2
Study Sites

The three sites of this study surround and include three different sky islands within southeastern Arizona: the Catalina-Rincons, Chiricahuas and Huachucas.

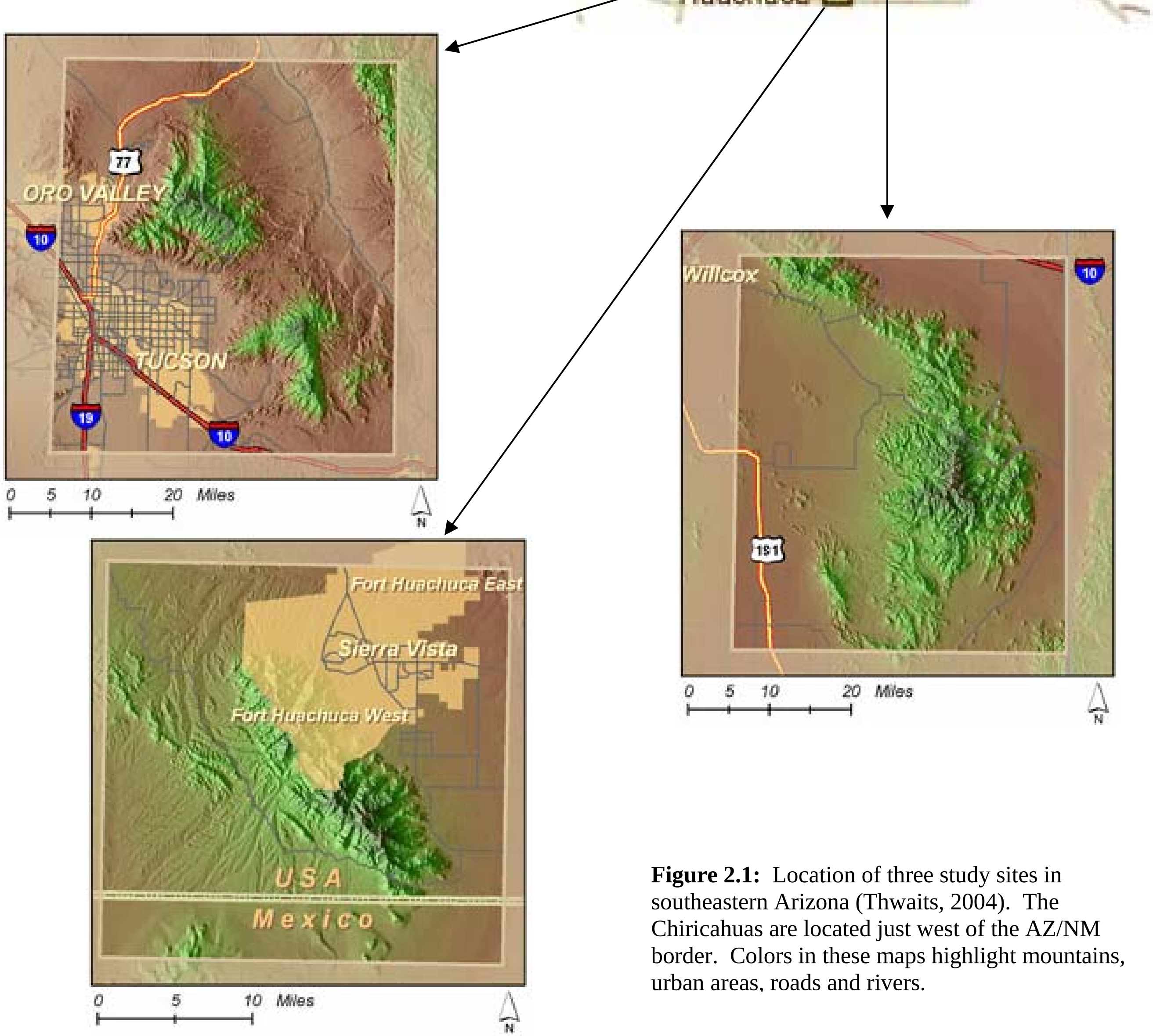


Figure 2.1: Location of three study sites in southeastern Arizona (Thwaits, 2004). The Chiricahuas are located just west of the AZ/NM border. Colors in these maps highlight mountains, urban areas, roads and rivers.

2.1
Elevation

Southeastern Arizona is characterized by a classic basin and range topography with numerous mountain ranges, or *sky islands*, studding a relatively level plain that rises from about 914 meters at the base of the Catalina-Rincons to about 1524 meters at the base of the Huachucas. The Catalina-Rincon site spans the largest range of elevation of the three sites, while the Chiricahuas and Huachucas are situated in higher elevation lowlands and rise to higher elevation peaks (Warshall, 2004).

Table 2.1: Elevations of bases and highest peaks and ranges spanned across the sky islands located in the three study sites (Warshall, 2004).

Mountains	High point	Elevation (m)	Base (m)	Range (m)
Chiricahua	Chiricahua Peak	2986	1372	1614
Huachucas	Miller Peak	2885	1524	1361
Rincon	Mica Mountains	2641	914	1727
Santa Catalina	Mount Lemmon	2791	914	1877

Figure 2.2: Looking north from I-10 to the south side of the Rincons.

The map shown in figure 2.3 illustrates elevational variation across the three study site region.

Figures 2.4-2.6 show close up elevation maps of each of the study sites.

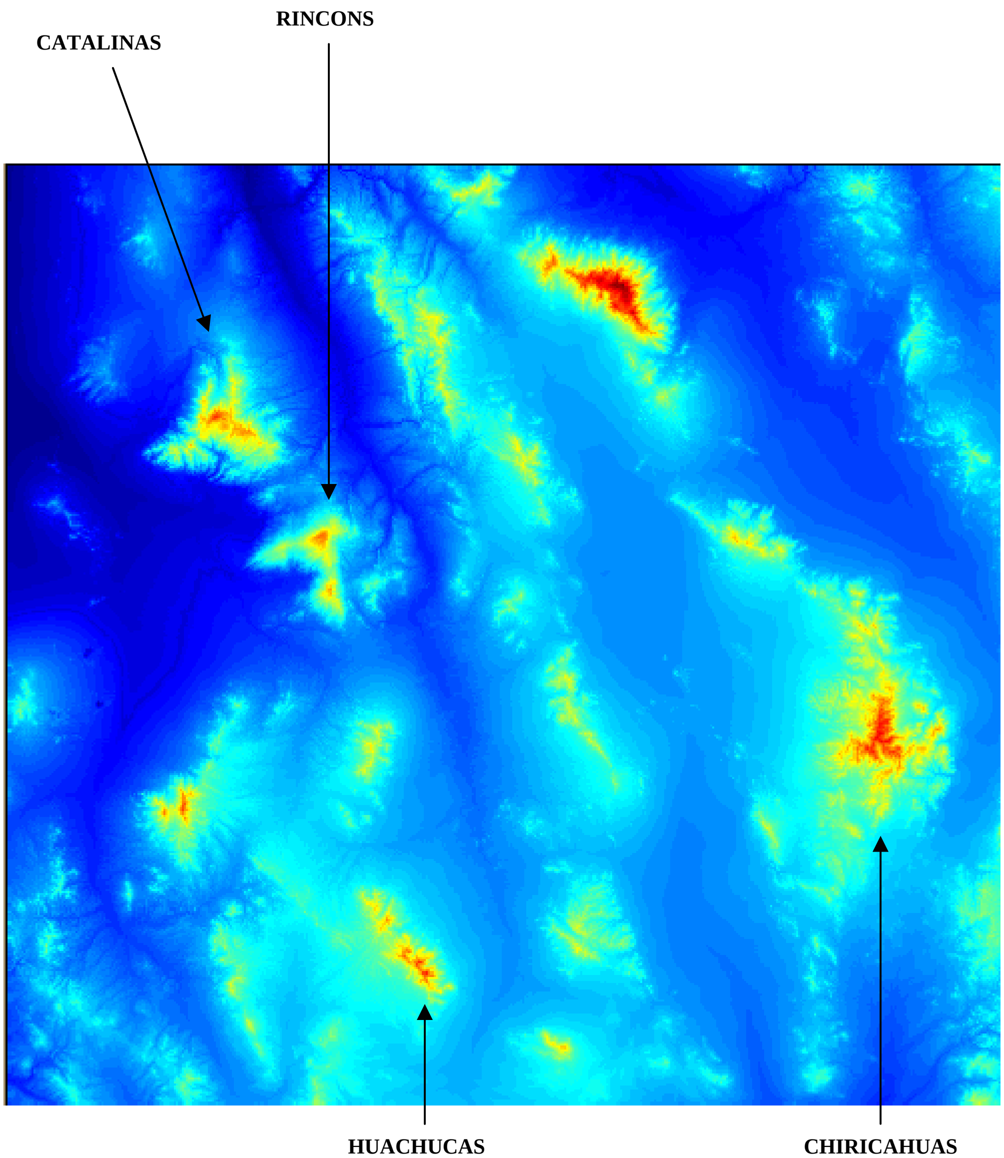


Figure 2.3: Map showing elevations of portion of southeastern Arizona that contains the three study sites. This map was created in Imagine from a 30 meter DEM and a Matlab jet-based colormap of depth 256.

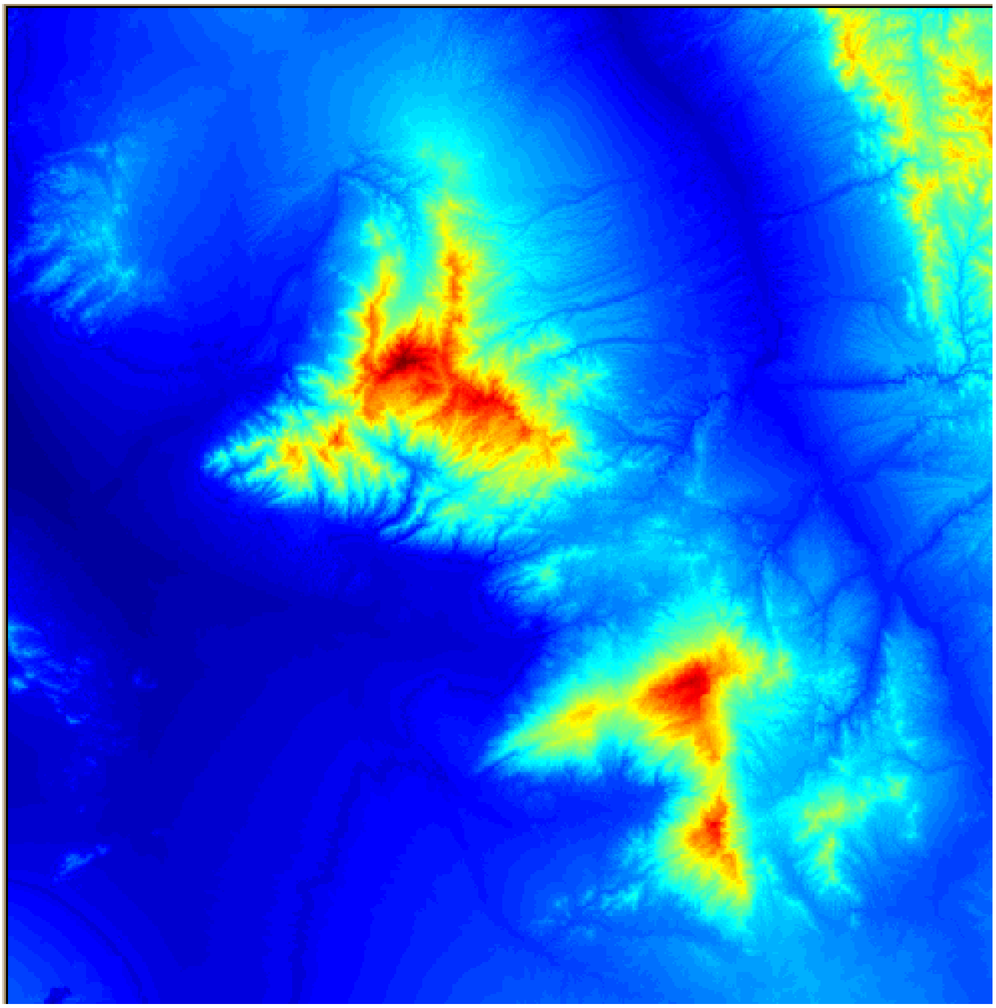


Figure 2.4: Elevations in the Catalina-Rincon study site. This map was created using a 30 meter DEM and a 256 depth Matlab jet-based color map.

637 meters  2789 meters

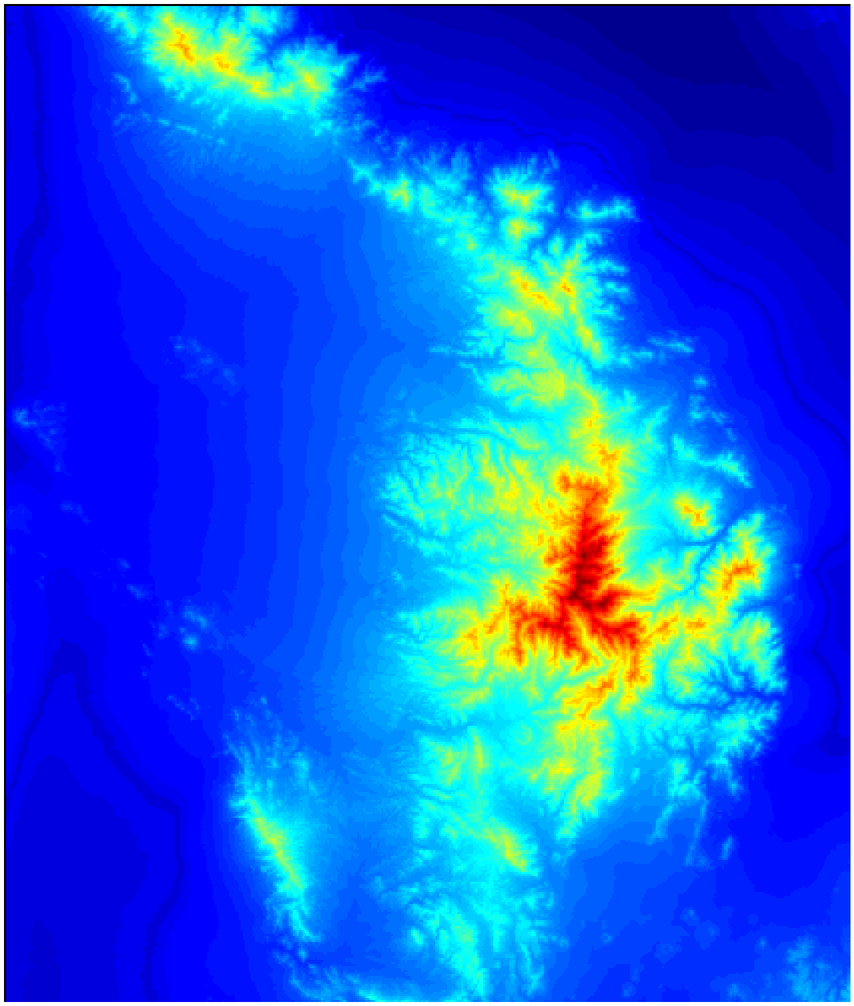


Figure 2.5: Elevations in the Chiricahua study site. This map was created using a 30 meter DEM and a Matlab jet-based colormap of depth 256.

1096 meters 2975 meters

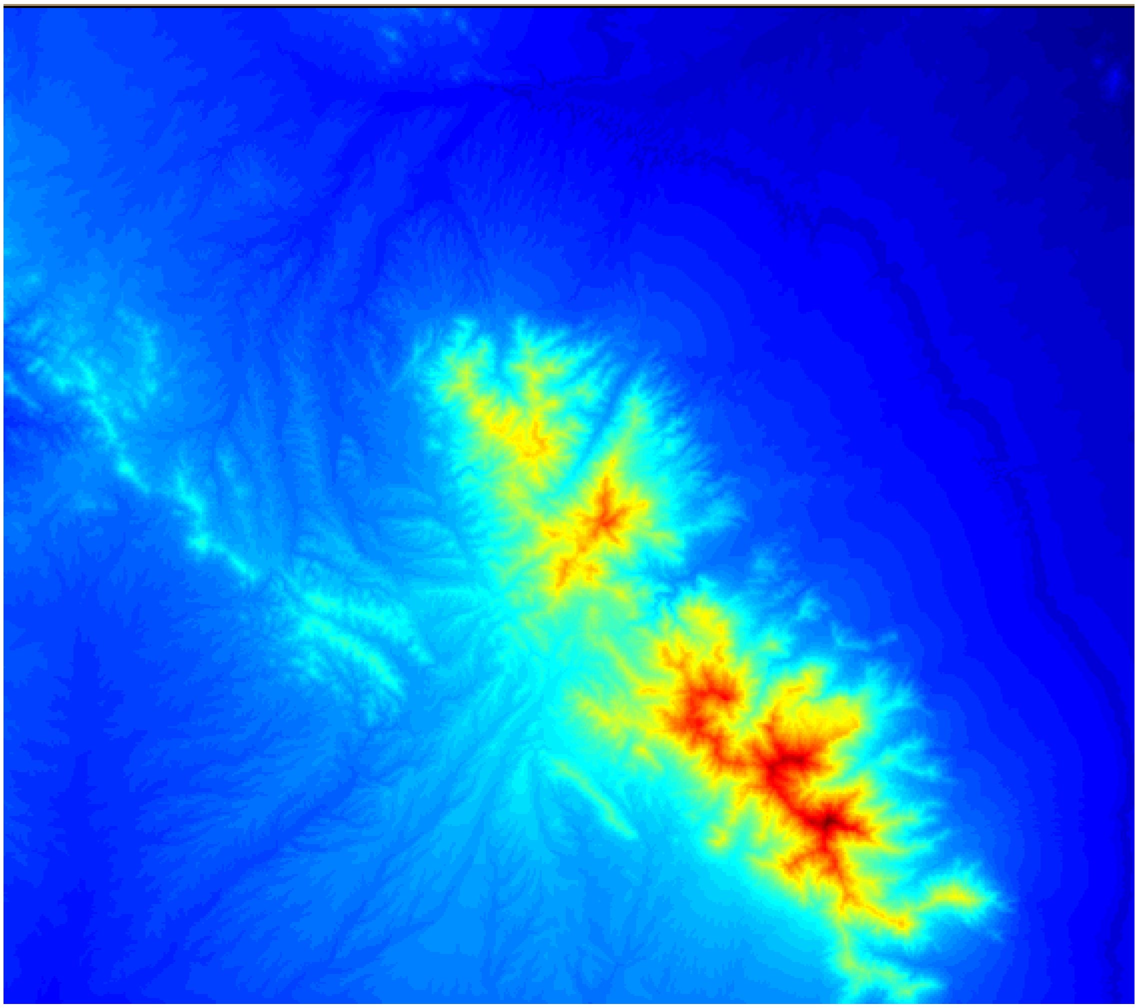


Figure 2.6: Elevations in the Huachuca study site. This map was created using a 30 meter DEM and a Matlab jet-based colormap of depth 256.

1188 meters  2882 meters

2.2
Vegetation

The large range of elevation and highly variable topography found over these sky island sites supports a rich biodiversity. Vegetation can transition from desert scrub or grassland at the base of sky islands to forests of mixed conifers or even subalpine firs at their heights. As far back as the nineteenth century, the concept of “life zones” was developed by Merriam, who identified climate/vegetation relationships in the San Francisco peaks in northern Arizona (Merriam, 1890). Forrest Shreve extensively documented observed relationships between vegetation and climate with changing elevation and topography in the Catalinas (Shreve, 1915). Later workers have confirmed that major vegetation communities form a sequence of zones that situate themselves around slopes, thriving where elevation and aspect combine to create favorable microclimates (Brown, 1994; Whittaker and Neiring, 1964, 1968). Figure 2.7 provides a diagram that schematizes the close relationship between location of vegetation communities and elevation and aspect in southeastern Arizona sky islands. Figures 2.8 and 2.9 provide more detailed diagrams for the south slope of the Catalinas and the north slope of the Catalinas.

Vegetation maps for the entire study site area and close-up maps of each study site follow in figures 2.10-2.16.

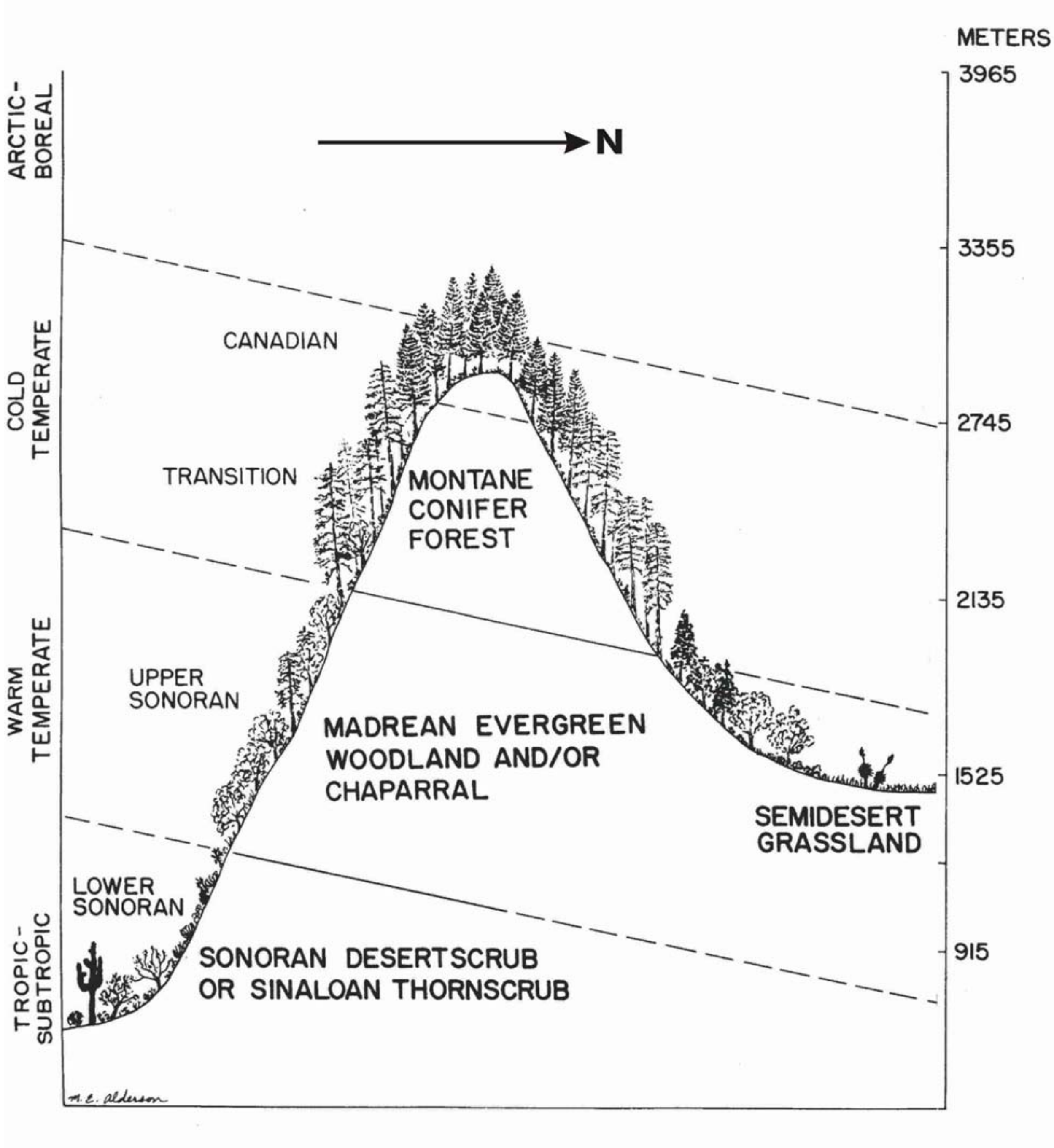


Figure 2.7: Diagram illustrating distribution of vegetation types about sky islands in southeastern Arizona and the concordance of Merriam's "life-zones" with biotic communities. Based on diagram in Brown (1994).

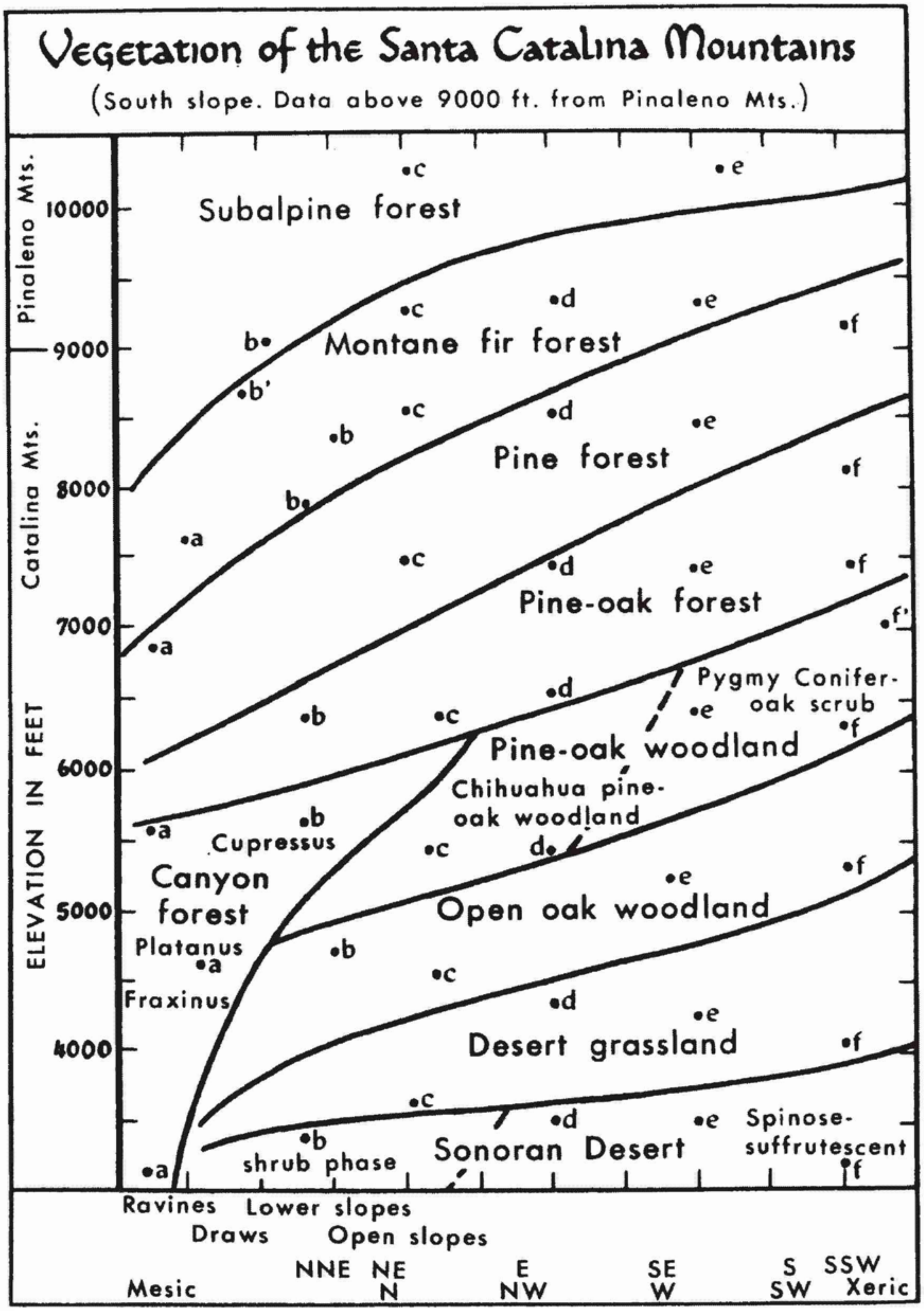
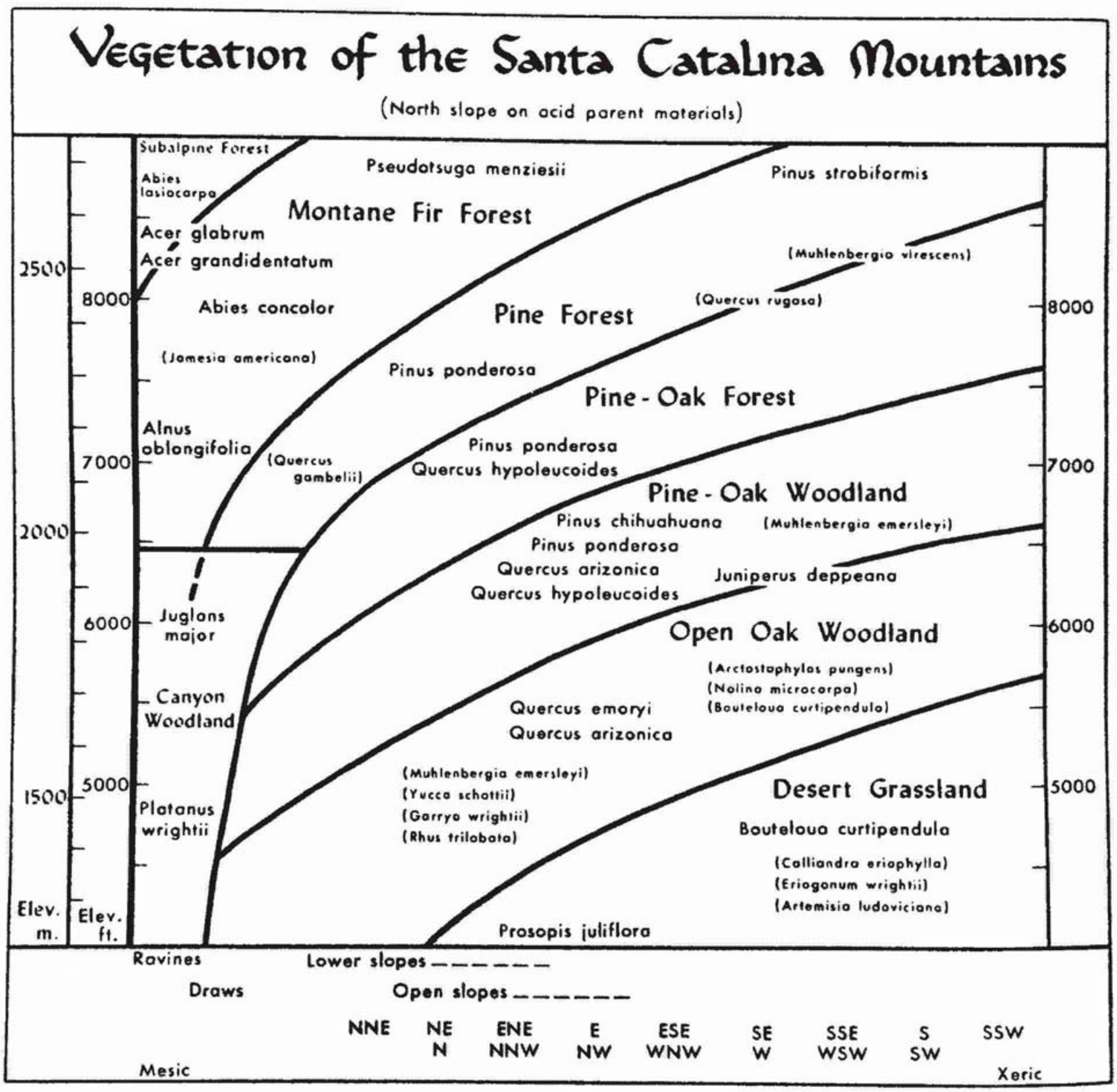


Figure 2.8: Diagram illustrating distribution of vegetation types along south slope of the Catalina mountains (Whittaker and Niering, 1964).



Vegetation pattern of the northeast side of the Santa Catalina Mountains, Arizona, on acid parent materials (quartz diorite, etc.) near the Oracle Road, based on 180 vegetation samples. Major species are indicated by their areas of maximum importance; dominants of lower strata are indicated in parentheses. A corresponding diagram for the south side of the range is given by Whittaker & Niering (1964, 1965).

Figure 2.9: Diagram illustrating distribution of vegetation types along north slope of the Catalina mountains (Whittaker and Niering, 1968).

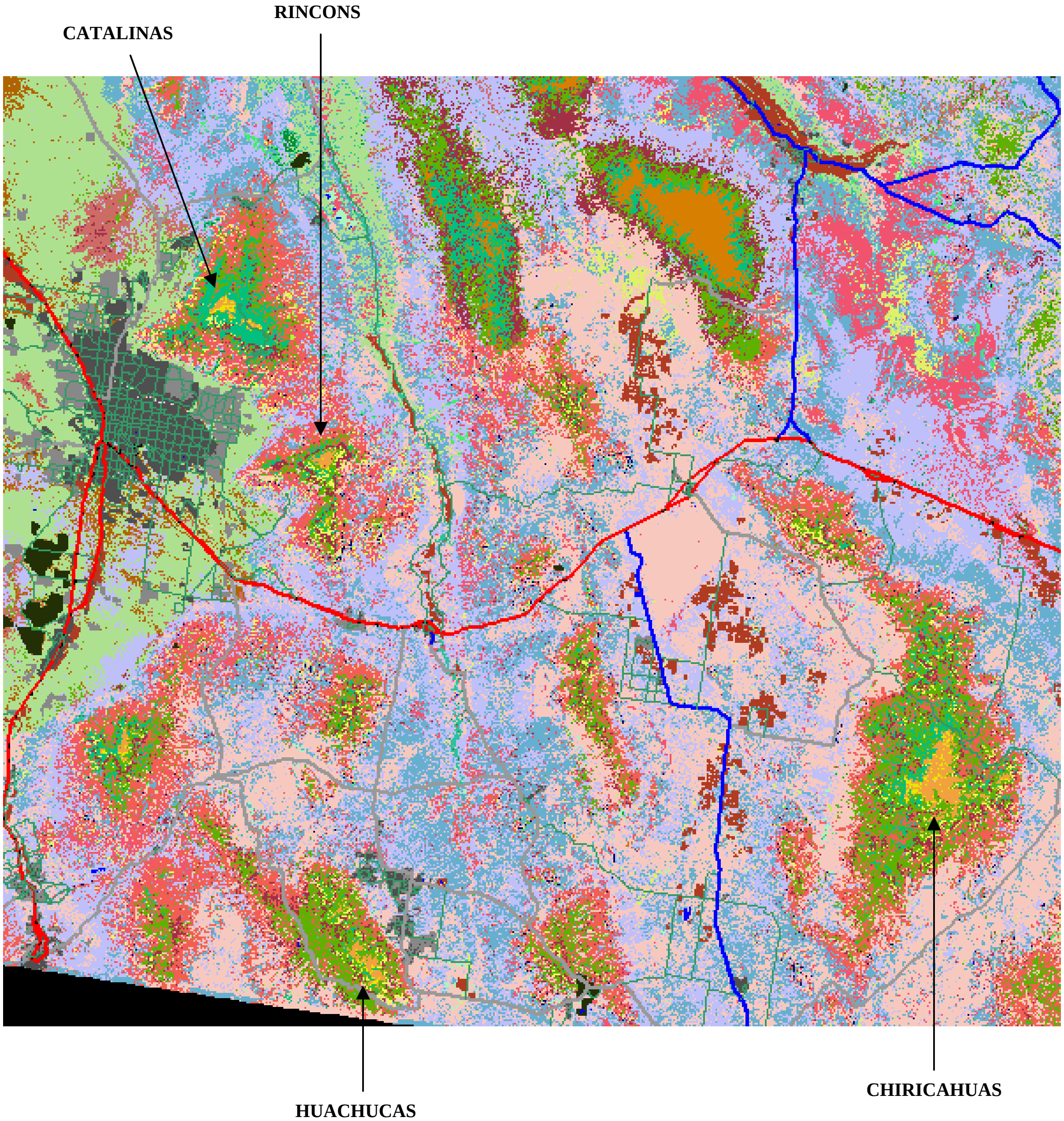


Figure 2.10: Landcover over portion of southeastern Arizona that contains the three study sites. This map was created on the Southwest Regional GAP Landcover Map Server (NBII, 2004).

Note: The legend for this map is so extensive it could not be included here, but is located in figure 2.17.

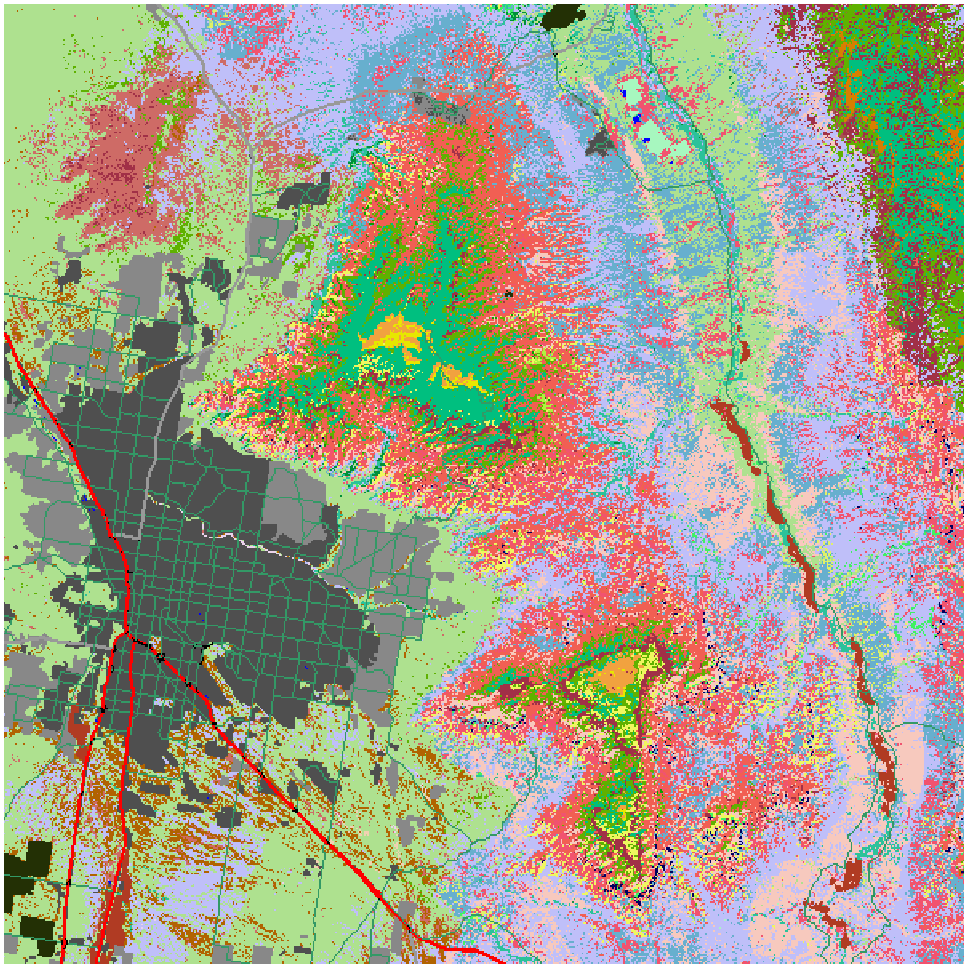


Figure 2.11: Catalina-Rincon landcover map. This highly detailed landcover map was created on the Southwest Regional GAP Landcover Map Server (NBII, 2004). *Note*: The legend for this map is so extensive it could not be included here, but is located in figure 2.17.

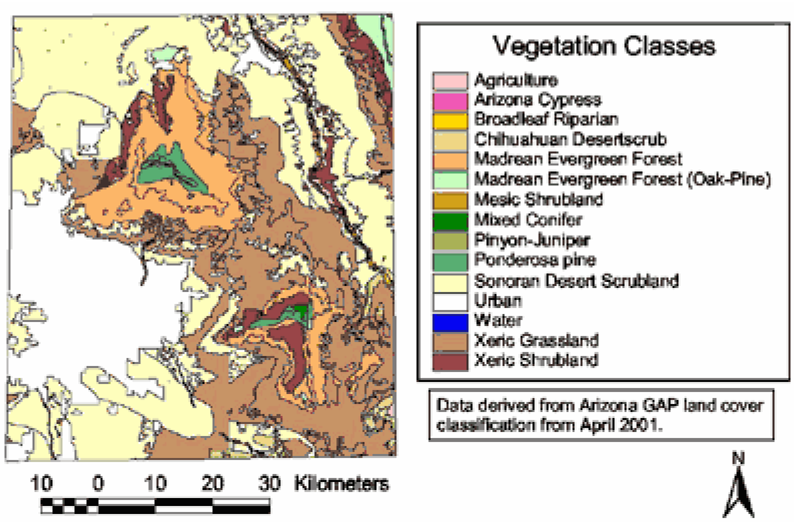


Figure 2.12: General vegetation classes in the Catalina site (Thwaits, 2004).

Note: The legend shown here does not apply to the above landcover map.

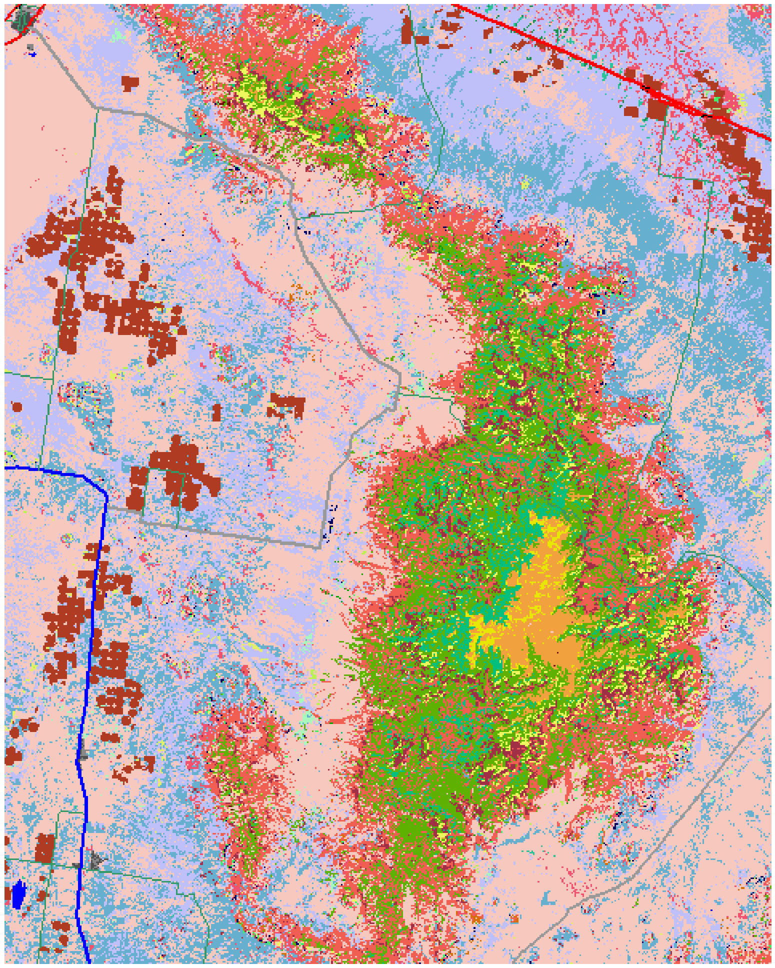


Figure 2.13: Chiricahua study site landcover map. This map was created on the Southwest Regional GAP Landcover Map Server (NBII, 2004). *Note*: The legend for this map is so extensive it could not be included here, but is located in figure 2.17.

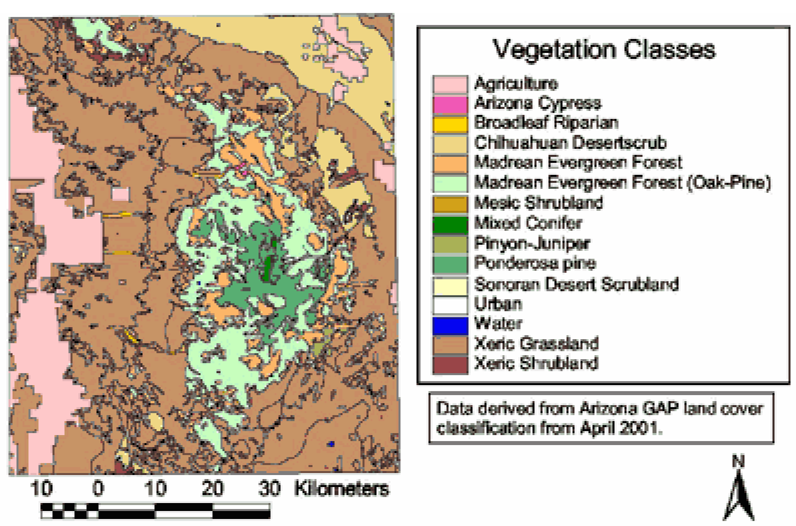


Figure 2.14: General vegetation classes in the Chiricahua site (Thwaits, 2004).

Note: The legend shown here does not apply to the above landcover map.

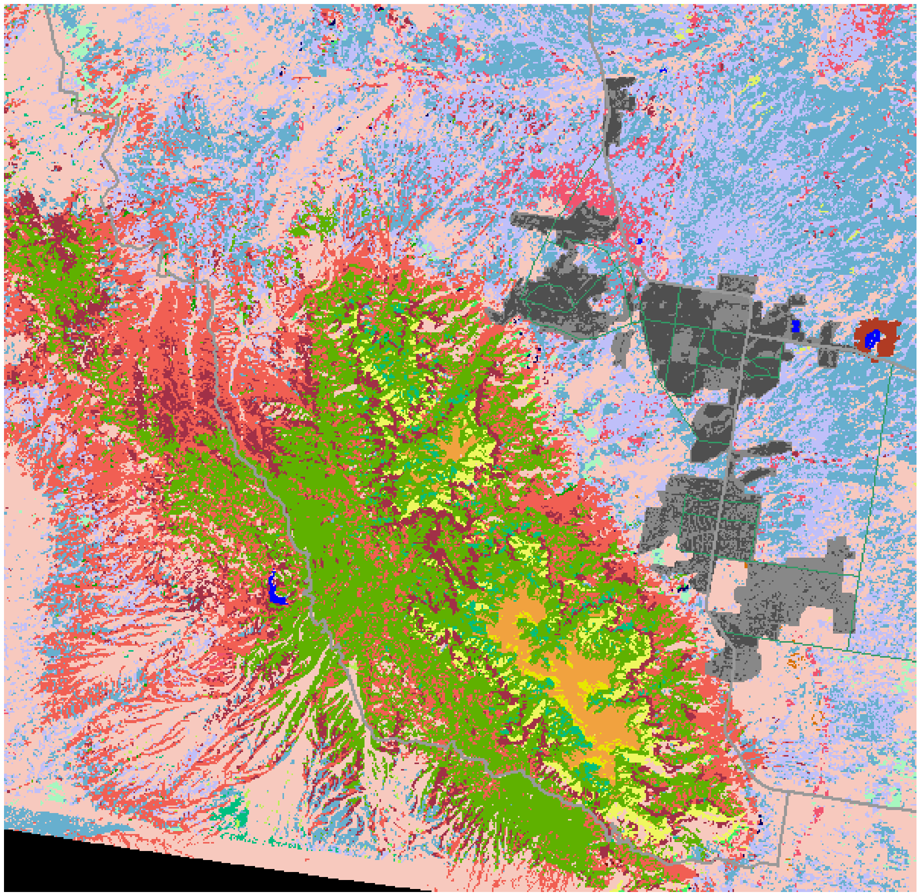


Figure 2.15: Huachuca study site landcover map. This map was created on the Southwest Regional GAP Landcover Map Server (NBII, 2004). *Note*: The legend for this map is so extensive it could not be included here, but is located in figure 2.17.

Figure 2.16: General vegetation classes in the Huachuca site (Thwaits, 2004).

Note: The legend shown here does not apply to the above landcover map.

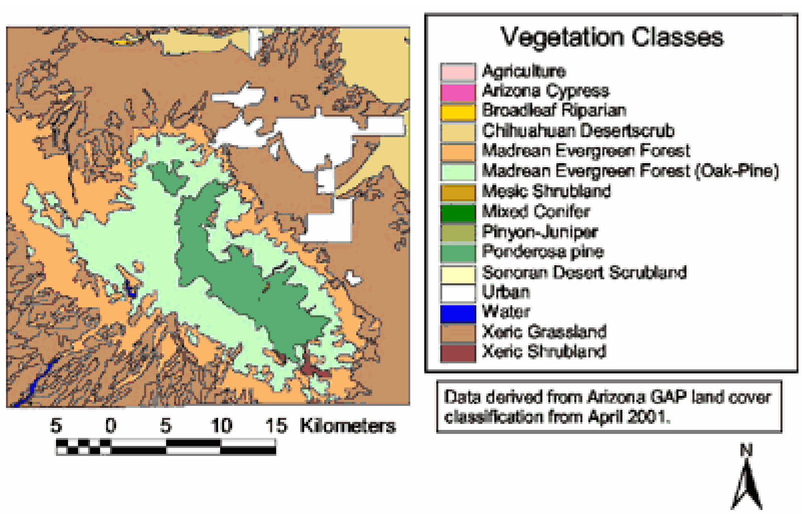


Figure 2.17: Landcover classification legend for maps shown in figures 2.10, 2.11, 2.13 and 2.15.

Colorado Plateau Blackbrush-Mormon-tea Shrubland
Mojave Mid-Elevation Mixed Desert Scrub
Chihuahuan Succulent Desert Scrub
Chihuahuan Creosotebush, Mixed Desert and Thorn Scrub
Sonoran Paloverde-Mixed Cacti Desert Scrub
Inter-Mountain Basins Mixed Salt Desert Scrub
Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub
Sonora-Mojave Creosotebush-White Bursage Desert Scrub
Sonora-Mojave Mixed Salt Desert Scrub
Inter-Mountain Basins Montane Sagebrush Steppe
Southern Rocky Mountain Juniper Woodland and Savanna
Inter-Mountain Basins Juniper Savanna
Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe
Inter-Mountain Basins Big Sagebrush Steppe
Inter-Mountain Basins Semi-Desert Shrub Steppe
Chihuahuan Gypsophilous Grassland and Steppe
Rocky Mountain Dry Tundra
Rocky Mountain Subalpine Mesic Meadow
Southern Rocky Mountain Montane-Subalpine Grassland
Western Great Plains Foothill and Piedmont Grassland
Central Mixedgrass Prairie
Western Great Plains Shortgrass Prairie
Western Great Plains Sandhill Prairie
Inter-Mountain Basins Semi-Desert Grassland
Rocky Mountain Subalpine-Montane Riparian Shrubland
Rocky Mountain Subalpine-Montane Riparian Woodland
Rocky Mountain Lower Montane Riparian Woodland and Shrubland
North American Warm Desert Lower Montane Riparian Woodland and Shrubland
Western Great Plains Riparian Woodland and Shrubland
Inter-Mountain Basins Greasewood Flat
North American Warm Desert Riparian Woodland and Shrubland
North American Warm Desert Riparian Mesquite Bosque
North American Arid West Emergent Marsh
Rocky Mountain Alpine-Montane Wet Meadow
Temperate Pacific Montane Wet Meadow
Mediterranean California Subalpine-Montane Fen
Western Great Plains Saline Depression Wetland
Chihuahuan-Sonoran Desert Bottomland and Swale Grassland
Madrean Upper Montane Conifer-Oak Forest and Woodland
Madrean Pinyon-Juniper Woodland
Chihuahuan Sandy Plains Semi-Desert Grassland
Sonora-Mojave-Baja Semi-Desert Chaparral
Madrean Juniper Savanna
Chihuahuan Mixed Salt Desert Scrub
Coahuilan Chaparral
Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
Western Great Plains Floodplain Herbaceous Wetland
Mediterranean California Red Fir Forest and Woodland
Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland
Mediterranean California Ponderosa-Jeffrey Pine Forest and Woodland
Rocky Mountain Foothill Limber Pine-Juniper Woodland

Wyoming Basins Low Sagebrush Shrubland
Sonoran Mid-Elevation Desert Scrub
Western Great Plains Tallgrass Prairie
North Pacific Montane Grassland
Southern Colorado Plateau Sand Shrubland
Western Great Plains Mesquite Woodland and Shrubland
Open Water
Developed, Open Space - Low Intensity
Developed, Medium - High Intensity
Barren Lands, Non-specific
Agriculture
Disturbed, Non-specific
Recently Burned
Recently Mined or Quarried
Invasive Southwest Riparian Woodland and Shrubland
Invasive Perennial Grassland
Invasive Perennial Forbland
Invasive Annual Grassland
Invasive Annual and Biennial Forbland
Recently Logged Areas
Recently Chained Pinyon-Juniper Areas
Disturbed, Oil well

2.3
Climate

The three study sites are located in Arizona Climate Division 7, which can be found in the southeastern corner of the climate division map shown in figure 2.18. The annual precipitation pattern in this region is bimodal, with high intensity rains occurring in July and August when moisture from tropical regions of Mexico and the Gulf of California is drawn into Arizona. Longer duration precipitation is ushered across the regions by fronts and synoptic scale disturbances during the winter months of December and January, with snow occurring in highest elevations. Extending from the end of the winter wet period to the start of the summer wet period, is a harshly arid and hot fore-summer that can last from March through July in lower elevations. The arid fore-summer cures fuels, which are especially susceptible to ignition by lightning strikes early in the monsoon season.

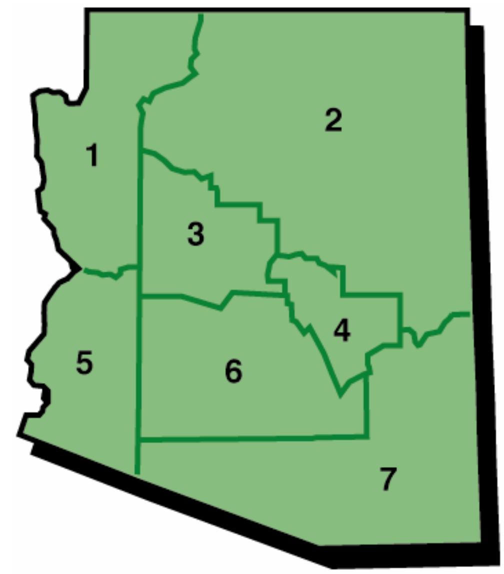
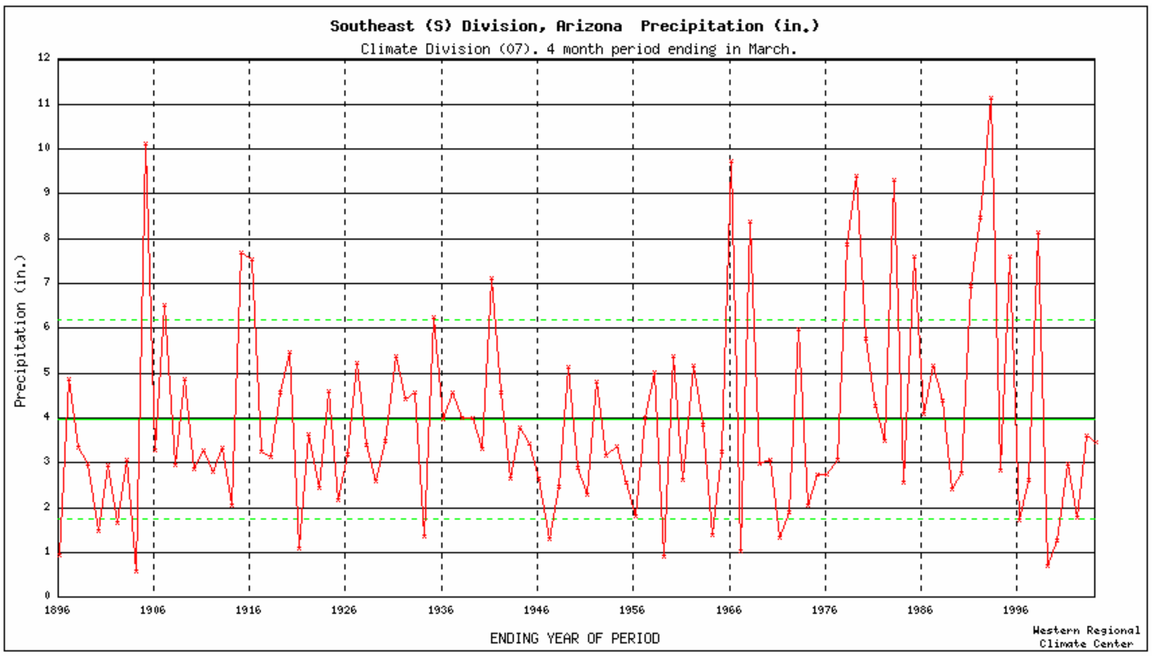


Figure 2.18: Arizona Climate Divisions. All three sites of this study are located in Climate Division 7. http://www.ncdc.noaa.gov/img/onineprod/drought/az.gif

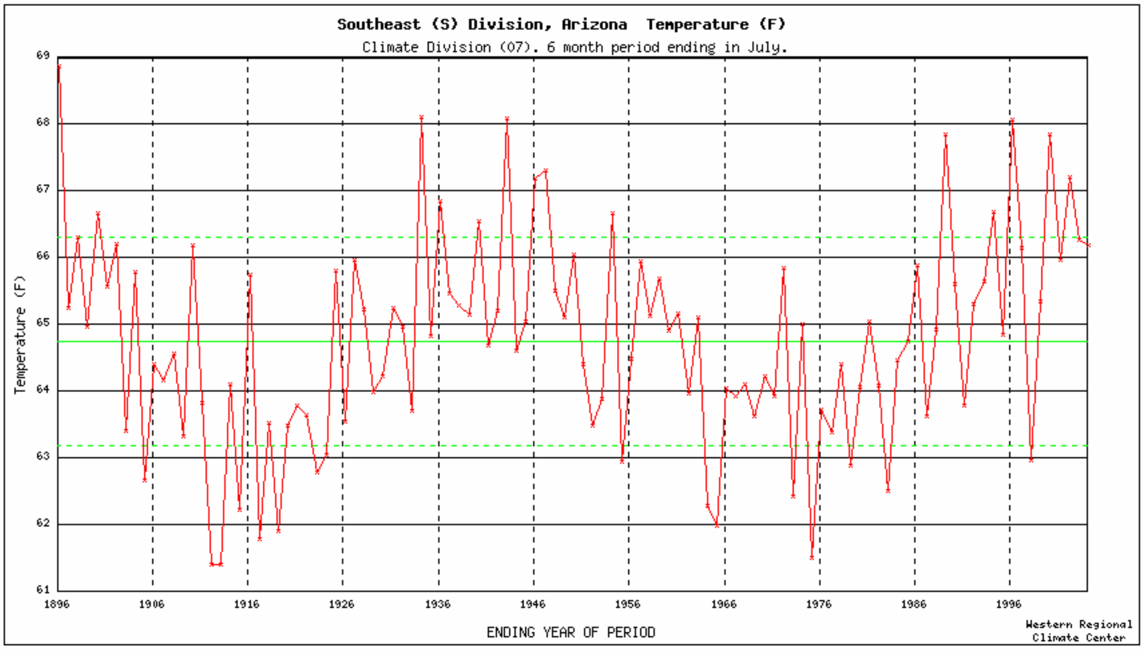
Figure 2.19 and 2.20 provide a longer term perspective of the variation in winter precipitation and fore-summer temperatures over the last approximately 100 years. Figure 2.19 shows average precipitation over December through March and figure 2.20 shows average temperature over February through July between 1896 and 2004. The temperature plot strongly suggests a periodicity lasting approximately fifty years. It appears that since the 1960s fore-summer temperatures have been generally on the rise since the 1960s. No such clear pattern is immediately obvious in the precipitation plot, except that there may have been more precipitation since the 1960s. Since 1989 there have been a few very wet winters, but since 1998 there has been less than average and sometimes much less than average precipitation.



red - 4 month period
green - average (solid), ± sigma (dashed)

```
Total Precipitation          4-Month Period Ending in Month  3
   YEARS : 1896 - 2004
  AVERAGE             3.983
  SIGMA (RMS)         2.219
  COEFF OF VAR        0.557
  SKEWNESS            1.102
  MEDIAN              3.330
  MAXIMUM VALUE      11.130
  MINIMUM VALUE       0.570
  NUMBER OBS           108.
```

Figure 2.19: Mean precipitation for each Dec-Mar from 1896 to 2004.



red - 6 month period
green - average (solid), ± sigma (dashed)

```
Average Temperature          6-Month Period Ending in Month  7
   YEARS : 1896 - 2004
  AVERAGE             64.754
  SIGMA (RMS)          1.565
  COEFF OF VAR         0.024
  SKEWNESS             0.033
  MEDIAN              64.850
  MAXIMUM VALUE       68.867
  MINIMUM VALUE       61.400
  NUMBER OBS            109.
```

Figure 2.20: Mean temperature for each Feb-Jul from 1896 to 2004.