

Effects of Climate on Wood Physiognomy and Properties

For silviculturalists interested in wood quality, study of the relationships among climate parameters, wood anatomical characters, and wood physical properties has practical value in site selection. Ecologists are interested in the effects of climate change on vegetation characteristics, and paleontologists are interested in wood anatomy as a means to reconstruct paleoclimate from fossil assemblages.

Background

Temperature and rainfall affect wood anatomy and physical properties. Models have been proposed to relate these climate measures to wood physiognomy, mean wood specific gravity, and wood specific gravity variability. However, these models have not been extensively tested. Particularly lacking are studies relating tropical climates to tropical hardwood anatomy and properties. The extreme diversity of species and density of growth found in many tropical habitats makes them especially difficult to study. Sampling is difficult and expensive, often requiring

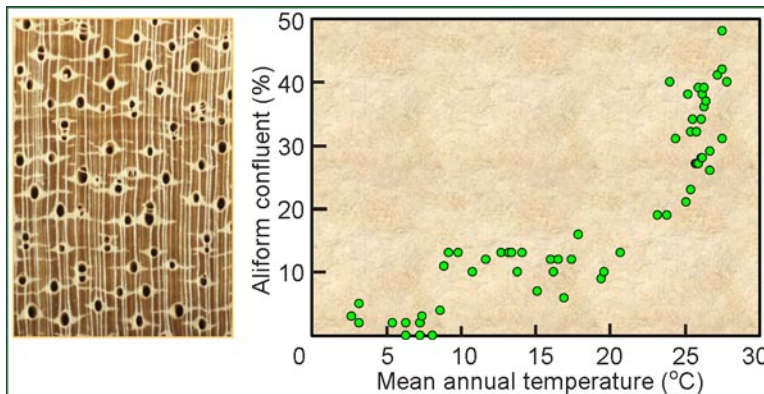


Figure 1—Character frequency increases with mean annual temperature.

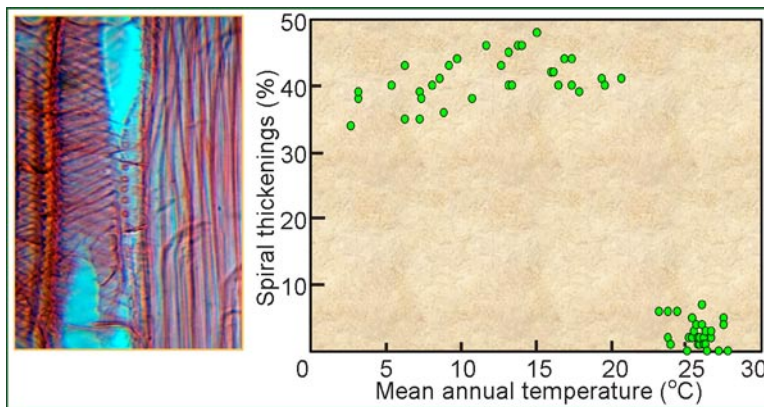


Figure 2—Character frequency decreases with mean annual temperature.

many years to obtain reasonably complete and representative assemblages of correctly identified wood samples.

As site mean annual temperature increases, some wood anatomical characters become more abundant (Fig. 1), some become less abundant (Fig. 2), and some do not change in abundance. In comparison, mean hardwood specific gravity gradually decreases as distance from the equator increases, and specific gravity variance among species increases markedly as one enters the tropics from the temperate zone (Fig. 3). Specific gravity relationships are confounded by precipitation

patterns, with precipitation having no apparent effect in the temperate zone but having a strong effect in the tropics. Specific gravity trends are quite likely associated with climate-related wood physiognomy trends. Because most physical and mechanical properties relevant to wood utilization are functions of anatomy and specific gravity, interrelationships among anatomy, properties, and climate constitute an extremely important area of inquiry.

The Center for Wood Anatomy Research is uniquely equipped to study these interrelationships. It has the world's largest wood collection, and many of the samples in the collection are carefully annotated with specific information about their collection sites and habitat characteristics. Sites having many such species are ideal candidates for validating models and formulating hypotheses about site, anatomy, and properties.

Objectives

The objectives of this research are to validate existing climate–anatomy models, to determine links among climate parameters and anatomical characters, and to discover the interrelationships among climate variables, anatomical characters, and physical properties.

Approach

Collection records will be perused to identify sites that have provided many species of wood samples. The gross and microscopic anatomy of these samples will be examined, and proportions of wood anatomical characters for entire assemblages will be determined. These proportions will be used to test the precision of anatomy-based climate prediction models and to determine the contribution of each anatomical character to climate prediction. Possible explanations for the associations among characters and climate variables will be proposed.

Regression and other statistical methods will be used to reveal associations among anatomical characters, mean wood specific gravity, and specific gravity variation.

The associations will be used to generate hypotheses to be tested in future research.

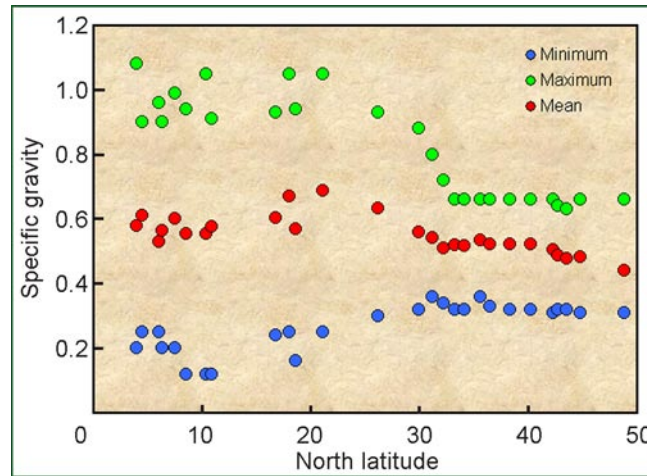


Figure 3—Specific gravity as a function of latitude.

Expected Outcomes

This research will verify or invalidate models presently used to relate climate to anatomy, will determine how the effects of temperature and precipitation on anatomy vary across a temperate–tropical gradient, and will determine which wood anatomical characters affect the mean and variability of specific gravity and other important properties. For species with wide ranges, the results will provide

valuable information on the importance of provenience on wood quality.

Timeline

This research is expected to be completed by June 2006.

Contact Information

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