USES OF URBAN VEGETATION

Some of the values of trees and associated vegetation are too obvious to belabor, such as beauty and shade. However, other values are less obvious and often difficult to measure in a very exact way. When I first started teaching Urban Forestry 10 years ago, my then 90 yr old father asked me what I was teaching in the Fall Quarter. I said Urban Forestry and he wanted to know what was going to be in the course. When I mentioned measuring the value of trees, his comment was, “well, everyone know that trees are valuable”.

Yes, everyone knows, but does everyone know the same thing? Are there different ways that trees have value? Can we measure just how valuable and assess whether they are as valuable as they are costly? We know that a Mercedes is valuable, but is it worth the cost?

Some examples of the values of trees include:

Modification of microclimates, both for human benefits, i.e. cooler, or moister air, or to provide a micro environment in which other attractive plants can be grown. For example high quality ferns can grow under a dense tree canopy, but would not survive without the trees.

Trees can also modify temperature in the buildings that they shade and make them more comfortable for humans, and less expensive to heat or air condition, and may save hydroelectric energy.
To some extent, trees have been found to remove pollutants from the air, although trees can also excrete volatile compounds into the air that are harmful to us.

Also urban greenbelts and parks can improve the quality of treated waste water, as certain elements are removed by the plants. Nitrogen is a common example where it is good for plants but not for us, especially in the nitrate form. Herbaceous plants, such as fescue, have been used to sequester selenium, which is toxic at higher levels, from polluted soils. It can also be transported to other areas where the soil is deficient in selenium. My sense, is that this field is just beginning to have the impact it will have in the future.

When trees and shrubs are planted in dense screens they can significantly reduce unwanted noise, at least in some wave lengths.

Trees can also reduce the glare from light covered surfaces, such as buildings.

And, vegetation, in general, can reduce wind and water erosion of exposed urban soils.

We will deal with each of these throughout the Quarter, but first we will consider a brief introduction to the history of tree uses presented by Miller.

The History of Trees in the City
We have already seen that trees were part of early Egyptian cities by 3000 BC and methods of transplanting trees were described by 1000BC. New plants had also been introduced to Egypt from India by 1000BC. In China by the 1200s Kublia Khan was requiring tree planting along roadways in Beijing. We also saw that villa gardens became fashionable in Italy by the 1500s, while throughout Europe the UF that common people lived in remained deplorable. This continued at least until the early 1700s, when conditions of the UF gradually began to improve. By the early 1800s European governments started to improve the UF specifically for the “humbler classes”

1. The Romantic Landscape in Europe

As we have already seen, the industrial revolution led to deplorable conditions in cities. This led to a movement to establish trees and natural areas into cities, perhaps beginning around 1800 in London. While the previous Baroque Gardens of France were quite formal, these Romantic Landscapes were quite informal, or more natural.

2. In American Cities

Early, pre revolutionary villages in 1600 and 1700s New England were built around the familiar village green, but it was not meant to be an aesthetic park as it would be today. It was a more practical place to muster the militia, and keep livestock in times of attack. However, William Penn designed 5-10 acre open spaces in Philadelphia in 1682 and had them filled with trees. But, trees were not yet planted along streets. As yet there were no Street Trees in America.

After the Revolution, our self image was still very agricultural and city dwellers were not considered in the main stream. Urban landscape design was slow to be
established. However, The **Territory of Michigan** enacted legislation providing for **the planting of trees along boulevards in Detroit** in **1807**. Others followed, and the Romantic Landscape movement from England was adopted in many industrialized cities in the mid 1800's, including Central Park in New York, designed by Frederick Law Olmstead.

As 1900 approached, we had become a country devoted to tree planting. **Arbor Day** was first observed in **Nebraska in 1872** and it spread rapidly across the country.

**USES**

**A. Today’s Architectural and Aesthetic Uses**

In 1970, a Harris poll found that 95% of Americans listed green grass and trees, along with friendly neighbors, churches, schools and good stores, as things they wanted to be nearby.

Now, in 2010, what do you think would be high on this list?

By 1981, Green Industries were listed in the Wall Street Journal with the top growth industries. However, not all of the urban vegetation has been professionally designed. Some landscapes are abysmal.

When used well, urban vegetation can form either:

a. **Architectural** characteristics, that create a **comfortable spaces** for humans.
This may include privacy or screen off undesirable elements, direct vision to something desirable, or break up large spaces, etc.

b. Aesthetic characteristics, deriving from the beauty of the plants themselves. And, Miller discusses many other uses of trees that you can read.

1. Recreation and Wildlife

In addition to architectural design and aesthetic uses, plants of the urban forest can be used to provide experiences in more informal settings.

These may include e.g.:

The Green Belts around Chicago or, the American River Parkway in the Sacramento area. Urbanites are increasingly wanting trails for hiking and biking, and want to see squirrels, waterfowl, reptiles, etc.

However, Dwyer (1982) concludes that people from the suburbs tend to use these resources more than people from the inner city, especially those that are elderly or handicapped. They may find inner city parks more accessible than the more natural greenbelts.

The management of trees in these reserves is clearly less intensive, but there can be costs associated with the management of wildlife.

B. Climatological Uses

Before we discuss climate and its effects on people and plants, it is useful to
define climatological differences on three scales:

1. Climatic Scales

**Macroclimates** describe climates from very distant regions of the country. Areas within a macroclimate will have the same rainfall, temperature, wind, etc. I have compared the Continental Climate of the East with Mediterranean Climates of the West. These are distinct Macroclimates.

**Mesoclimates** describe climates that vary within a region primarily due to topographic features such as mountains or bodies of water. Differences between climate between Golden Gate Park and downtown San Francisco are Mesoclimates. The rainfall is about the same, but there are differences in hours of fog per year, and some differences in wind velocity, and temperature.

**Microclimates** describe differences of a few feet to several yards and may result from the presence or absence of other plants. The microclimate on the south side of a tree will be different than on the north side of a tree.

2. Human Comfort

Human comfort is primarily affected by 4 climatological factors.

a. **Solar radiation**
When heat is a problem, trees can be used for shade, which is the direct interception of infrared light that caused our bodies to become hot. In addition, trees and other plants can be used to screen infrared light from the reflecting off of buildings, the ground or other surfaces. Also, plants use this radiation for photosynthesis and growth. Dense canopies provide more protection than sparse canopies. In areas where the shade is unwanted in the winter, deciduous trees and associated vegetation are better. You will need to consider these features in your site project.

b. Air movement

Plants can also be used to control air movements in a number of ways.

**Obstruction**, occurs when a very dense planting at 90 degrees to the prevailing wind actually blocks (reduces) the wind. Since airspeed is determined by density of the planting, it is best to have trees and shrubs, and hence the shrubs will have to be somewhat shade tolerant. If winds are primarily in the summer, deciduous species can be used; if winds are in the winter, evergreen species are best.

Winds, or breezes, like our delta breezes, can also be directed to an area by vegetation for the cooling effects in hot summer areas. Landforms and structure must also be considered.

Just the opposite may be used to direct air currents away from a site where they may be undesirable.
Finally, air currents can be reduced by wind breaks that simply filter the wind as it passes through. These are common in agricultural areas of California where eucalyptus wind breaks were planted to protect crops such as oranges from the hot dry Santa Ana winds in Southern California.

c. Air temperature

It is sometimes thought that trees in a city will reduce air temperature. This apparently is not true for street trees, at least in a study from Syracuse, N.Y. However, there is no questioning the values of street trees from aesthetic considerations, or from the shade they provide humans.

In addition, it is cooler in forested areas than in adjacent cities, just as it is cooler next to a nearby alfalfa field than it is in Davis or Woodland, especially in a parking lot.

d. Humidity and precipitation

The relative humidity is higher in a forest stand than in cities, although, again in Syracuse, street trees were not effective in increasing RH.

In another study comparing conifers with hardwoods, it was found that stands of coniferous trees retained more rainfall (40%) and allowed it to evaporate into the atmosphere, thus increasing the RH. Hardwoods, on the other hand, retained less (20%) and more of the rainfall reached the ground. Therefore, conifers should be chosen to increase RH and hardwoods to increase soil water in watershed lands.
3. Energy Budgets for Buildings

a. Heating Buildings

There are three ways that buildings loose heat and vegetation can reduce each one of these.

Air infiltration occurs as a result of wind and air pressure differences in the building. Outside, wind creates high pressure on the windward side of the building that forces itself into the building through cracks around doors and windows. Negative pressure is created on the leeward side of the building sucking warm air out. Inside the building warmer air moves up levels creating an increased pressure pushing warm air out. Negative pressure is created at lower levels which sucks cold air in. On windy winter days, infiltration can account for a 50 % heat loss.
Bottom of Bld  Lower Temp  Lower Pressure

Also,

**Heat conduction** carries heat **across solid substances**. Insulation traps air in its fibers in order to reduce conduction.

And,

**Radiation loss** occurs from windows, and double pane windows use an air space between the pain to reduce radiation losses.

Therefore,

Vegetation can reduce wind velocity that causes infiltration, and dense vegetation next to a building can create a layer of insulation and reduce radiation loss.

However,

Vegetation that shades a building in the winter can increase heating costs by reducing radiant energy that would reduce heating costs. Therefore, a complete energy budget needs to be estimated for any situation.

b. **Cooling Buildings**

Cooling buildings in Summer is required because buildings will heat up due to radiation through windows and conduction through solid structure such as walls and roofs. Summer shade from trees can reduce air conditioning costs of up to 50%, and even 60% in mobile homes that are not as well protected. I have noticed that the Yolo Mobile Home Park along Pole Line Road just north of 5th st and the Post Office, has a very
dense tree canopy of trees, many of which are fast growing. I assume they very significantly reduce cooling cost and increase human comfort.

c. **Solar energy and trees**

As conservation of energy becomes more and more important in urban ecosystems, we are constantly looking for better sources of energy. Solar power has been promoted as a better source than electricity or gas, but there are questions that arise concerning the shade they cast. Thayer and Maeda (1985) here at Davis analyzed solar energy use in Village Homes and suggest a planned solar access neighborhood approach would be more efficient than each home having its own panels on the roof. It is better not to have solar panels providing shade on the roof in the winter.

4. **The Urban Mesoclimate**

**Heat Islands**

Although vegetation does not significantly effect macroclimate, the lack of vegetation does effect a mesoclimate, such as urban heat islands.
Rowntree et.al (1982) conclude that the heat island in Dayton, OH, as well as similar cities could be reduced by 25% through the introduction of woody and herbaceous vegetation. In California, studies have shown an increase in temperature over the past 100 years, of about 0.67 degrees per decade. This is not a rapid increase but, over a long period of time could be devastating. These could be totally mitigated by an increase of 25% in tree cover in Sacramento, according to computer models.

**Glare and Reflection Reduction**

Intense glare has been a problem for all of us, especially when driving. While we can use vegetation to either block or filter the glare, it may be difficult to plan the position of vegetation. The sun changes angles both during the day and during the course of the year.

**Urban Wastewater**

Urban waste water can be cleansed either by chemical means, which is getting expensive, or by passing the water through landscapes or watershed lands. Either are better than polluting rivers as we have done in the past. In irrigating watershed lands we must take care not to pollute aquifers from which we derive our water. Miller discusses a significant study in Pennsylvania in which amounts of waste water that could be used were determined that would not increase nitrates to dangerous levels.
Actually, growth of the forest was increased. The nitrates actually go into plant growth.

We also need to be careful with regard to levels of heavy metals. Important papers by Sopper and his colleagues may be of interest to you. They appear at the end of Chapter 4, which is where we are now,

**Air Pollution Reduction**

This is a very complex subject because our atmosphere is polluted with so many different elements, they tend to vary in their occurrence from place to place, each has a different capacity to be removed by vegetation, and each has a different capacity to damage the plants that might otherwise be helpful in their reduction. The first transparency illustrates the extent of this complexity.

SLIDES

BREAK

PROJECT