its surrounding mountainous terrain. The city is marked with a yellow star and labeled "Salt Lake City" in yellow text. The map shows the city situated in a valley, with steep, rugged mountains rising on all sides. The mountains are depicted with brown and tan shading to indicate elevation. A large body of water, Lake Utah, is visible in the upper left corner. The overall terrain is characterized by high relief and complex mountain ranges.

Salt Lake
City

Relief/aspect

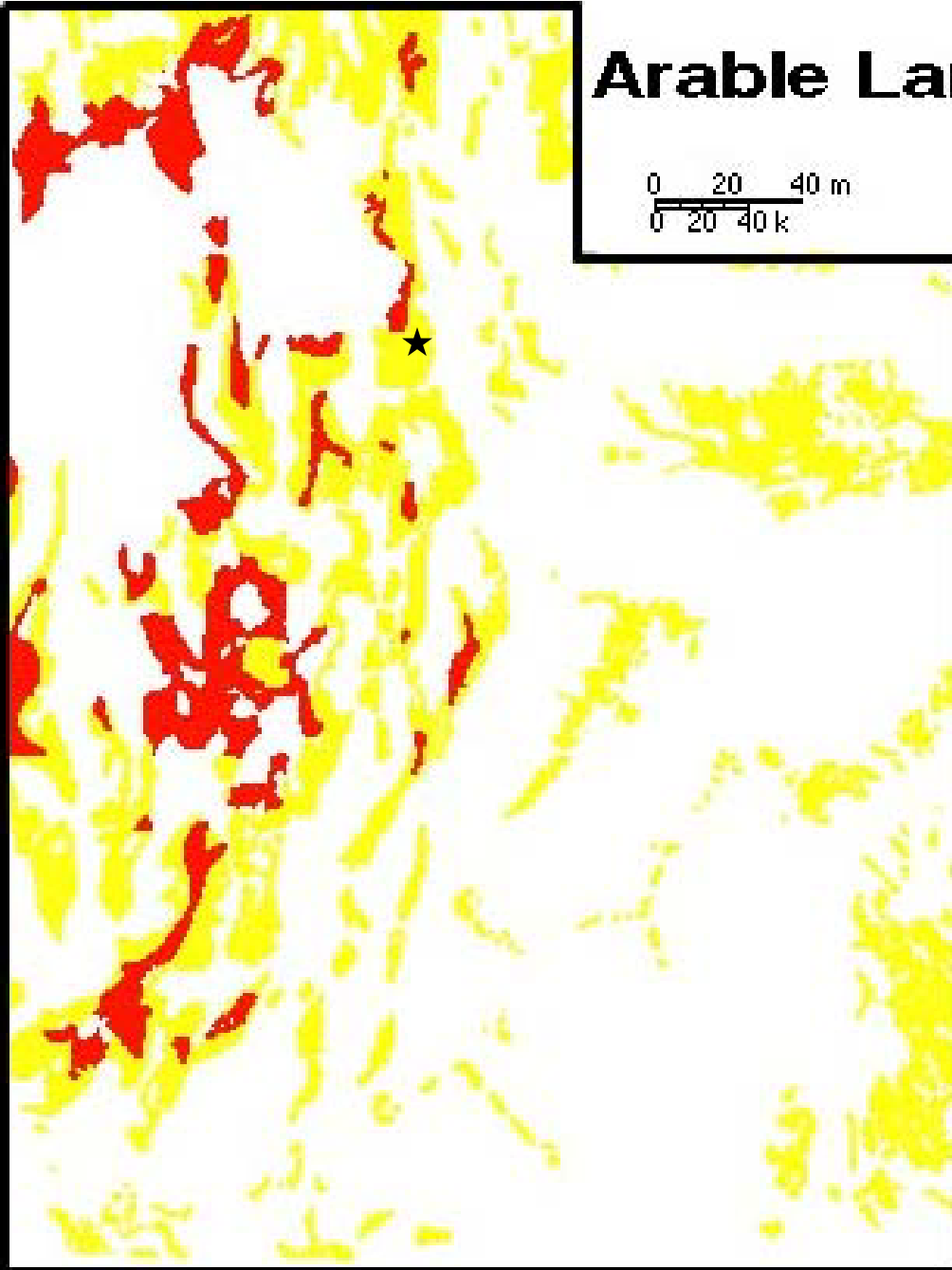


Relief/aspect



Arable Lands

0 20 40 m
0 20 40 k



*Poorer soils
(arability)*

Legend

- Arable
- Arable/Drainage

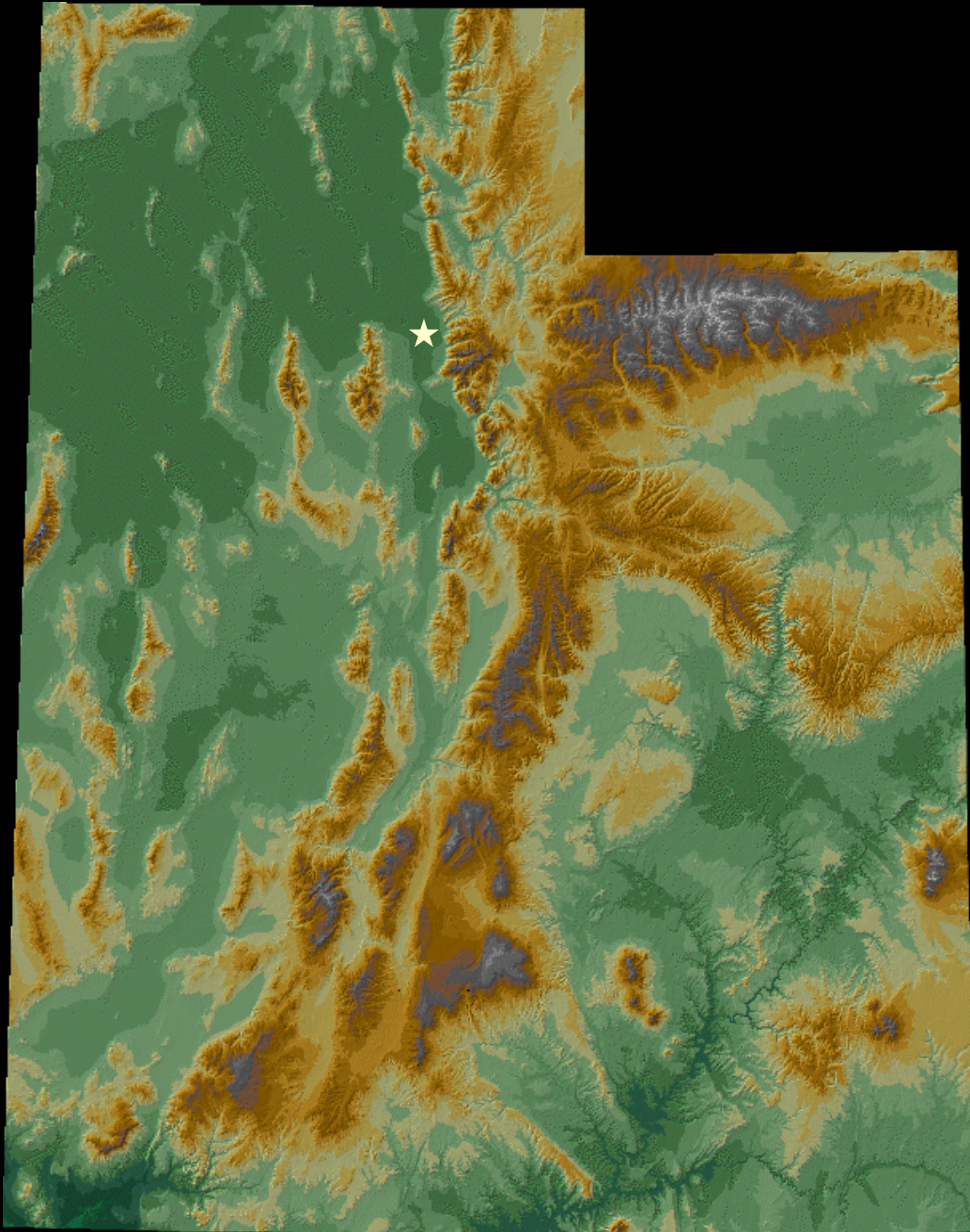
(source www.engineering.usu.edu/uwrl/atlas/ch3/ch3arable.html)

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



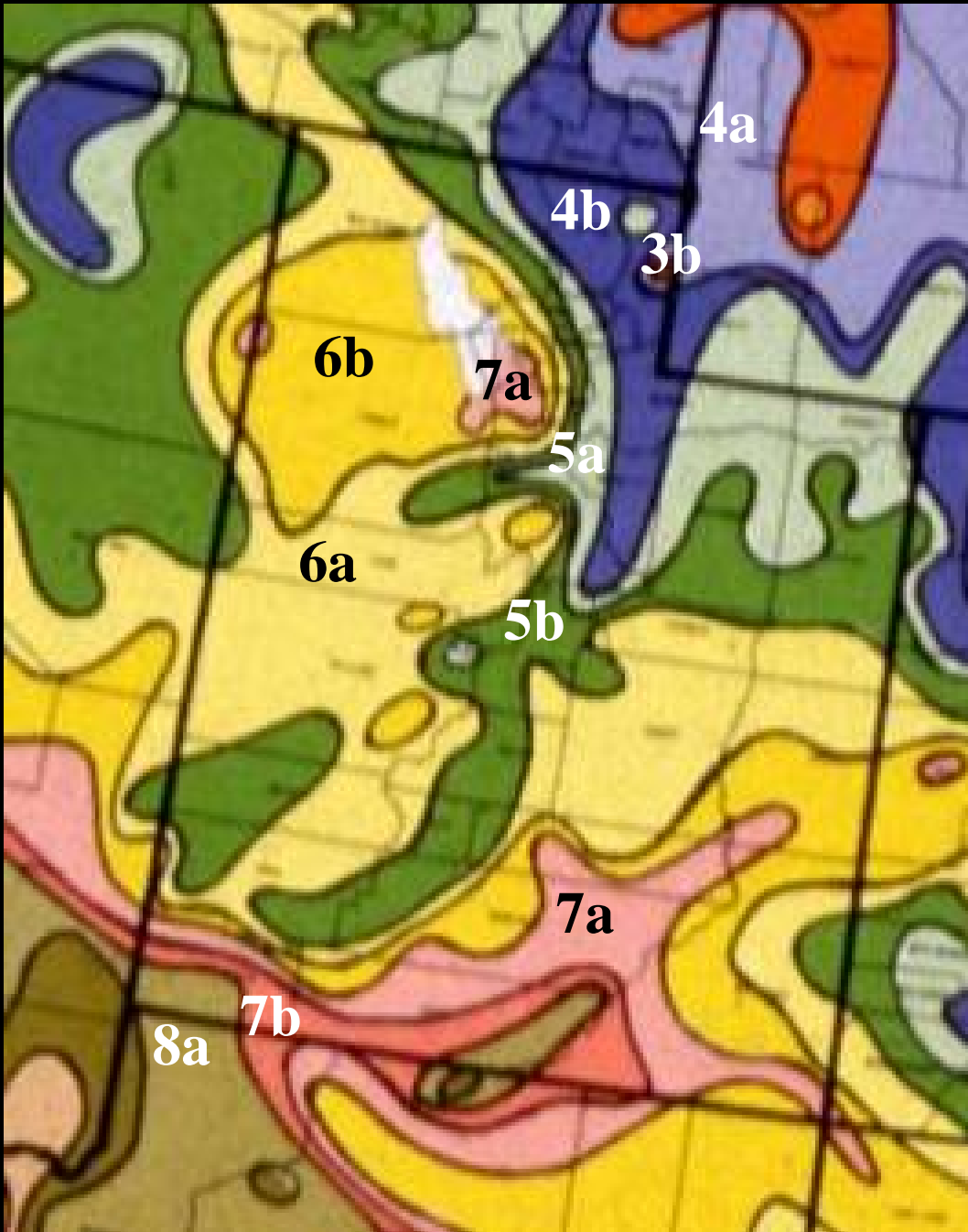
Site and tree assessment is crucial

- 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

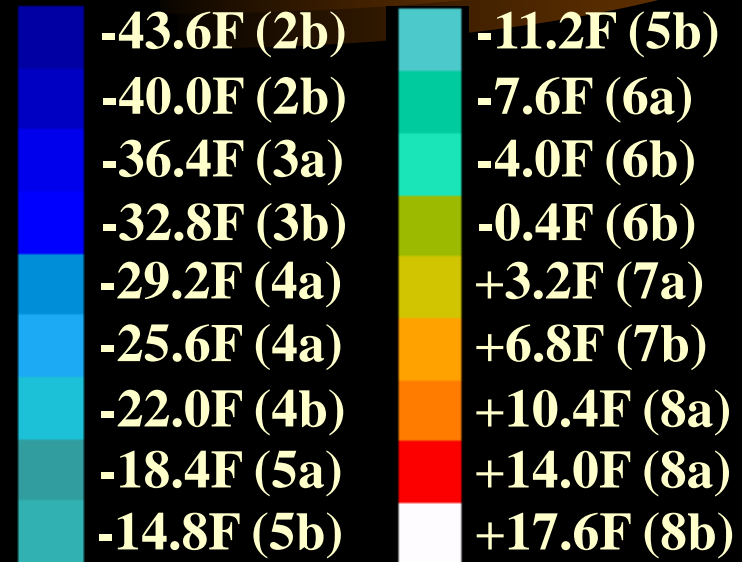
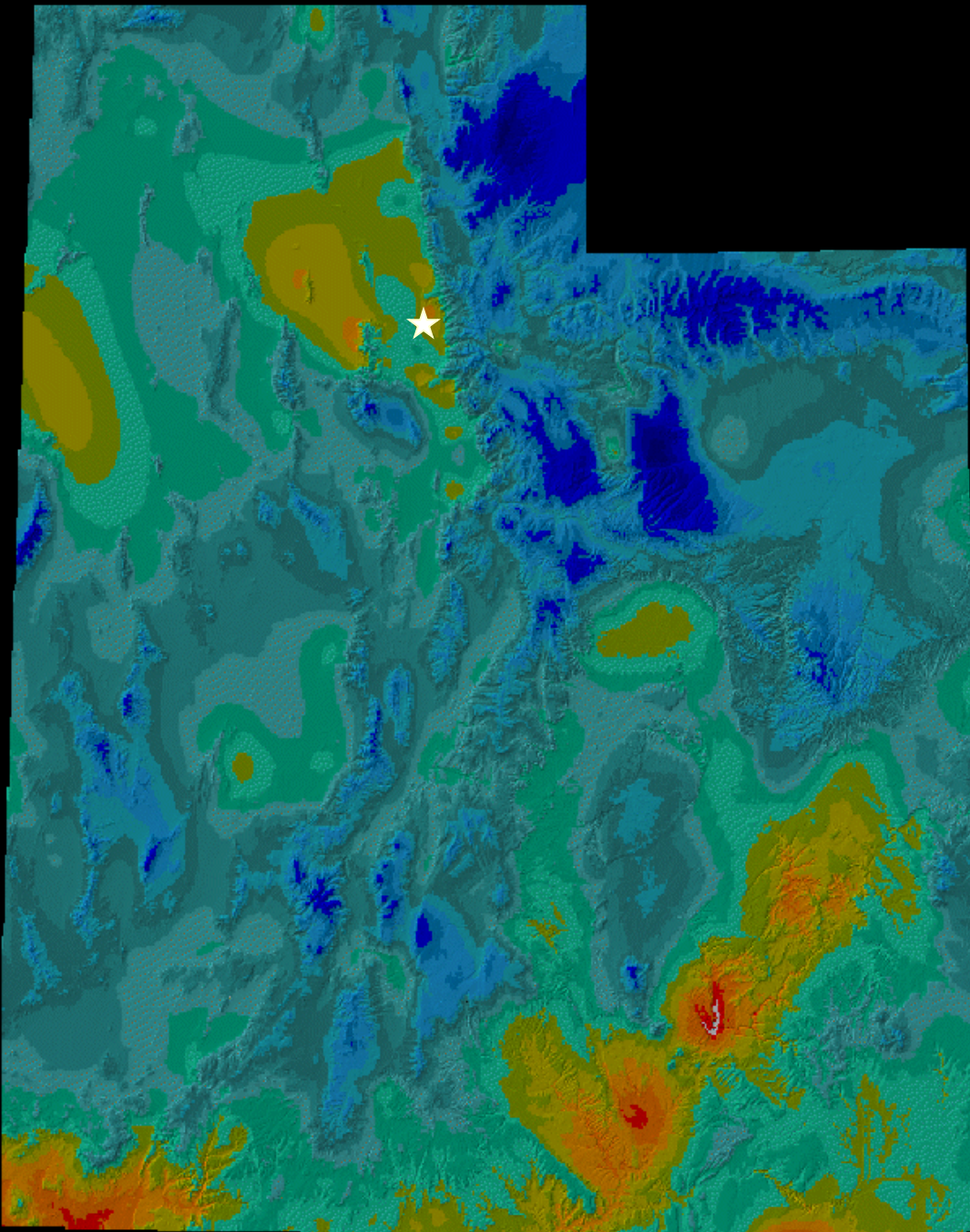
Station	Elevation (feet)	Zone (Ave., Min.)
Summit Coalville	5550	5, 3
Summit Echo	5470	4, 3
Summit Kamas 3 NW	6480	5, 3
Summit Wanship	5940	4, 3
Wasatch Deer Creek	5270	5, 3
Wasatch Heber	5630	5, 3
Wasatch Snake Creek	6010	5, 3



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](http://www.nr.usu.edu/Geography-Department/utgeog/climate.html))

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

Trees for high elevations in Utah – Natives

- Selected broadleaves (15 in UTB)
 - canyon maple (*Acer grandidentatum*)
 - water or river birch (*Betula occidentalis*)
 - curleaf 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 dioica*)
- 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, purplebloss (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, Lavalley (*Crataegus laevigata*, *viridis*, x *lavalleyi*)
- 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)



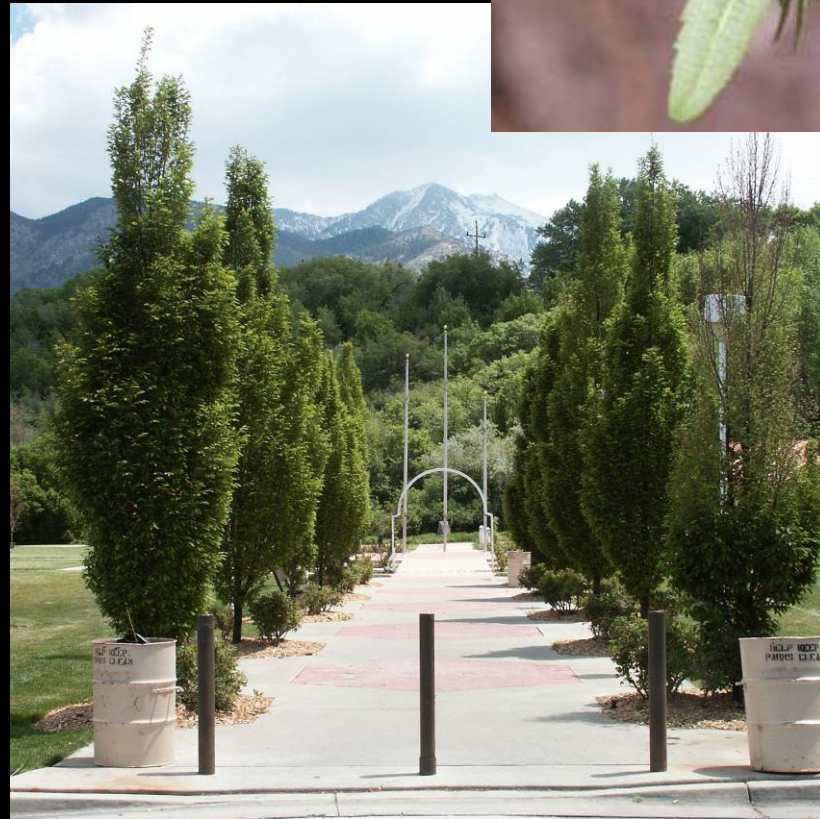
canyon maple (*Acer grandidentatum*; Zone 4)* (native)



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 dioica*; Zone 3)



yellow-poplar (*Liriodendron tulipifera*; Zone 4)



Loebner magnolia (*Magnolia x loebneri* 'Leonard Messel'; Zone 3)



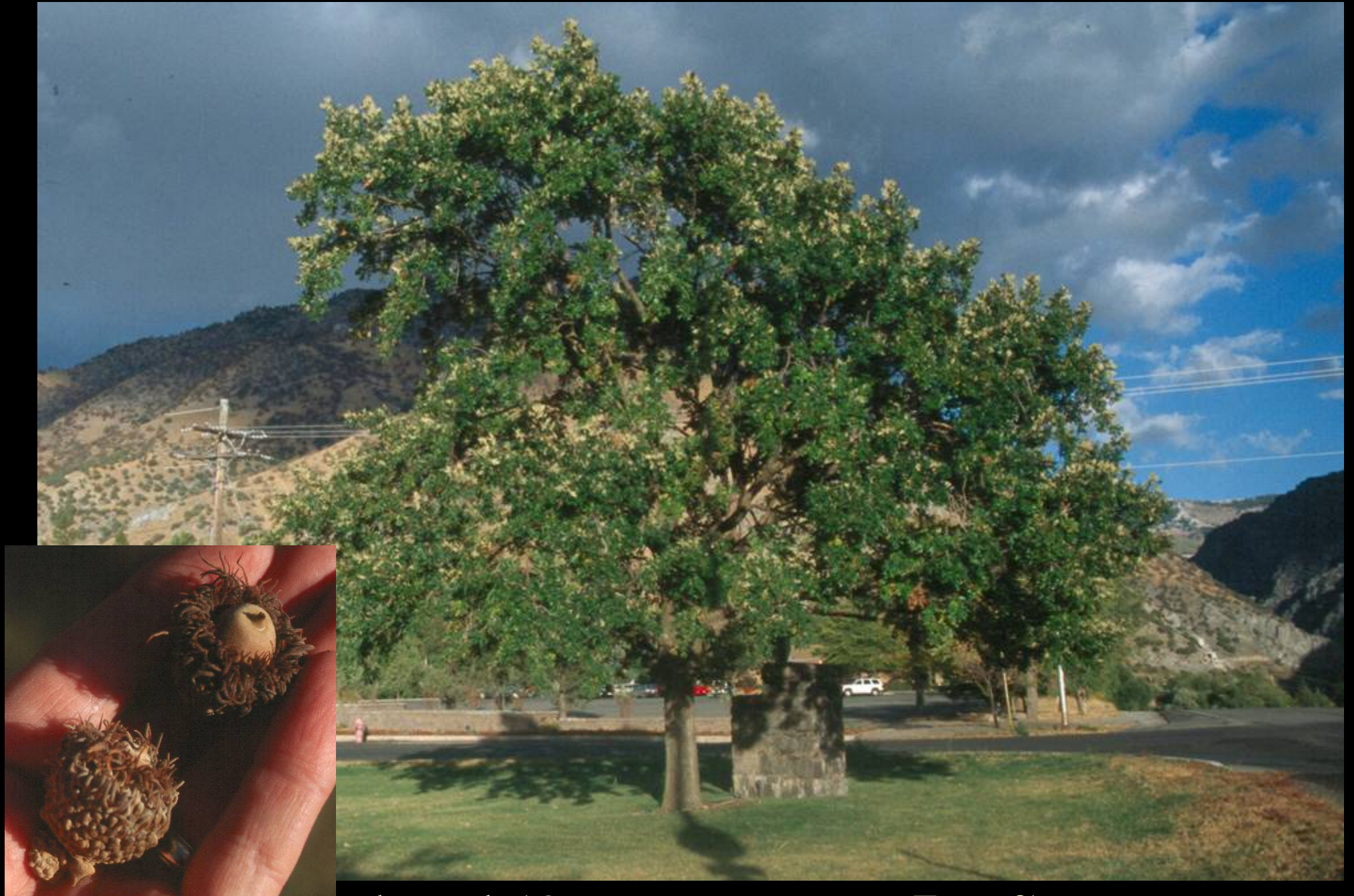
star magnolia (*Magnolia stellata*; Zone 4)



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)*



‘Gray Gleam’ cv.



European larch (*Larix decidua*; Zone 4)



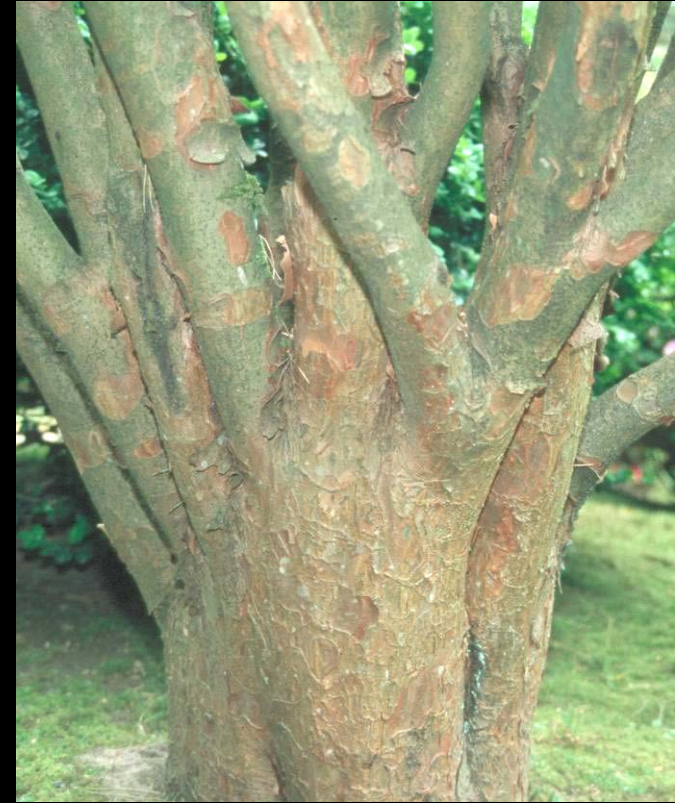
Blackhills (white) spruce (*Picea glauca* 'Densata'; Zone 2)



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

The screenshot shows the Utah Tree Browser website. At the top, there's a search bar labeled "FIND A TREE" and a question mark icon. Below this, the "CHARACTERISTICS" section on the left allows filtering by General (Family, Cultivar Availability, Hardiness Zone, Type, Utah Native), Growth (Growth Rate, Mature Height, Longevity, Power Lines, Crown Shape), Ornamental (Flowers, Fruit, Foliage, Fall Color, Bark), and Tolerance of... (Shade, Salt, Drought, Poor Drainage, Alkalinity, Transplanting). The "TREE LIST" table in the center shows columns for Common Name, Scientific Name, Family, and Favorites. The table lists various trees like Alder, Apple, Apricot, Arborvitae, Ash, and Fraxinus. The right side of the interface shows a detailed fact sheet for "Alder, European or Common" (*Alnus glutinosa*), including its general characteristics, growth rate, ornamental features, and tolerance levels. A "Favorites" section with a "Clear" button is also present. The bottom right corner features the "Utah State University COOPERATIVE EXTENSION" logo.

Common Name	Scientific Name	Family	Favorites
Alder, European or Common	<i>Alnus glutinosa</i>	Betulaceae - Birch	<input type="checkbox"/>
Alder, Thinleaf or Mountain	<i>Alnus tenuifolia</i>	Betulaceae - Birch	<input type="checkbox"/>
Apple	<i>Malus pumila</i>	Rosaceae - Rose	<input type="checkbox"/>
Apricot	<i>Prunus armeniaca</i>	Rosaceae - Rose	<input type="checkbox"/>
Arborvitae, Oriental	<i>Thuja (Platycladus) orientalis</i>	Cupressaceae - Cypress	<input type="checkbox"/>
Ash, Blue	<i>Fraxinus quadrangulata</i>	Oleaceae - Olive	<input type="checkbox"/>
Ash, European	<i>Fraxinus excelsior</i>	Oleaceae - Olive	<input type="checkbox"/>
Ash, Green	<i>Fraxinus pennsylvanica</i>	Oleaceae - Olive	<input type="checkbox"/>
Ash, Singleleaf or Dwarf	<i>Fraxinus anomala</i>	Oleaceae - Olive	<input type="checkbox"/>

Alder, European or Common
Alnus glutinosa

General
Family: Betulaceae - Birch
Cultivar Availability: Yes
Hardiness Zone: 3 - 7
Type: Broadleaf
Utah Native: No

Growth
Growth Rate: High
Mature Height: Medium
Longevity: Medium
Power Lines: No
Crown Shape: Oval

Ornamental
Flowers: No
Fruit: Yes
Foliage: No
Fall Color: No
Bark: No

Tolerance of...
Shade: Medium
Salt: Low
Drought: Medium
Poor Drainage: High
Alkalinity: Medium
Transplanting: High

Leaves: Dark green, glossy, hairless above, paler green below with tufts of hair on veins; alternate; simple, oval to circular, 2" to 4" long; apex is rounded or notched; broadly wedge-shaped base, gummy when young, edges coarsely and doubly toothed; tufts of fine hair below where veins meet; veins in 6-8 pairs; petiole 1/2" to 1" long; some cultivars have lobed leaves; deciduous.

Twigs/buds: Twigs greenish-brown to brown, hairless, sticky. Buds on stalks; 1/4" to 1/2" in.

TreeBrowser

References



- Books
 - Dirr, Manual of Woody Landscape Plants
 - Kuhns, Trees of Utah and the Intermountain West
- Web sites
 - forestry.usu.edu
 - www.treebrowser.org
 - www.usna.usda.gov/Hardzone/ushzmap.html

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