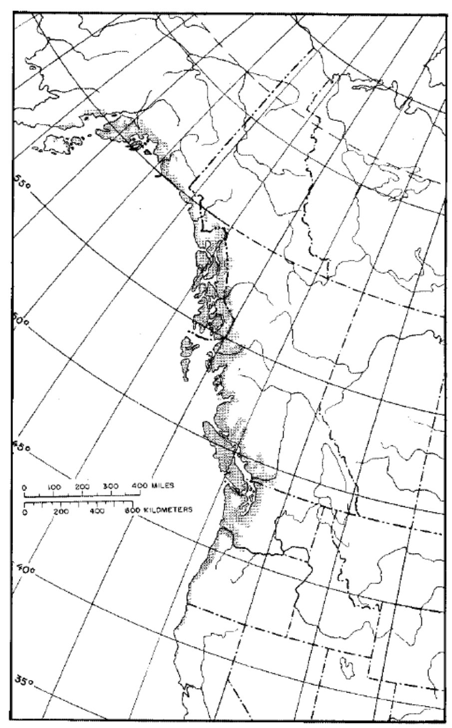
Sustainability and Musical Instruments

All musical instruments are made of materials of some kind. Stringed instruments (*e.g*. guitars, members of the violin family, mandolins, pianos, harpsichords, etc.) as well as certain wind instruments (*e.g*. clarinets, oboes, bassoons, …) and many percussion instruments (drums, marimbas, xylophones/vibraphones…) are made of wood, – more specifically, ***tonewoods*** – *i.e*. wood from a certain ***limited*** number of species of trees that have ***musica***l, ***aesthetically pleasing tonal properties*** – whereas wood from many other species of trees is either tonally ***neutral*** (*i.e*. "blah"-sounding) or downright musically unpleasant and/or even nasty-sounding. Brass instruments (*e.g*. the trumpet, saxophone, French horn, tuba, …), the harp, the snare & kettle drum, cymbals, gongs, bells are made of metals – *e.g*. musical brass, musical bronze – certain alloys that also have "good" musical/tonal attributes, as opposed to other metals which again are (again) either musically neutral or downright musically unpleasant and/or even nasty-sounding.

The detailed physics associated with the materials that go into the construction of a musical instrument – how sound propagates through a vibrating piece of wood or metal, its absorptive/ dissipative properties, and as a function of frequency dictate whether or not the material will or will not have musically interesting, and therefore musically useful properties or not. For example, wood has a 3-dimensional anisotropic grain structure (the 3-D elasticity of which can be described *e.g*. by a 6×6 matrix, in the generalized anisotropic version of Hooke's law). The 3-D orientation of the grain – how it is used in a wooden musical instrument matters greatly in the tonal properties of the instrument, not to mention its structural/strength properties. The density (*i.e*. tightness) of the grain, the speed of propagation of sound (the higher the better – from a stiff, but light piece of wood), the elasticity *vs*. dissipative/absorptive properties of the tonewood, the harmonic emphasis – i.e. the frequency dependence of these latter quantities, what the soil conditions were where the trees that are used for tonewoods were growing, the climate, ***etc***. all matter, musically. High-end clarinets & oboes use grenadilla – a dense, stable hardwood, *aka* African blackwood.

Sitka spruce – *e.g*. used as the soundboard in acoustic guitars – comes from a narrow strip of Pacific coastal region from $61^{o} N$ in south central Alaska to $39^{o} N$ in northern California, as shown in the RHS figure. In order to have good musical qualities, acoustic guitar soundboards must be knot-free and have a tight, uniform grain, which is oriented parallel to the strings. The "best" musical-sounding Sitka spruce does (did) come from Alaska – where the climate is cooler – i.e. slower tree growth per year, resulting in a tighter grain (compared to growth in a warmer climate, such as California). However, because of the increasing rate of logging over the past century, there is little of the original "old-growth" Sitka spruce left in Alaska, so much so that acoustic guitar companies such as C.F. Martin, Taylor Guitars, Gibson, Fender and Yamaha to mention a few have become increasingly concerned about long-term supplies of Sitka spruce and other tonewoods, that they have become actively involved in the conservation of this species of wood, and preservation of what remains of the old-growth stands of Sitka spruce in Alaska, as well as other tonewoods growing elsewhere on our planet. Tonewood supplies are rapidly dwindling with time.



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