Outreach
Warnell School of Forestry & Natural Resources
UNIVERSITY OF GEORGIA

Georgia Pines:
Identification & Concerns

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Pines are trees which smell, sound, and look like home to many people. Pines are also one of the most important industrial tree groups on Earth. Our pines have been and continue to be a critical tree for our quality of life. Pines have meant cardboard boxes which carry our food, wood of our houses, and renewable production units which propelled the industrial revolution across the South. Pines are considered by many to be the lowest of the trees because they are so common. But they remain a lead tree actor in an ecological play of rural lands and urban communities.

Pines are one of the most economically important trees in the world. For example, pines are used to produce lumber, poles, and posts. Pines have been used for centuries to gather turpentine, pine oils, tars and rosins. These materials come principally from slash pine (*Pinus elliottii*) and longleaf pine (*Pinus palustris*) in the United States, maritime pine (*Pinus pinaster*) around the Mediterranean area, and chir pine (*Pinus roxburghii*) in India. Some species like pinyon pines are used for their edible seeds. Pine wood fibers are used in pulp to make paper. Pines are also used for plywood and composite wood products. Pines are an important part of our modern life and represent a historic legacy.

Moonlight Through The Pines

Georgia's pines are more than filters for romantic moonlight. Georgia has eleven native and naturalized pines. Each is akin to the others, but unique in where it grows and how it grows. This paper will help define what pines are, where they grow, how they are related to each other, as well as introducing some of their cousins from around the world. This will be an exploration of the background and lives of Georgia pines.

Pride of the Conifers

Pines are in one of six families within the conifers (*Pinales*). The conifers are divided into roughly 50 genera and more than 500 species. Figure 1. Conifer families include pine (*Pinaceae*) and cypress (*Cupressaceae*) of the Northern Hemisphere, and podocarp (*Podocarpaceae*) and araucaria (*Araucariaceae*) of the Southern Hemisphere. The *Cephalotaxaceae* (plum-yew) and *Sciadopityaceae* (umbrella-pine) families are less commonly seen conifers. Members from all these conifer families can be found as ornamental and specimen trees in yards around the world, governed only by climatic constraints.

Family

The pine family (*Pinaceae*) has many genera (~9) and many species (~211). Most common of the genera includes fir (*Abies*), cedar (*Cedrus*), larch (*Larix*), spruce (*Picea*), pine (*Pinus*), Douglas-fir (*Pseudotsuga*), and hemlock (*Tsuga*). Of these, pines and hemlocks are native to Georgia. The pine genus (*Pinus*) contains the true pines.

Genus

Pines (*Pinus* species) are found around the world almost entirely in the Northern Hemisphere. They live in many different places under highly variable conditions. Pines have been a historic foundation for industrial development and wealth building. Pines continue to be a valuable renewable natural resource generating paper, cardboard, lumber, plywood, composite products, chemicals, and food. Pines are the centerpiece and back-drop for homes and communities.

Trees generically considered pines were first placed in the *Pinus* genus in 1753. The name of the genus is the Latin word for "pine." Other historic names for the genus have been *Apinus* (1790), *Strobus* (1854), and *Caryopitys* (1903). The pine genus (*Pinus*) contains ~95 species (ranging from 66-120 species depending upon the taxonomist) from around the Northern Hemisphere. Only one pine species' range crosses the equator into the Southern Hemisphere in Sumatra.

Northern Hemisphere Thing

Pines can be found across the Northern Hemisphere of the globe. Pines range from polar regions into the tropics. Within this huge range, pines, along with oaks, dominate major forest types. The genus *Pinus*, contains ~95 distinct species found throughout Central America, Mexico, the United States, Canada, Japan, China, and stretching down into the highlands of Vietnam, across the Himalaya mountains through the old Soviet Union republics, and across Europe. Relatively little is known about pines found in Central China, Mexico, Honduras, and the Western Himalaya mountains.

Of the 95 species of pine in the world, 60 of these species are found in North America. Nine pines are native in Canada, 36 in the United States, 36 in Mexico, 8 in Central America as far South as Nicaragua, and 4 in the West Indies. The old world has 35 different species of pine that includes one species in the Canary Islands, 4 in North Africa, 34 in Eurasia, and 27 in Asia.

Non-Tropical

Pines are found primarily in the North temperate region of the globe with a few range extensions leading Southward into the topics, usually at high elevations. Many pines have been taken away from their native ranges and planted world-wide. A few of these species grow better in their new homes than in their native ranges. Because most pines are temperate region trees, the Southeastern United States holds great promise for growing a large number of different pines (exotics) from around the world.

The Eastern United States has 13 native pines, of which 11 are native or naturalized to Georgia. Georgia's eleven native and naturalized pines are:

Pinus clausa -- sand pine, *Pinus echinata* -- shortleaf pine, *Pinus elliottii* – slash pine, *Pinus glabra* – spruce pine, *Pinus palustris* -- longleaf pine, *Pinus pungens* -- table mountain pine, *Pinus rigida* -- pitch pine, *Pinus serotina* -- pond pine, *Pinus strobus* – Eastern white pine, *Pinus taeda* -- loblolly pine, *Pinus virginiana* – Virginia pine.

Divisions

Pines can be divided into three groups: soft pines, hard pines and Vietnamese pine. There is only one member of the Vietnamese group. For the soft and hard pines, the appearance of the wood can usually help

separate groups. Soft pines have a gradual transition within each annual increment (ring) from springwood to summerwood. Hard pines usually have an abrupt annual increment (ring) transition from wood produced early in a year to wood produced later in a year.

The soft pine group contains 31 species divided into stone, white, pinyon, foxtail and chilgoza pines. The hard pines, of which many can be found in the Southeast United States, are composed of 62 species world-wide divided into the Chihuahua, Canary Island, Italian stone, Scots, Southern yellow, ponderosa, digger, lodgepole, and Monterey pines.

Where Georgia Pines Line Up

Worldwide, the pine genus is divided into 15 subsections. Georgia's native pines can be placed into one of three of these subsections. Figure 2. The different subsections of *Pinus* groupings for Georgia pines are the: 1) white pine group; 2) Southern yellow pine group; and, 3) jack pine group.

Home Raised Genetics

The geographic distribution or ranges of our pines can be immense or minute. Within each pine's native growth range are genetic differences which allow for more efficient survival and growth under a variety of conditions. Many pines have regional races which do not perform well outside their native area. The species may be the same, but regional races within one species may have widely variable attributes based upon climate, soil, and pests differences.

Pines also form hybrids, where one species will interbreed with another species. The hybrid offspring of these pairings may pose identification problems and regeneration opportunities with their mix of growth attributes. Within closely related groups of pines, natural hybridization or cross-breeding occurs occasionally. The potential for artificial hybridization of pines might lead to tremendous gains in tree quality. Because pines have adapted to many different site characteristics around the world, these special traits could be used in breeding an outstanding urban or forest tree.

Native Range

Knowing where Georgia pines grow can assist in identification. Figure 3 provides general growth areas for pines in Georgia. Knowing a species' native range is helpful in judging potential tree stress from planting and growing out-of-range. Maps here summarize general native ranges of Georgia pines. Growth ranges were developed over time through referencing federal species maps, state species maps, herbarium specimens, and personal observations by the author. Range areas and delineating lines should be considered estimates, not absolute locations. Outlying and disjunct small populations are not considered a part of a native range here.

Figure 4 demonstrates the North / South distribution for centers (i.e. range centroids) of native pine species ranges in Georgia. Generally, Georgia has mountain pines and Coastal Plain pines with two growing Statewide. Figure 5 provides an estimated number of native pines for each Georgia county by species number class. Note the relatively low numbers of native pines across the Piedmont area of Georgia.

Can't See The Trees

As important as pines have been, and continue to be in Georgia, many people have difficulty identifying one native pine species from another. Can you identify the pines around you? Remember there is great variation among many attributes of pines across their growth range. Because pines can interbreed (hybridize) naturally and share features of both genetic parents, they can be difficult to identify. See the pine hybrid net of interactions and potential shared characteristics in Figure 6.

The environment can also mess up pine identification. Highly stressed and pest impacted trees may have characteristics representing symptoms of stress or pests, not of the basic pine species. Pines growing outside their native range can appear slightly different than individual pines growing at the center of their range.

Zoned In

Figure 7 shows Coder Tree Grow Zones (CTGZ) in Georgia, which are based upon multiple interactions of climatic components and the variability of Georgia's weather. This map was generated using cluster analysis combining climatic data which included average monthly precipitation, average annual precipitation, average monthly temperature, high and low temperature extremes, average monthly evaporation, and average monthly solar radiation, all for the past 30 years. This Tree Grow Zone map represents ecological homoclimates for Georgia.

Figure 8 presents Coder Tree Planting Zones (CTPZ) for Georgia. This map was developed using only temperature and precipitation factors. It was originally developed for planting various types of native trees. Figure 9 shows general pine species location zones in Georgia based upon historic ranges for Georgia pines. Figure 10 provides the various growing areas or zone mapping systems for Georgia pines. This figure shows the previous three methods of describing, appreciating, and defining pine planting and growth areas across the State.

Pine Identification Features

Basic Features To Examine

Needles on pine are usually found in bunches (fascicles) of 2 to 5, but can range from having a single needle to 8 needles. Needles usually stay on a tree from 2 to 4 years but can sometimes last for as many as 15 years. Pines produce both male and female cones on the same tree but in different locations within each crown (i.e. a pine is monoecious). Mature female cones are a series of spirally bound bracts or scales which hold seeds at their base which are open to the environment. These woody cones mature in two seasons.

Looking & Seeing

In identifying pines, gather as much information regarding its native range and normal characteristics as possible. Collect twigs, examine multiple terminal buds, and many different needle bundles (fascicles) from different places in a tree crown. Note the bark (periderm) texture, pattern, color, and thickness. Collect female cones and note the shape and size of the entire cone and its parts, especially outer tips of individual bracts or scales. Examine each cone for how it was attached to a tree and how the base of the cone broke off from a tree. Note number and distribution of female cones throughout a tree crown.

Record pine height (Figure 11), girth (Figure 12), crown size and relative proportions. Tree age should be estimated. Notice any sprouting, needle growth, and female cones growing from the main stem and primary branches. Be observant for minutia of pine growth, as well as for how the whole tree appears.

Leaves – Young children can usually discern pines from most other trees. Pines have leaves which are long and narrow, termed "needles." Pine leaves or needles are semicircular to triangular in cross-section and not noticeable flattened. Needle bases in each bundle are held together with a papery sheath. Needles are held in multiple needle bundles called fascicles. Bundles of needles on the twig of each pine species may have different lengths (Figure 13), and different numbers of needles per bundle (Figure 14). Having evergreen, bunched, needle-shaped leaves are key identifiers for pines. Pine needles are described having a number of unique characteristics. Figure 15. Native Georgia pines usually have either 2, 3, or 5 needles within each bundle. Figure 16.

Young Cones – Pines have both sexes of cones on the same tree (monoecious), although male and female flowers are separated throughout the tree crown. Young female cones (which produce woody cones) tend to

be in higher crown locations to keep predators away from seeds and provide a high distribution point for the viable seeds. Male pollen cones tend to be lower and to the outer edge of the crown in order to place male cones in the way of swirling wind, which provides buoyancy and a lower relative humidity, allowing airborne pollen to be delivered to receptive female cones.

Pine pollen has two small wings and is carried by wind to small female cones in the tree crown. The receptive female cones are small and aerodynamically designed to capture pollen of its own species most effectively. Once pollen is captured, female cones close and seeds develop over time. Seeds are distributed in the Fall of the year, a year after pollen capture. In other words, from pollen capture to seed release takes two growing seasons with an intervening dormant season. Figure 17 provides the age when pines become sexually mature and begin producing female cones.

Woody Cones -- Pines need two growing seasons to generate one set of female cones containing viable seed. In Spring of one year, tiny receptive female cones usually go unnoticed among foliage. These recieve pollen provided by male cones. By the second year, female cones rapidly grow and yield the species-specific woody pine cones seen on a tree and littering the ground below. Open pine cones on the ground have usually already distributed their viable seeds in most species. Some species of pine keep cones glued shut with resin until heat from a ground fire causes them to open. These resinous cones may fall to the ground with viable seeds inside, or stay on a tree for several years. Figure 18 shows a generic winged pine seed.

Female cones are seed holders composed of a woody spiral of many flat fibrous fingers (scales) with two seeds developing near the center or along the inside column of each cone. Figure 19 provides a view of a single female cone scale, from the side and from above, showing seeds. Multiple scales compose a single female cone. Seed wings develop toward the outside edges of a cone and cone scales.

Seed holding woody cones scales can have several different shapes and can be tipped with various types of points depending upon species. The whole spiral collection of woody fingers holding winged seeds connected by a short center stalk is called a female cone. The woody fingers (cone scales) close in high humidity or can be glued together with pine resin. When seeds are ready and humidity is low, cone scales open up and wind blowing past seed wings lifts and scatters the seeds.

Mature pine cones can be used to differentiate between various pine species. Figure 20 lists mature female cone length, prickle form and special cone appearance features. Figure 21 helps to compare mature female cone length for Georgia pines. Figure 22 uses descriptors from taxonomists in describing types of cone scale prickles in Georgia pines. Cone length, prickle type, color / sheen, and shape can all help in identifying Georgia pines.

Buds -- Terminal buds on different pine shoots appear to be different from one another due to color and amount of plant hairs (tricombes) present. Some pines have long white or silvery tricombes covering and enclosing the terminal bud. Other pines have buds which are unadorned. Terminal bud size varies greatly.

Bark (Periderm) -- Pine periderm has great variation in thickness, blockyness, ease of layer separation, and number and length of longitudinal fissures. Periderm color can vary, but other organisms growing on periderm surfaces can change its appearance. Older periderm has oxidized and changed color from when it was first exposed to air, rain, and sunlight. Often, wet periderm will look different from always dry or protected periderm.

Resin – Pines generate resin, which is a mixture of solid and liquid materials. Essential pine oils, turpentine, tars, and rosin are generated by specialized cells in living cells of a tree. Liquids in resin can evaporate leaving behind any solids and dissolved materials. Residues of resin flow can be seen on the bark near wounds.

Stress Problems

Georgia's native pines share many serious pest related problems. Tree survival depends upon many factors which integrate site and environment, tree genetic combinations, pest genetic combinations and complexes, and chaotic chance. Developing a sense of problem priority across pines of Georgia can assist tree health care specialists better manage pines and help tree owners more fully appreciate pest issues. Figure 23 presents a general pest matrix for Georgia pines. This figure shows by species, major or significant pests cited in the literature.

Also cited within research literature are a number of stress problems which can represent serious concerns for native pines of Georgia. These stress problems include fire damage, lightning strikes, ice storms, snow loading, drought, air pollutants, low fertility, grazing / browsing by animals, high elevation and exposed sites, and wind storm damage. Figure 24 shows the expected life-span of Georgia pines under normal, non-extreme conditions.

Conclusions

Pines are strange and fascinating creatures. When you live surrounded by 11 native and naturalized pines all your life, you might not care about the other 84 pine species of the world. But, because pines can be shipped around the world and made to form hybrids, you might plant and care for a tree someday developed from Himalayan or Yugoslavian pines.

Georgia's pines have been a great asset for the State. Native pines will continue to be "green gold" for Georgia into the future. Urban, rural, or interface sites all can make use of pines whether for recreation, plywood, pine straw, lumber, resin products, watershed protection, carbon-dioxide capture, or aesthetics. Pines represent both Georgia's glorious past and it wonderful future.

Conifers (*Pinales*)

(~50 genera / >500 species)

Conifer Families:

araucaria	(*Araucariaceae*)
plum-yew	(*Cephalotaxaceae*)
cypress	(*Cupressaceae*)
podocarp	(*Podocarpaceae*)
umbrella-pine	(*Sciadopityaceae*)
pine	(*Pinaceae*)

Pine Family: (~9 genera / ~211 spp.)

fir	(*Abies*)
cedar	(*Cedrus*)
larch	(*Larix*)
spruce	(*Picea*)
Douglas-fir	(*Pseudotsuga*)
hemlock	(*Tsuga*)
pine	(*Pinus*)

Figure 1: Conifer and pine family relatives.

1) white pine group =

Pinus strobus	**Eastern white pine**

2) Southern yellow pine group =

Pinus echinata	**shortleaf pine**
Pinus elliottii	**slash pine**
Pinus glabra	**spruce pine**
Pinus palustris	**longleaf pine**
Pinus pungens	**table mountain pine**
Pinus rigida	**pitch pine**
Pinus serotina	**pond pine**
Pinus taeda	**loblolly pine**

3) jack pine group =

Pinus clausa	**sand pine**
Pinus virginiana	**Virginia pine**

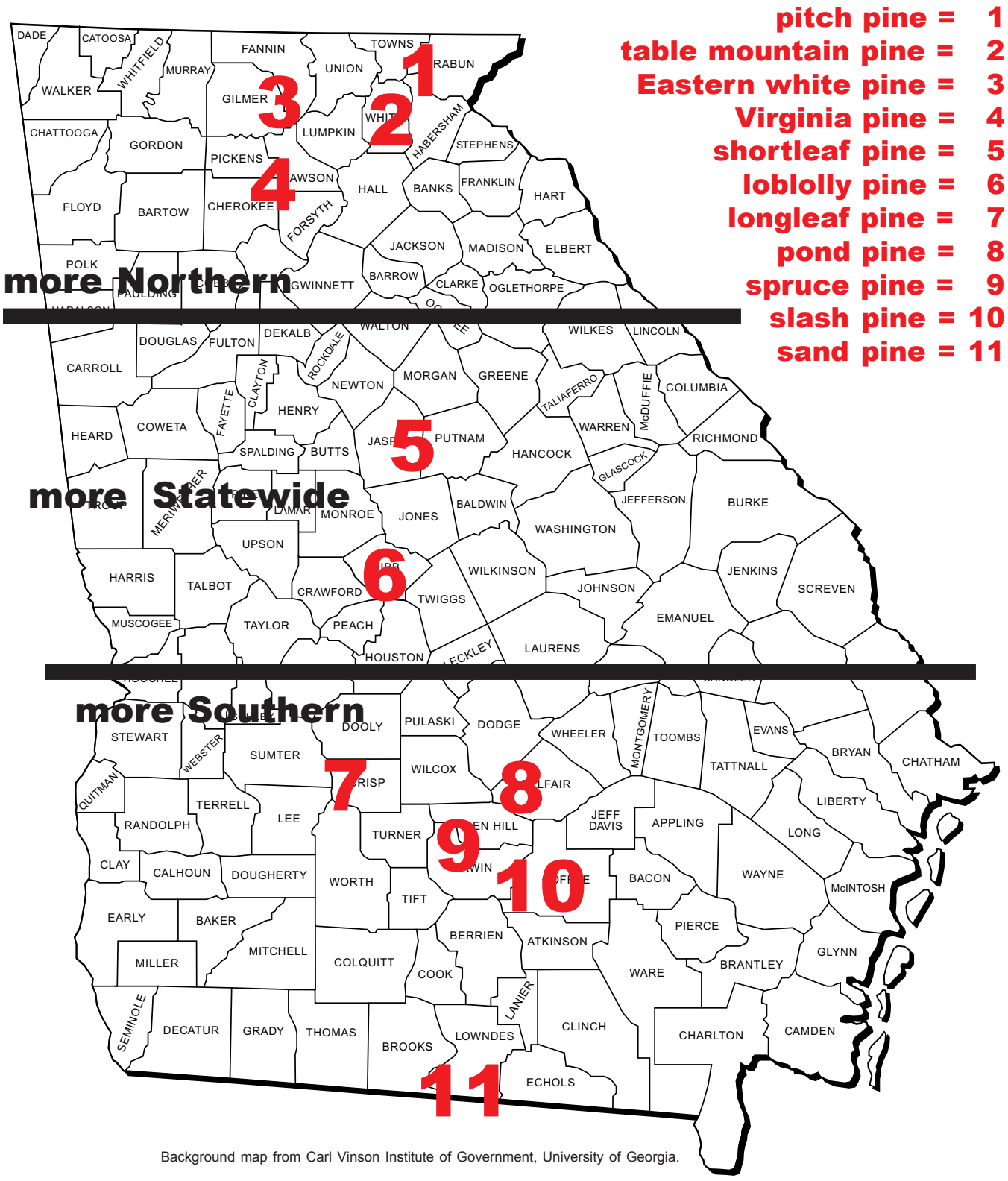
Figure 2: The native and naturalized pines of Georgia divided into three genetic groups, and listed by scientific and common name.

scientific name / common name	general tree location in Georgia
Pinus clausa sand pine	far South Georgia
Pinus echinata shortleaf pine	statewide except Coast
Pinus elliottii slash pine	South Georgia
Pinus glabra spruce pine	South half Georgia
Pinus palustris longleaf pine	South & West Georgia
Pinus pungens table mountain pine	far Northeast Georgia
Pinus rigida pitch pine	far Northeast Georgia
Pinus serotina pond pine	Southern half Georgia
Pinus strobus Eastern white pine	far North Georgia
Pinus taeda loblolly pine	statewide except NE corner
Pinus virginiana Virginia pine	North Georgia

Figure 3: Locations where Georgia pines grow.

Figure 4: Center of Georgia pines' native ranges.

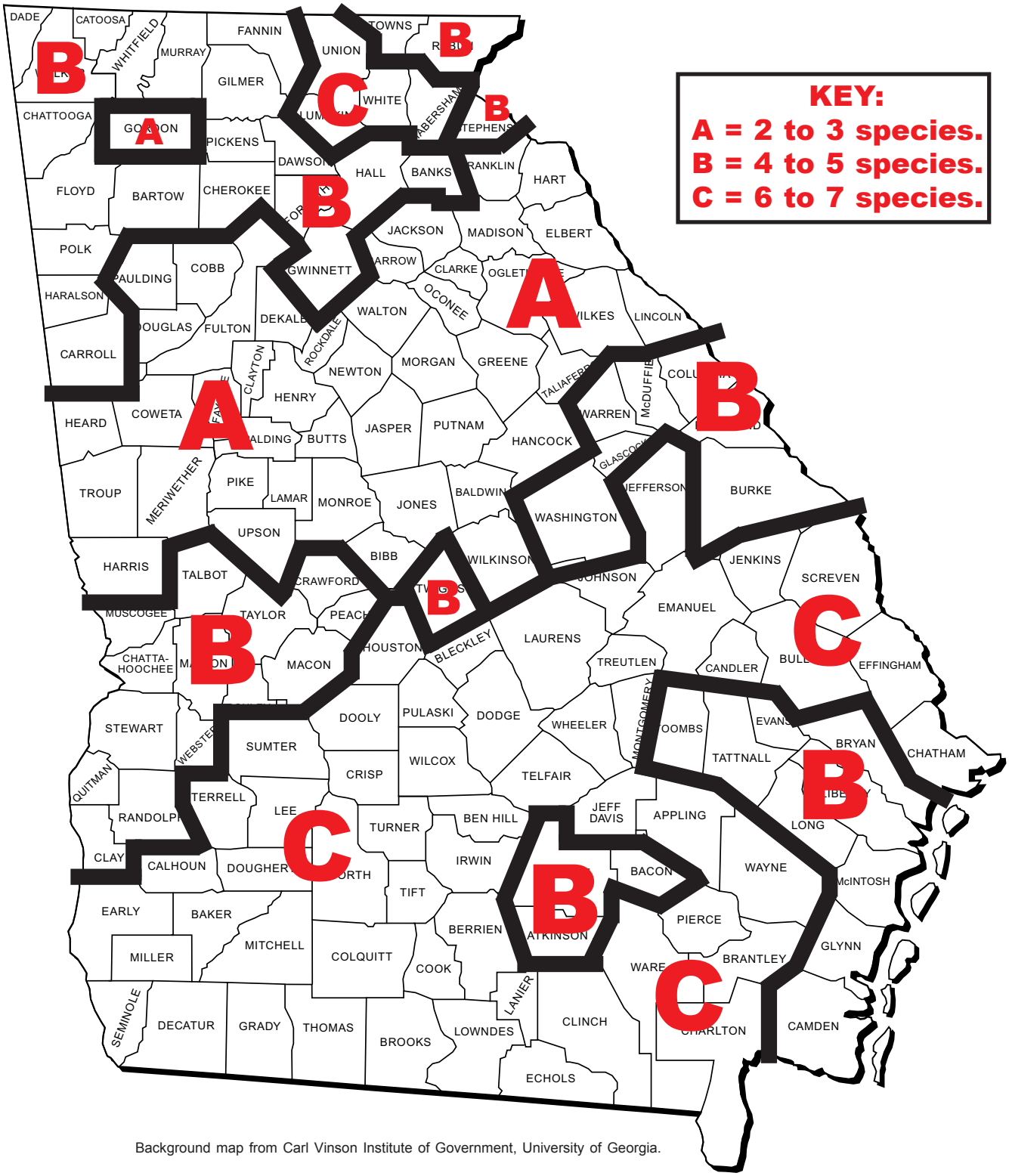
Numbers represent common names of pines and are placed in an idealized center of their growth range within Georgia.



Background map from Carl Vinson Institute of Government, University of Georgia.

Figure 5: Number of Georgia pine species by county.

Native range counts from federal & state maps, herbarium samples and personal observations.



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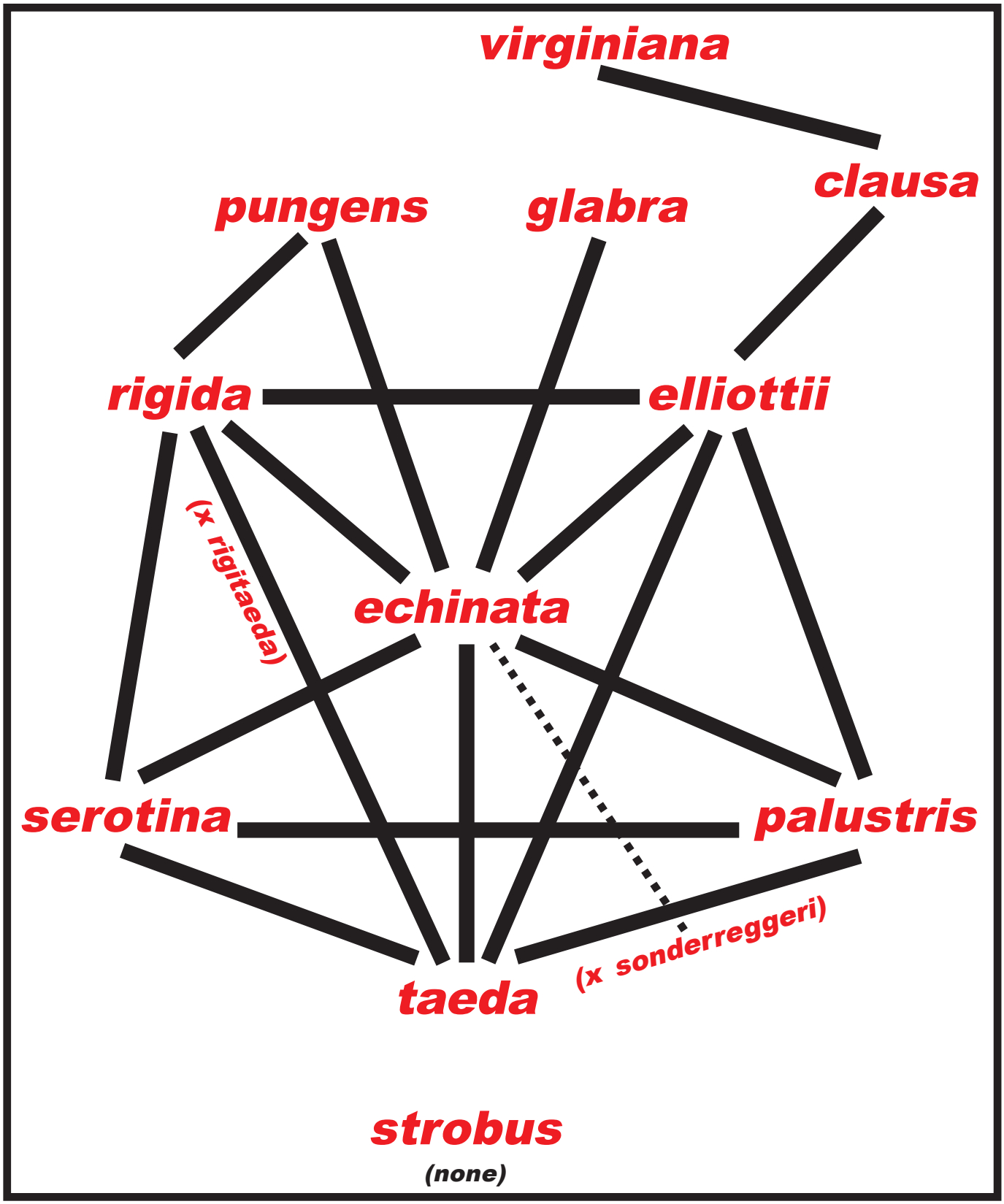
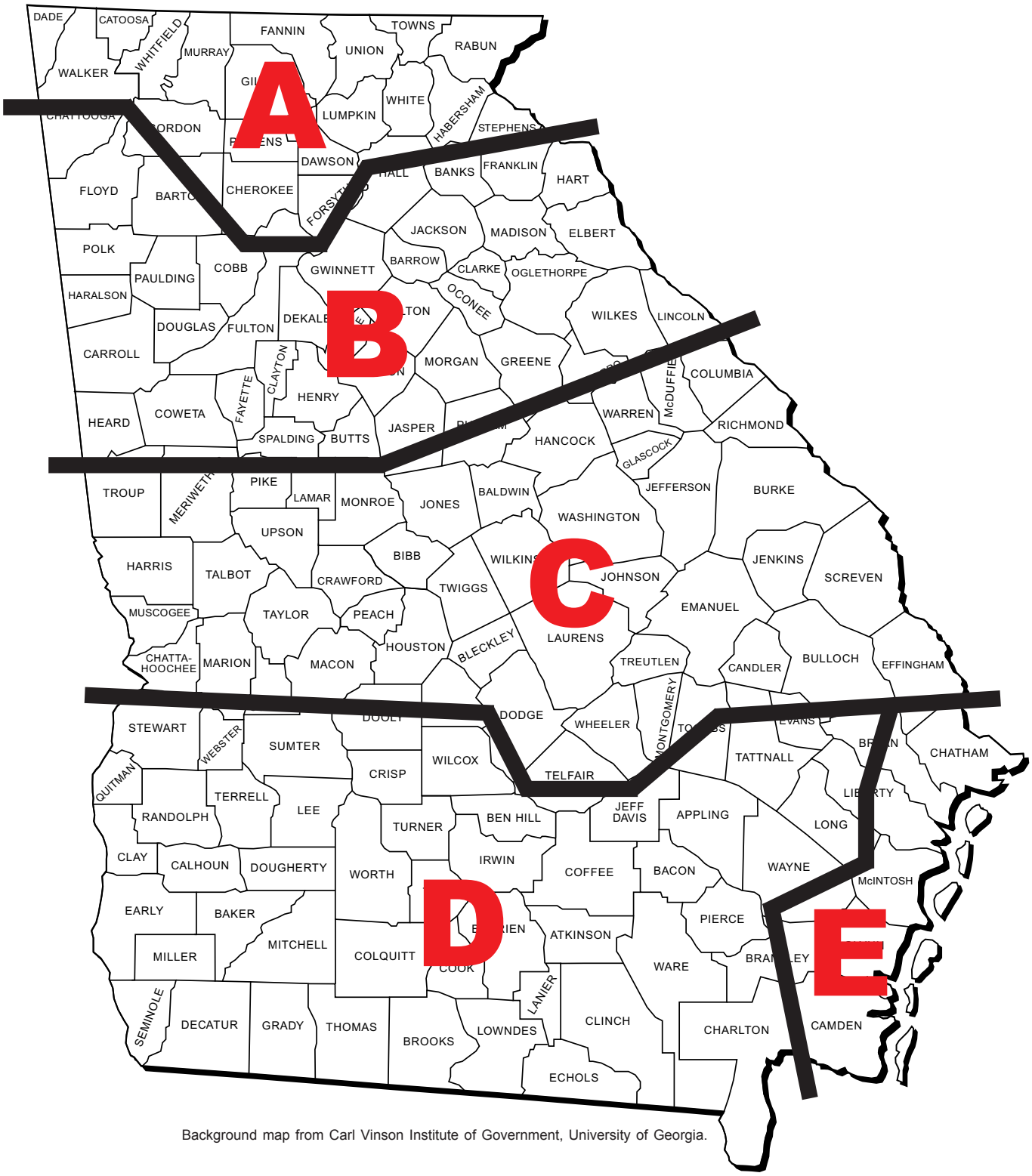


Figure 6: Georgia pines hybrid net representing gene sharing and generation of intermediate visible characters.

Figure 7: Coder Tree Growth Zones (CTGZ) In Georgia.

Map generated using cluster analysis with climatic data for the past 30 years. This map represents homoclimates of Georgia.



Background map from Carl Vinson Institute of Government, University of Georgia.

Figure 8: Coder Tree Planting Zones (CTPZ) of Georgia.

Map based upon normal temperature & precipitation data.

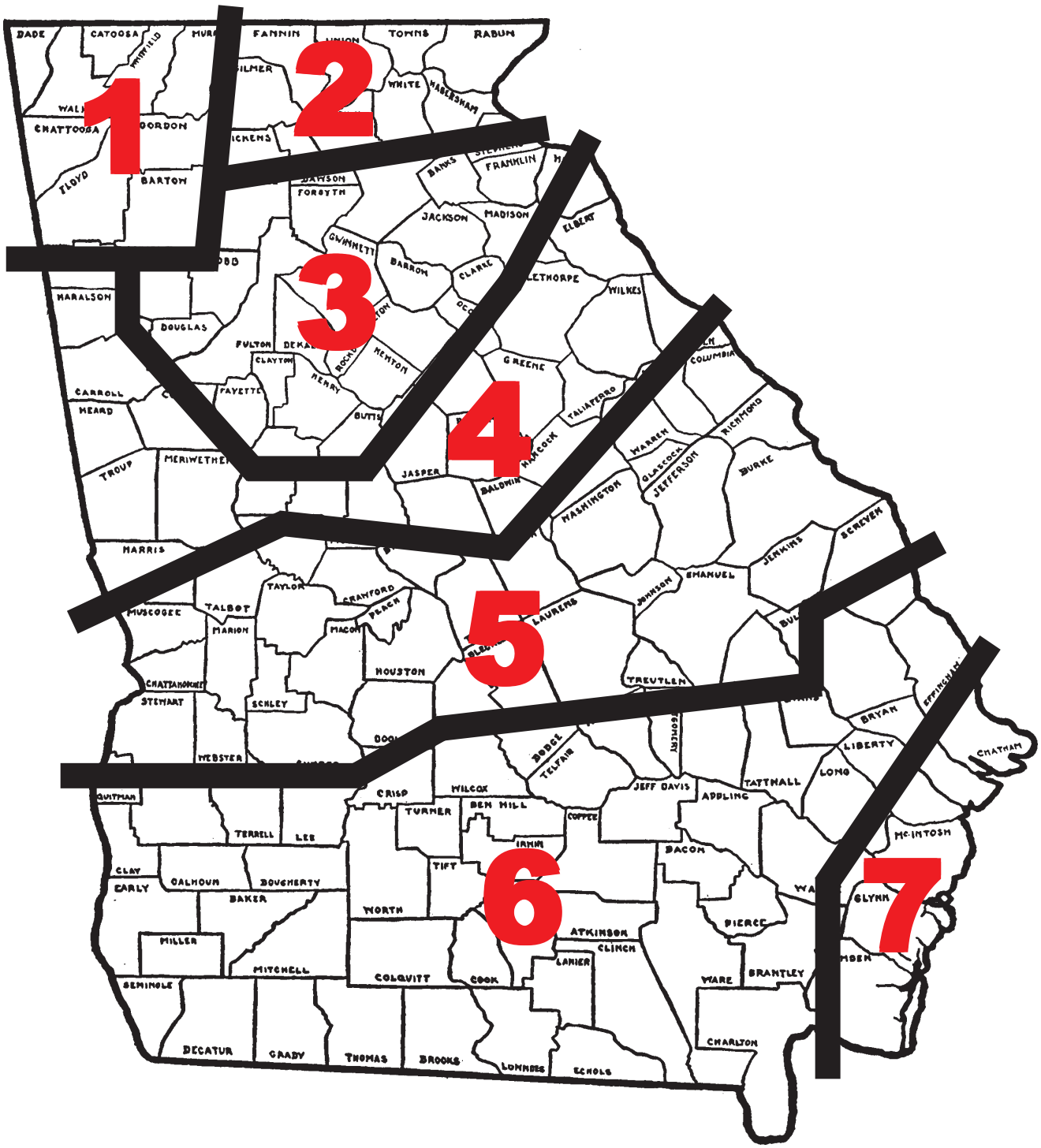
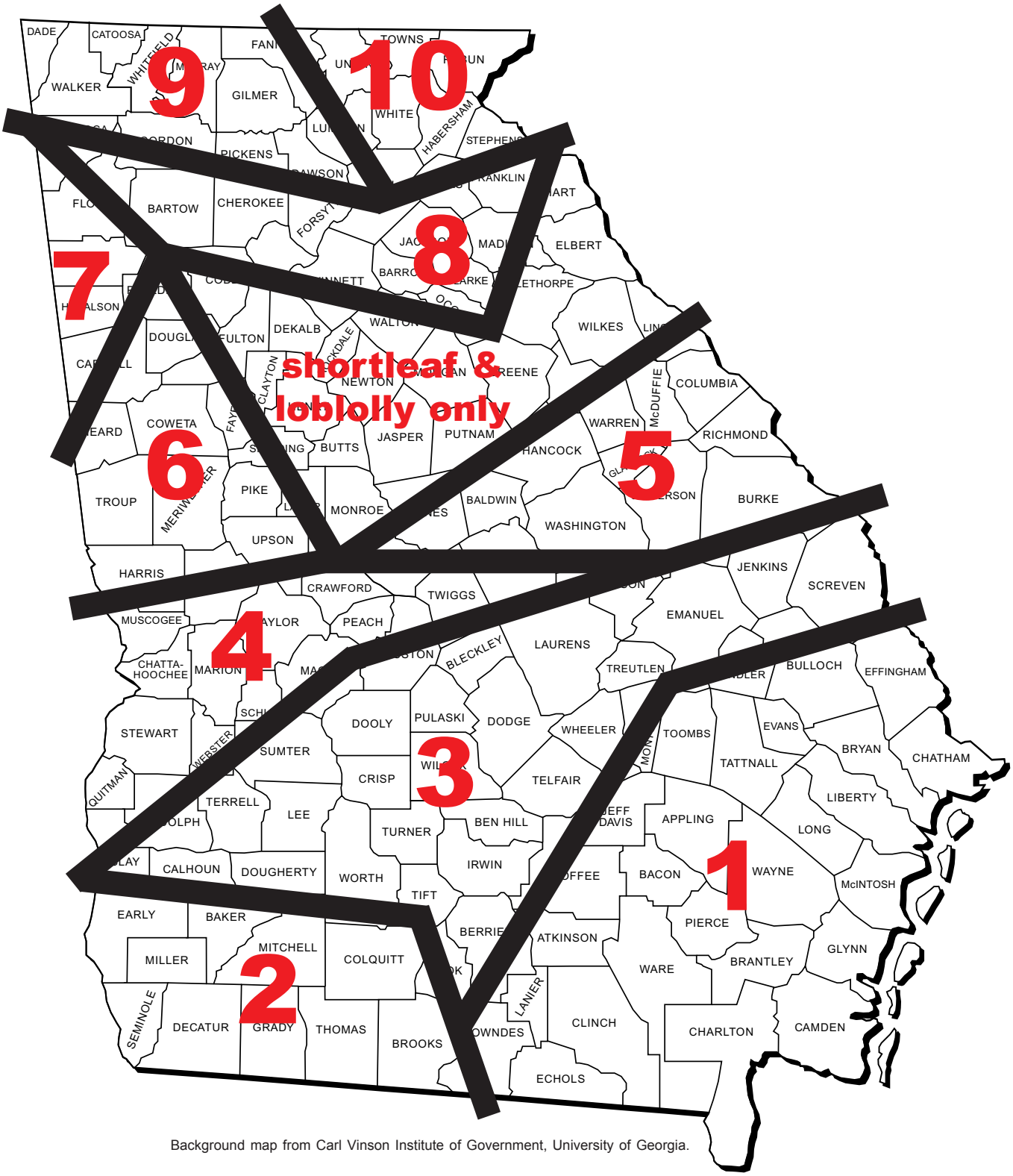


Figure 9: Composite Georgia Pine Location Zones (PLZ).



Background map from Carl Vinson Institute of Government, University of Georgia.

scientific name	PLZ	CTPZ	CTGZ	common name
Pinus clausa	1-2	6	D	sand pine
Pinus echinata	2-10	1-6	A-D	shortleaf pine
Pinus elliottii	1-3	5-7	C-E	slash pine
Pinus glabra	1-4	5-7	C-E	spruce pine
Pinus palustris	1-7	4-7	B-E	longleaf pine
Pinus pungens	10	2	A	table mountain pine
Pinus rigida	10	2	A	pitch pine
Pinus serotina	1-5	5-7	C-E	pond pine
Pinus strobus	9-10	1-2	A	Eastern white pine
Pinus taeda	1-9	1-7	A-E	loblolly pine
Pinus virginiana	7-10	1-3	A-B	Virginia pine

Figure 10: Georgia pines by range locations (PLZ), sustained growing success zone (CTGZ), and successful planting zone (CTPZ).

PLZ = Pine Location Zones in Georgia;
CTGZ = Coder Tree Growth Zones in Georgia;
CTPZ = Coder Tree Planting Zones in Georgia.

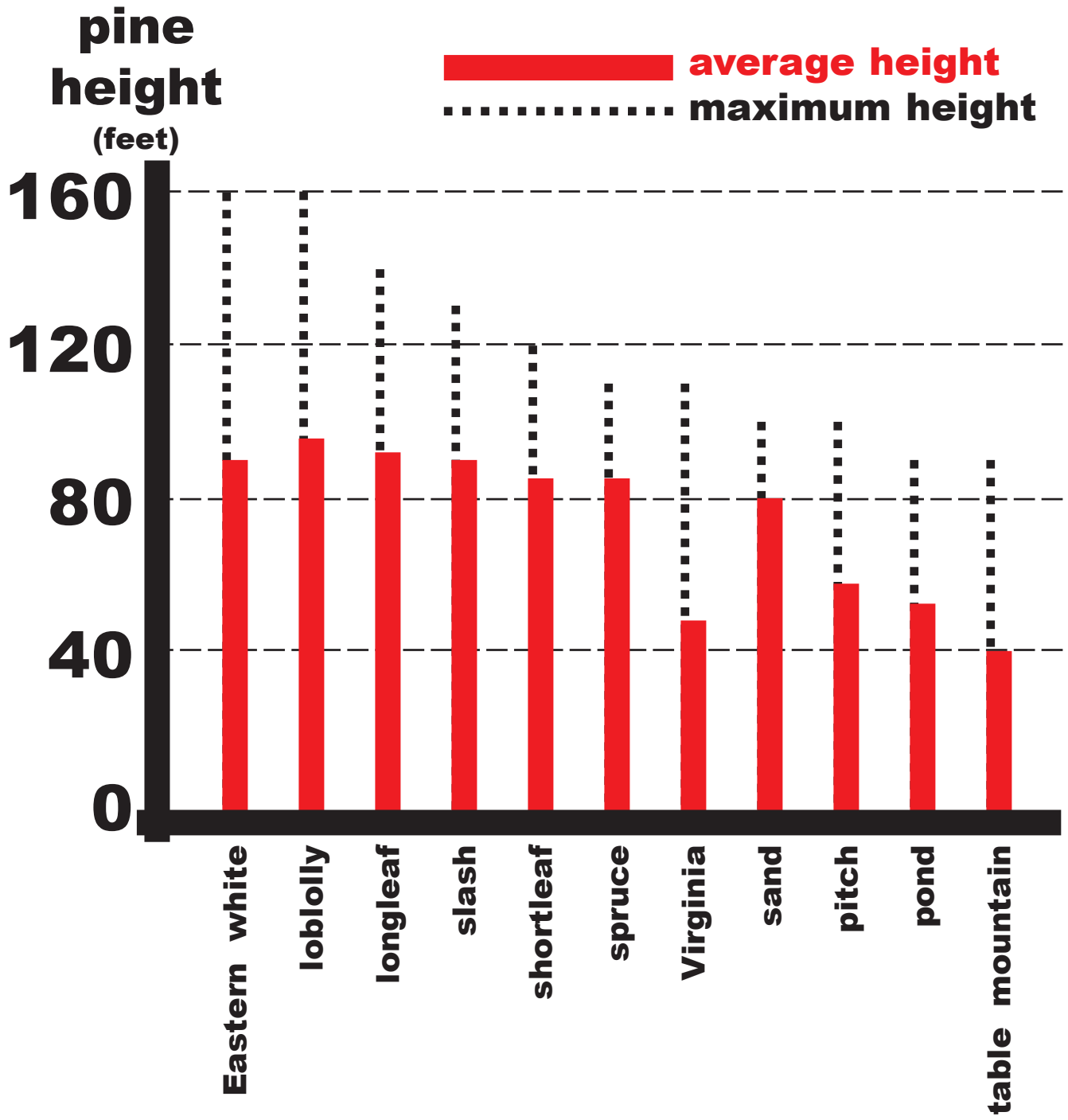


Figure 11: Average height (in feet) for Georgia pines under normal conditions and maxiumum height (in feet) attained under best conditions.

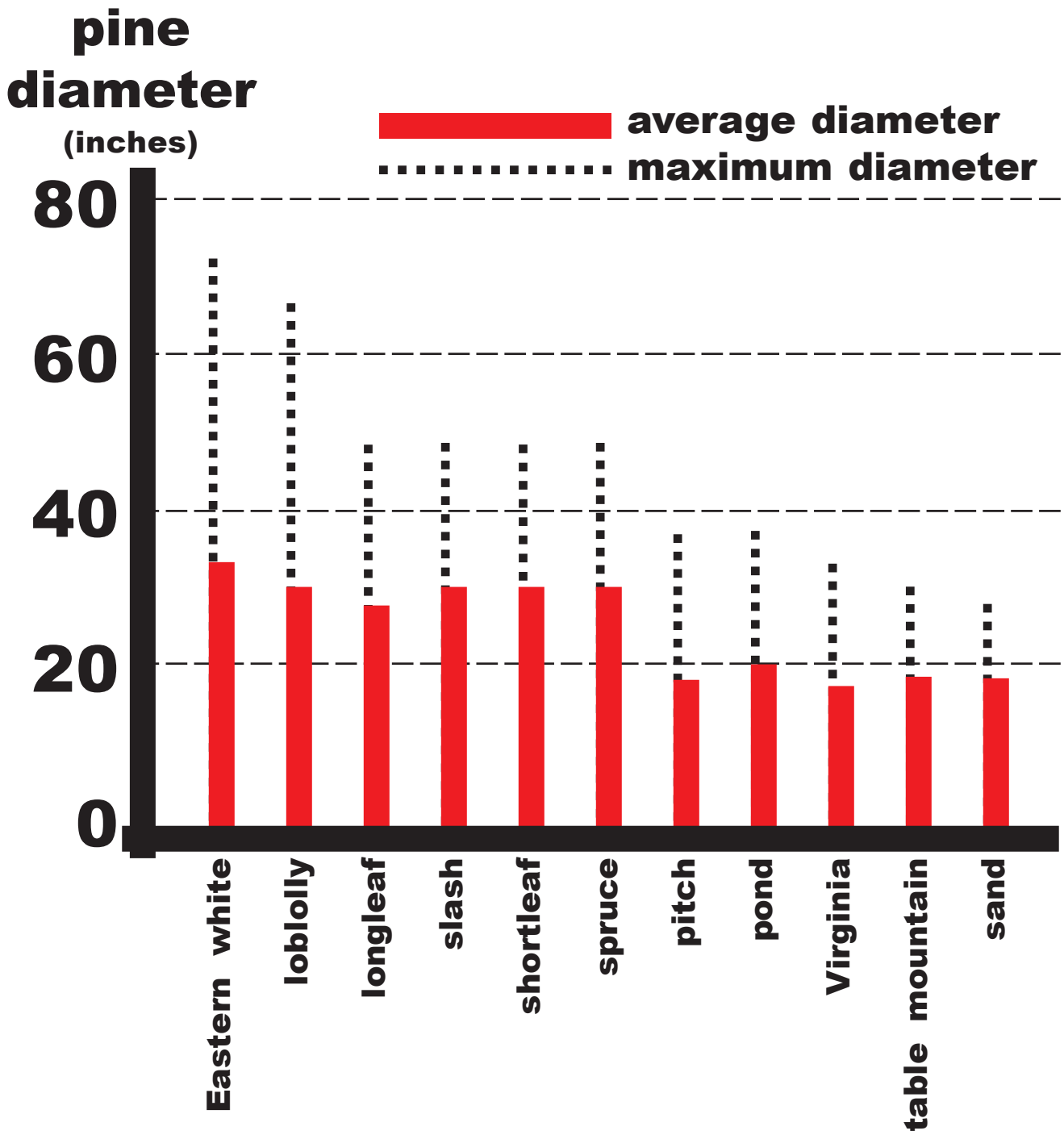


Figure 12: Average mature diameter (DBH in inches) expected for Georgia pines under normal conditions and maximum diameter (DBH in inches) attained under best conditions.

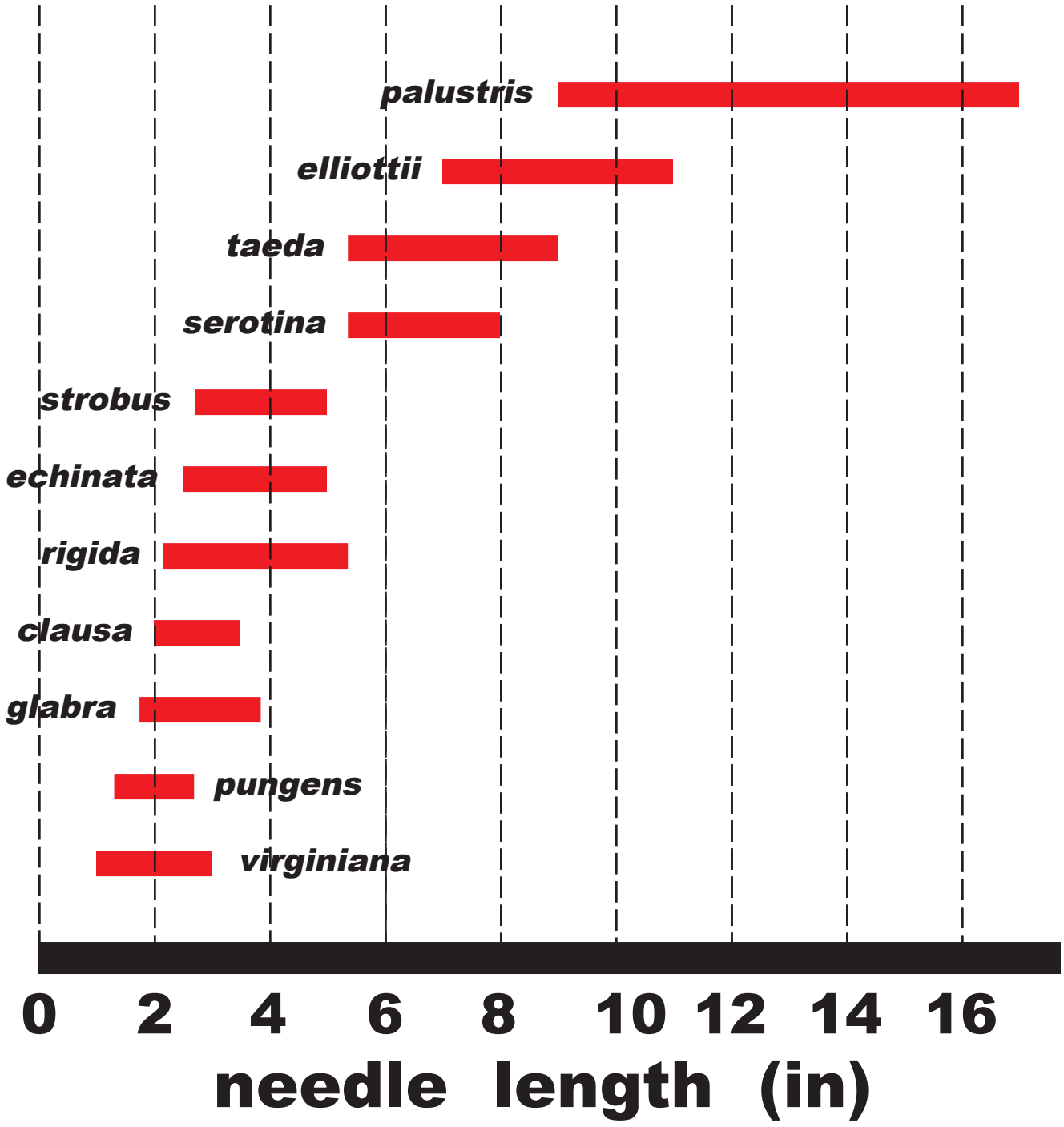


Figure 13: Comparison of Georgia pines needle lengths.

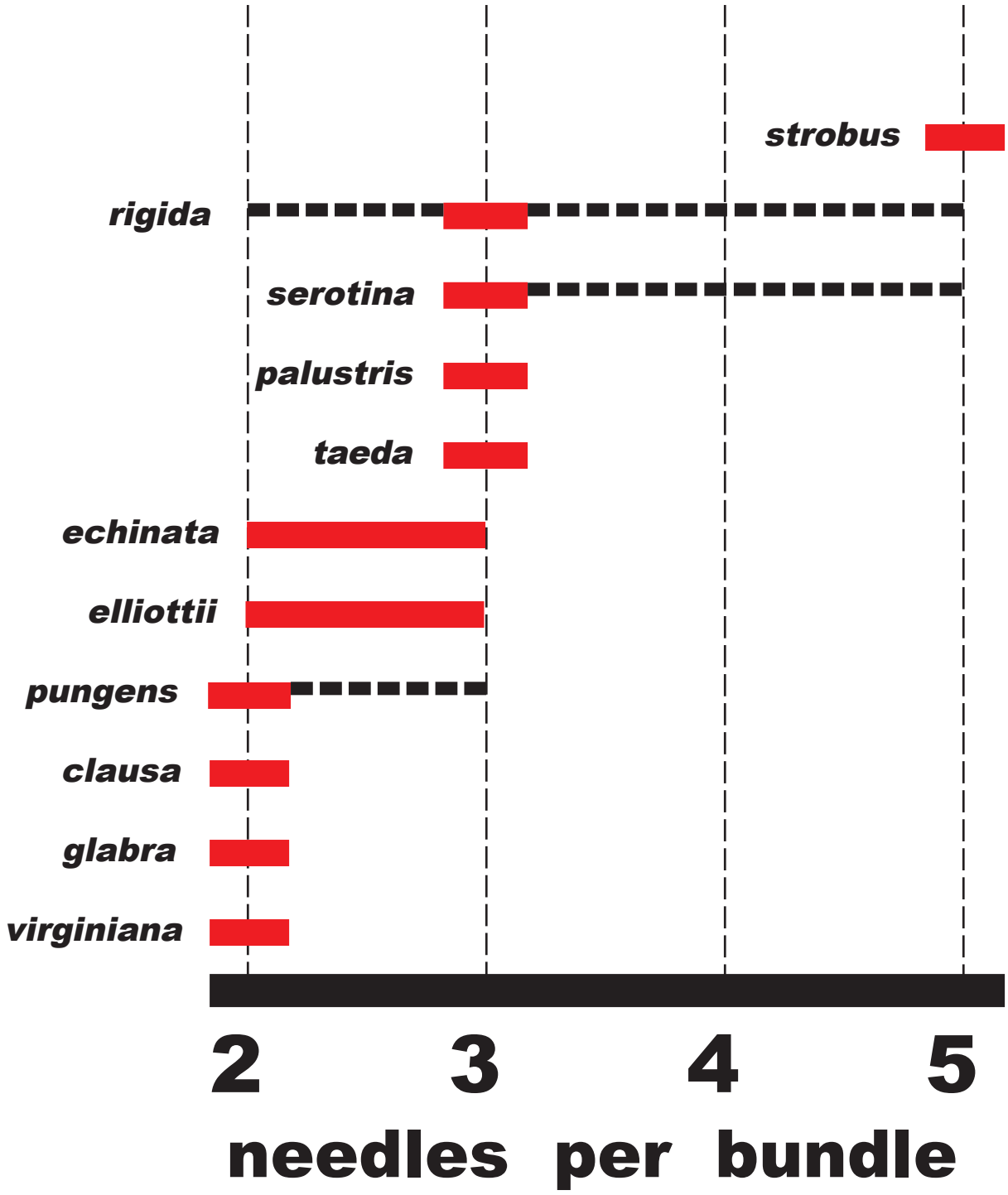


Figure 14: Comparison of expected Georgia pine needles per bundle (soilid line) and number of needles possible (dotted line).

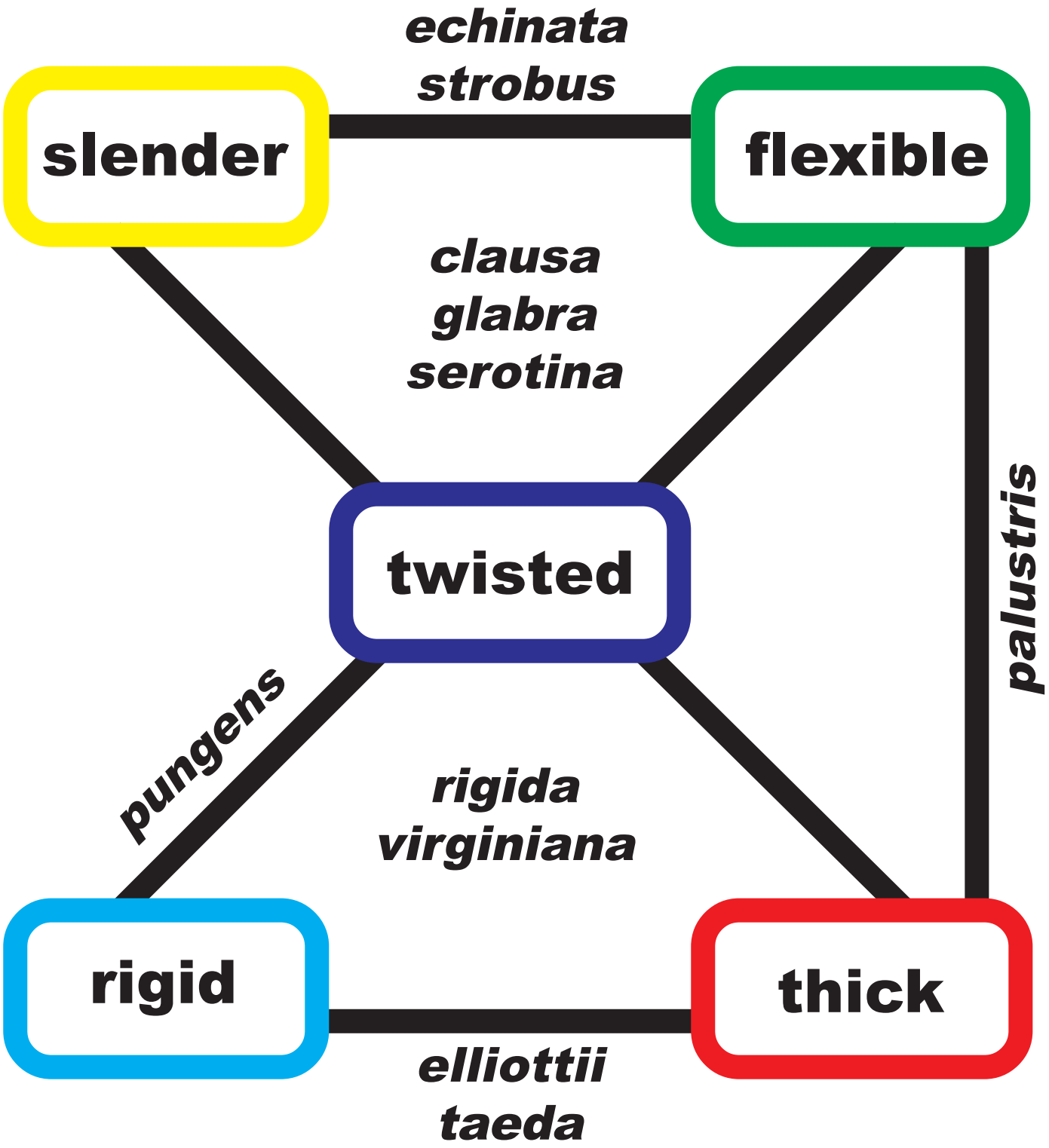


Figure 15: Word descriptions of Georgia pines needle forms.

	needle length (in)	needles per bundle	needle form
Pinus clausa sand pine	2 - 3.5	2	twisted slender flexible
Pinus echinata shortleaf pine	2.5 - 5	2 or 3	slender flexible
Pinus elliottii slash pine	7 - 11	2 or 3	thick rigid
Pinus glabra spruce pine	1.8 - 3.8	2	twisted flexible slender
Pinus palustris longleaf pine	9 - 17	3	thick flexible
Pinus pungens table mountain pine	1.3 - 2.6	2	twisted rigid
Pinus rigida pitch pine	2.2 - 5.4	3	twisted rigid thick
Pinus serotina pond pine	5.4 - 8	3	twisted flexible slender
Pinus strobus Eastern white pine	2.7 - 5	5	soft flexible slender
Pinus taeda loblolly pine	5.4 - 9	3	thick rigid
Pinus virginiana Virginia pine	1 - 3	2	twisted thick rigid

Figure 16: Needle characters of Georgia pines.

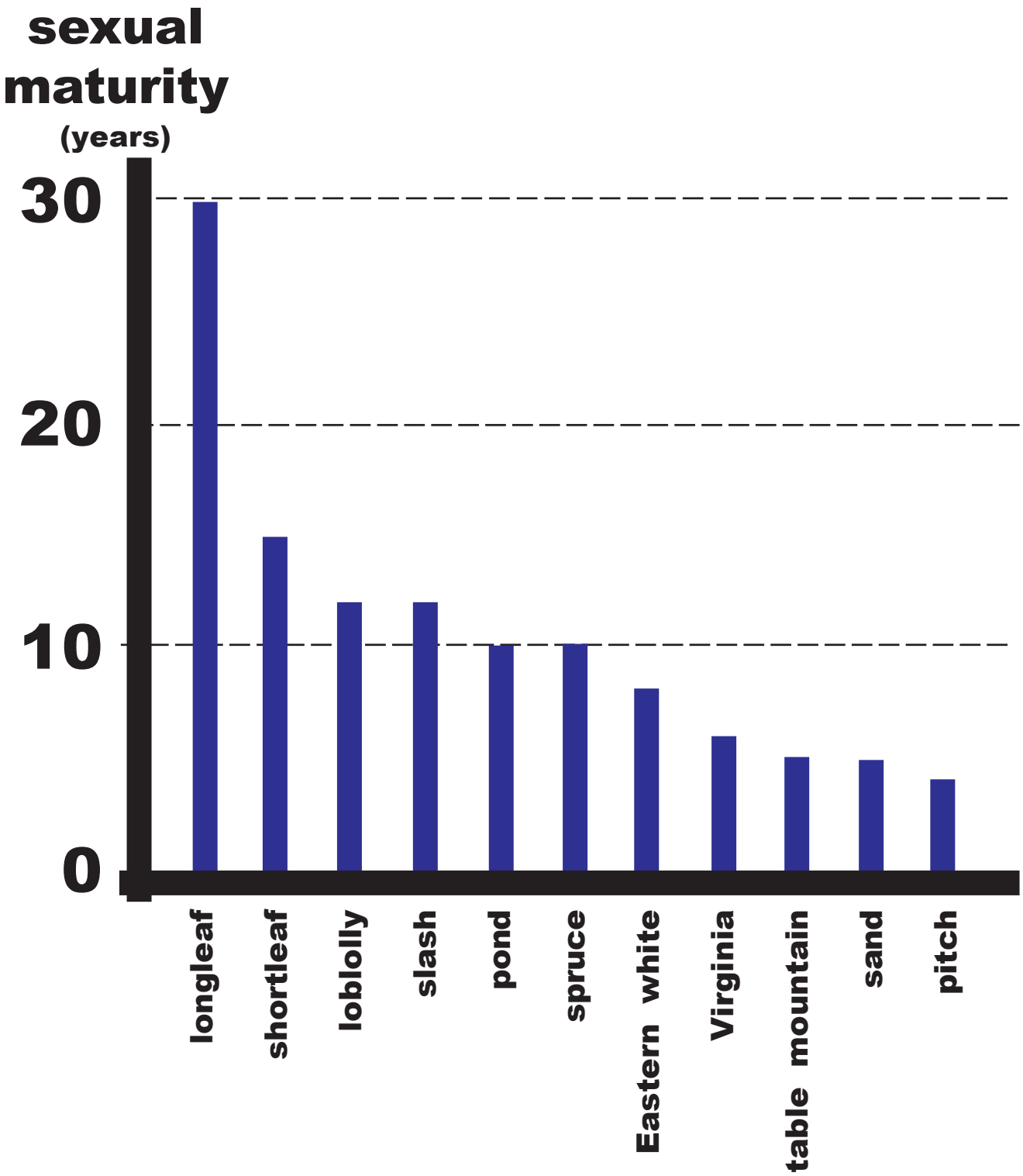


Figure 17: Expected years to sexual maturity / female cone production for Georgia pines under normal conditions.

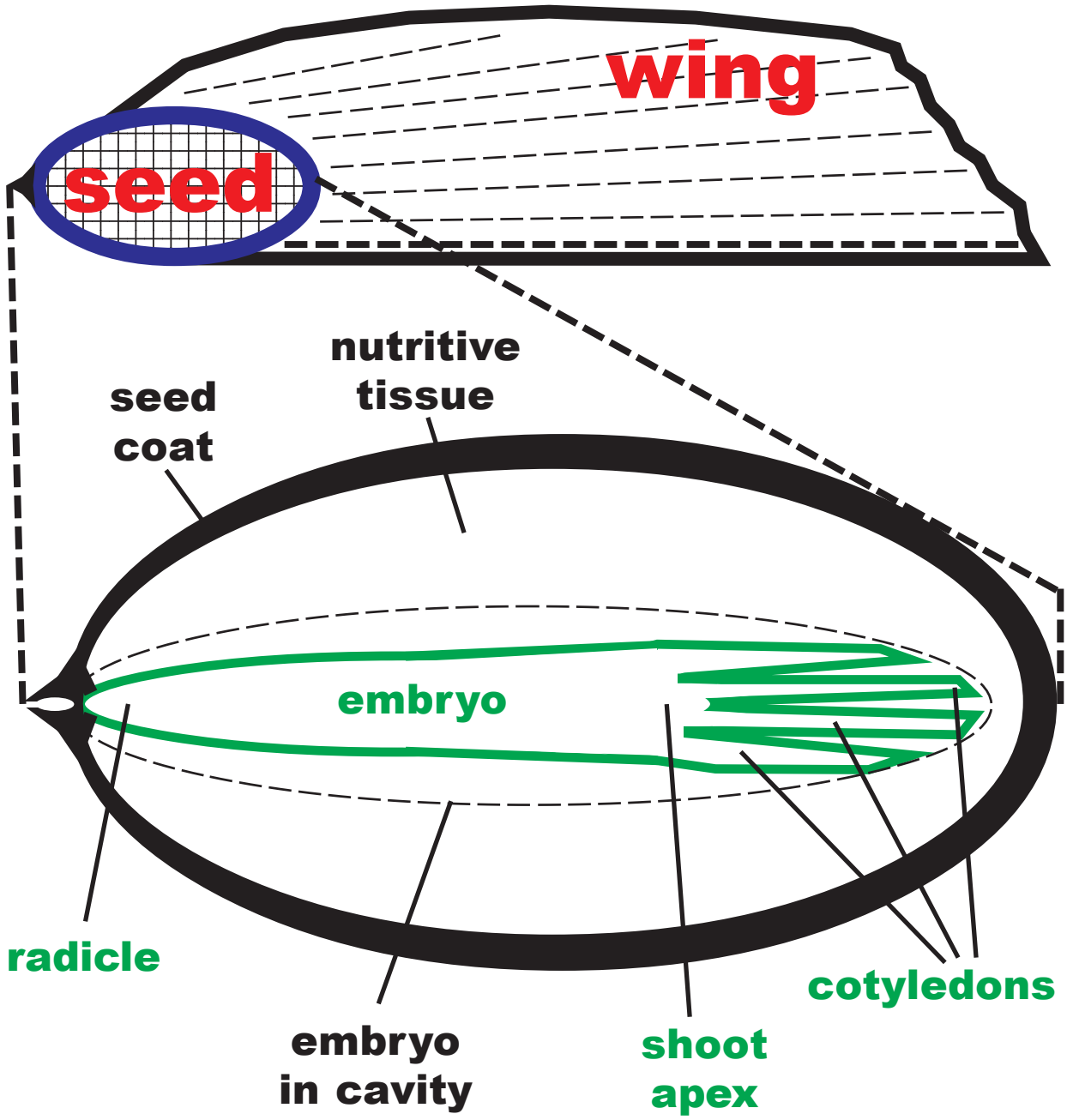


Figure 18: Simple diagram of generic winged pine seed with expanded view of seed parts.

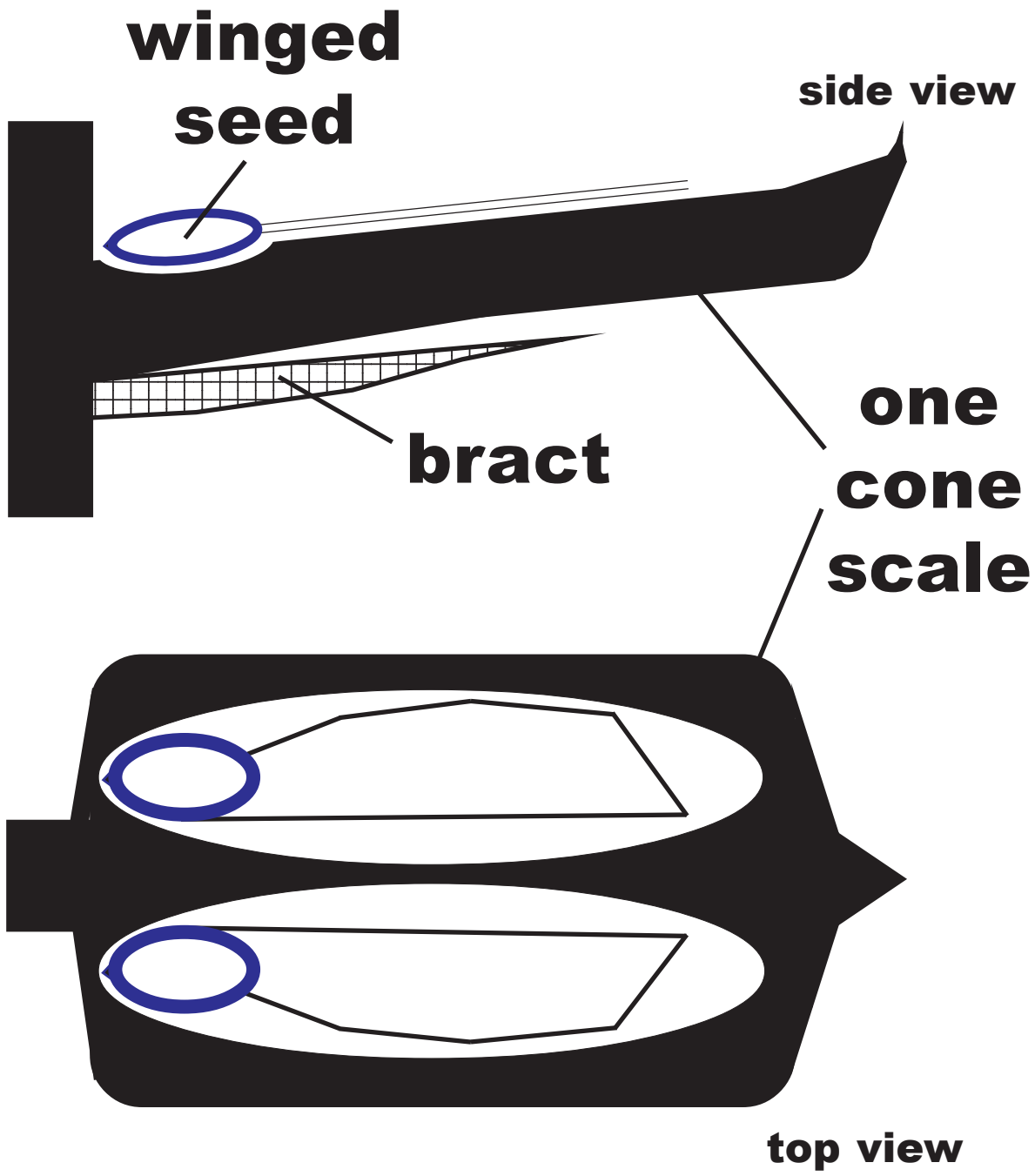


Figure 19: Diagram of a single generic female cone scale with seeds from a female pine cone.

	length (inches)	prickle form	appearance
Pinus clausa sand pine	1.5 - 3.5	small thick	mature cone closed
Pinus echinata shortleaf pine	1.5 - 2.5	small weak	dull grey color
Pinus elliottii slash pine	2.5 - 6.5	small thin	shiny tan color
Pinus glabra spruce pine	1.3 - 3.2	small deciduous weak	
Pinus palustris longleaf pine	6 -9	small weak	
Pinus pungens Table Mountain pine	2 - 3.5	thick hooked large	mature cone closed
Pinus rigida pitch pine	1.4 - 3.2	thin rigid small	mature cone closed
Pinus serotina pond pine	1.8 - 2.7	small weak	mature cone closed
Pinus strobus Eastern white pine	4 - 8	none	
Pinus taeda loblolly pine	2.6 - 6	thick sharp	
Pinus virginiana Virginia pine	1.4 - 2.8	small thin rigid	purple / red scale lip

Figure 20: Comparision of cited Georgia pine mature female cone attributes.

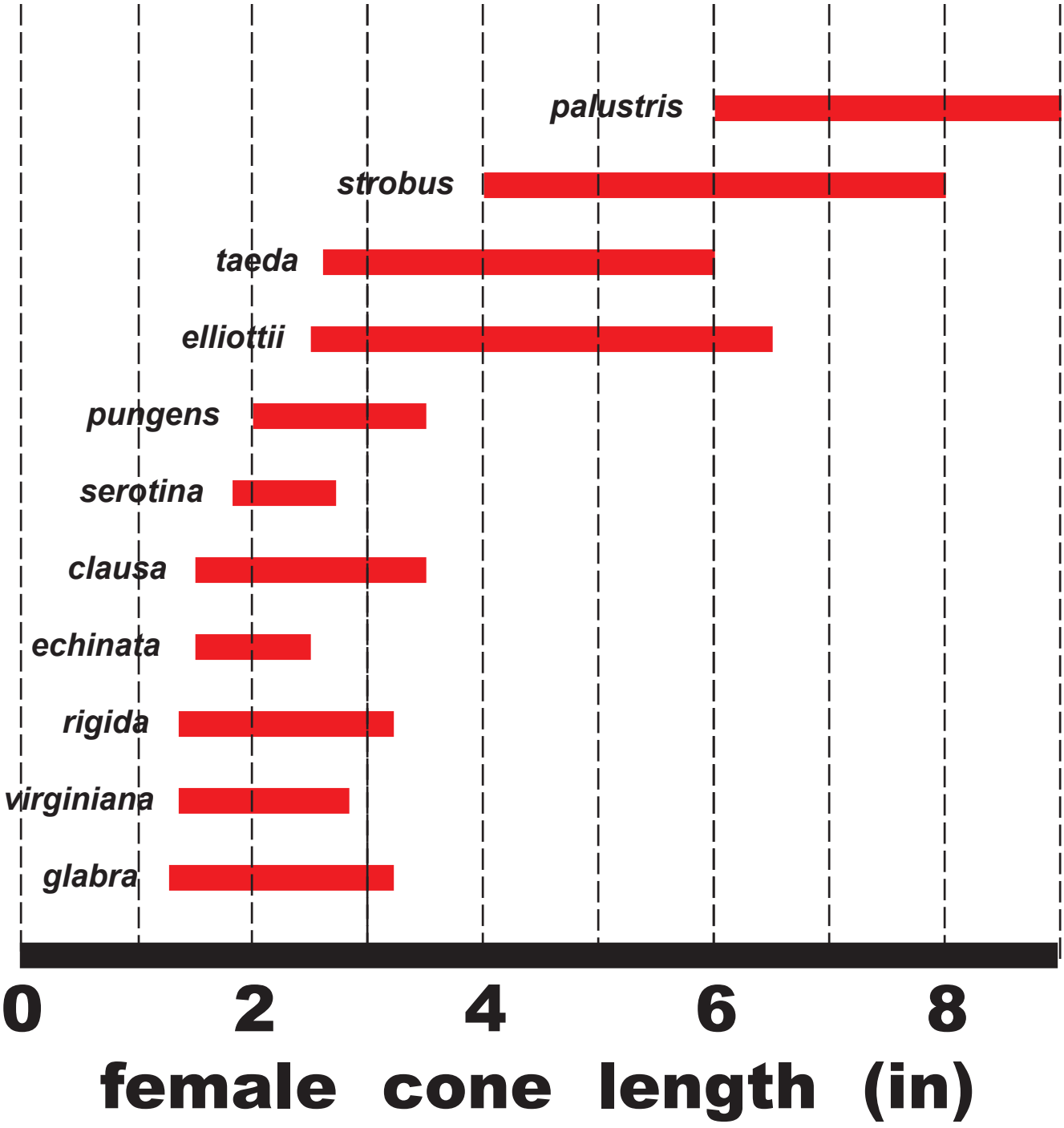


Figure 21: Comparision of mature female cone length cited for Georgia pines.

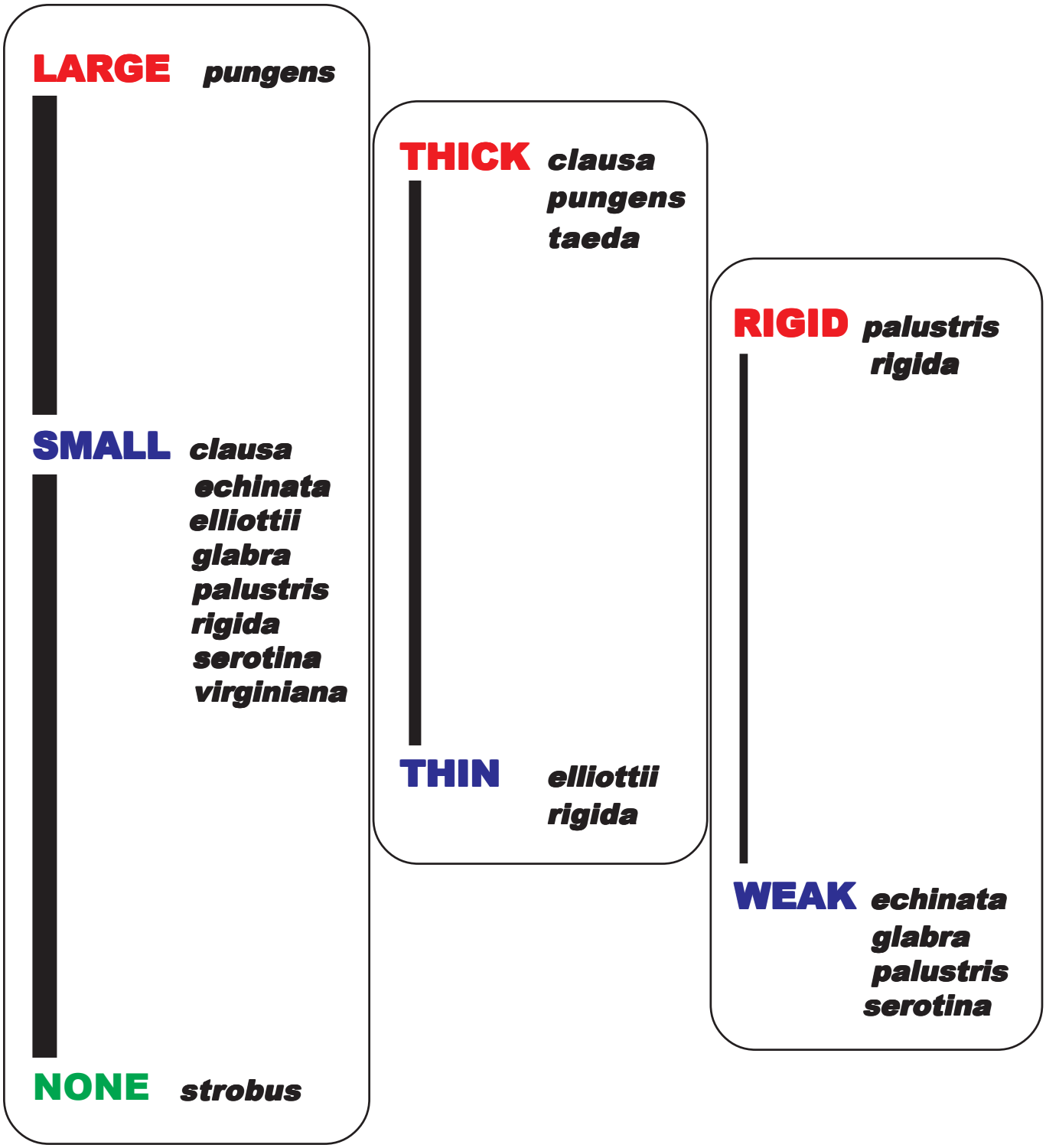


Figure 22: Cited word descriptors for Georgia pines mature female cone scale prickles.

Figure 23: General pest matrix for Georgia pines.

pests	sand	shortleaf	slash	spruce	longleaf	table mountain	pitch	pond	Eastern white	loblolly	Virginia
pine sawflies *Neodiprion* spp.	X	X	X	X		X	X		X	X	X
red heart *Phellinus pini* (old trees)	X	X	X			X	X	X	X	X	X
seedling weevils *Hylobius* spp. & *Pachylobius* spp. (young seedlings)	X	X	X						X	X	X
southern pine beetle *Dendroctonus frontalis*	X	X	X			X	X	X		X	X
annosum root rot *Heterobasidion annosum*		X	X		X		X		X	X	X
pine tip moths *Rhyacionia* spp.	X	X		X			X		X	X	X
pine engraver beetles *Ips* spp. (especially in droughts)	X	X	X	X	X			X		X	X
fusiform rust *Cronartium quercuum fusiforme*			X			X	X	X		X	
cone worms *Dioryctria* spp.	X					X		X	X	X	
Eastern gall rust *Cronartium quercuum*							X	X			X
black turpentine beetle *Dendroctonus terebrans*	X	X	X		X			X			
butt / root rot *Phaeolus schweinitzii* (old trees)						X			X	X	X
pitch canker *Fusarium moniliforme* var. *subglutinans*			X		X	X					X
brown spot needle blight *Scirrhia acicola*			X		X	X					X

Figure 23: Pest matrix for Georgia pines. (continued)

pests	sand	shortleaf	slash	spruce	longleaf	table mountain	pitch	pond	Eastern white	loblolly	Virginia
stem rust *Cronartium comandrae*		X					X	X			
needle spot *Coleosporium* spp.							X	X			
root rot / littleleaf *Phytophthora cinnamomi* (poorly drained sites)	X	X								X	
stem rust *Cronartium comptoniae*							X				X
needle blights *Ploioderma* spp.							X				
seed insects *Leptoglossus corculus*								X		X	
black root rots *Fusarium* spp. & *Macrophomina* spp. (seedlings)										X	
Eastern pine shoot borer *Eucosma gloriola*									X		
gall mite *Trisetacus floridanus*				X							
heart rot *Fomes* spp. & *Polyporous* spp.,										X	
needle cast *Hypoderma lethale*								X			
needle blight *Bifusella linearis* (new needles)									X		
pine webworm *Tetralopha robustella*			X				X				
pine twig gall scale *Matsucoccus gallicola*						X					

Figure 23: Pest matrix for Georgia pines. (continued)

pests	sand	shortleaf	slash	spruce	longleaf	table mountain	pitch	pond	Eastern white	loblolly	Virginia
pitch pine looper *Lambdina athasaria pellucidaria*							X				
pruning wound rot *Haematostereum sanguinolentum*									X		
shoe-string root rot *Armillaria mellea*									X		
stem canker *Atropellis tingens*											X
twig canker *Diplodia pinea*							X	X			
scale insects and aphids	X	X		X		X	X		X		X
white pine blister rust *Cronartium ribicola*									X		
white pine aphid *Cinara strobi*									X		
white pine beetle *Conophthorus coniperda*									X		
white pine weevil *Pissodes strobi*									X		

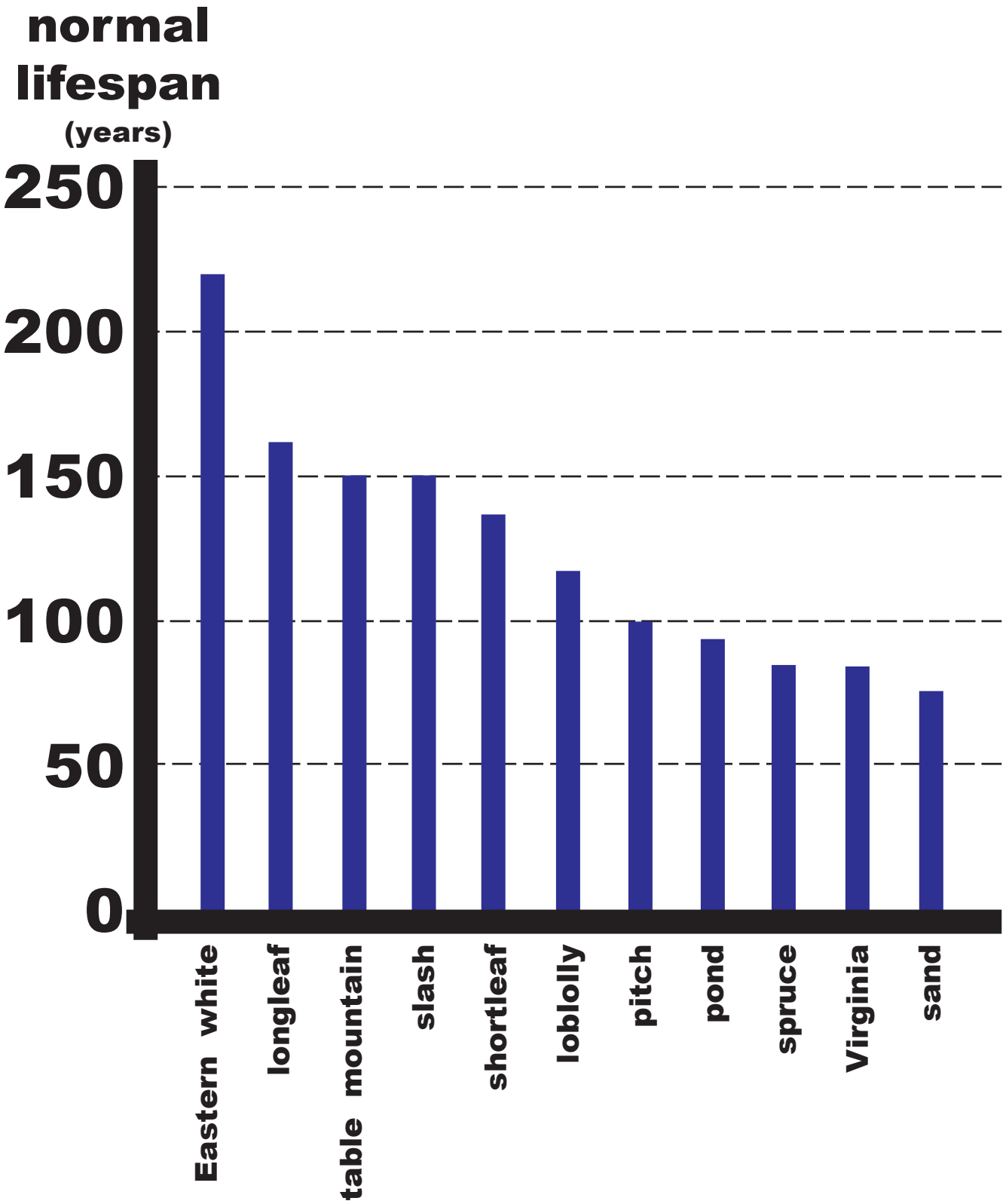


Figure 24: Normal / average lifespans (in years) of Georgia pines under non-extreme, low stress conditions.

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