



Creating the Nation's first BioPark

National Zoological Park · Smithsonian Institution · Washington, D.C. 20008-2598

Letter From the Desk of David Challinor
November 1995

The leaves are starting to turn as I write this letter; fall may be arguably the most beautiful time of the year in the Eastern United States. John Keats described fall as "the season of mists and mellow fruitfulness" and for me its special charm is most apparent in the tree family, Fagaceae: oak, beech and chestnut. Oak has long served humans with its wood and fruit (acorns) and this month I will extol its special qualities.

In North America there are two families of oaks -- the red and the white -- unlike in Europe where only white oaks are native. With a few exceptions, the easiest way to tell the two families apart is by their leaves. Red oaks have a bristle at the end of the leaf lobes, while white oak leaves have rounded lobes. There are other differences as well, but they are harder to observe. The acorns of American white oaks mature in one year. Thus catkins (blossoms) that are pollinated in the spring produce acorns the following fall that are ready to germinate when they fall on an appropriate site. Red oak acorns, on the other hand, take two years to mature on the tree, and when they ripen and fall they must stratify over the winter; that is, the acorn must be exposed to a cold period of two or three months for it to break dormancy and germinate in the spring.

Such reproductive strategies are complicated but have evolved over millions of years. All oaks seem to have mast years when large acorn crops are produced. Mast is a medieval term that refers to ripe nuts on the forest floor; mast is used as fodder for the pigs which swine herders used to drive through the forest to fatten. Mast years generally occur at three- or four-year intervals, but individual oak trees often do not cooperate and fail to produce any acorns at all in mast years.

Growing oaks for mast was common in Europe, especially in the times of powerful clergy and nobility. The early bishops of Wurzburg in central Germany, for example, controlled large forests and many enjoyed hunting on horseback. In the 15th and 16th centuries they had their serfs prune forest oaks high enough for mounted hunters to avoid low branches. Little did the bishops realize at the time that their pruning would pay off so handsomely centuries later. In the Spessart hills where such hunting took place, the soil is so poor that the oaks grow slowly (20-30 annual rings to the inch). The closer the rings, however, the denser the wood. When ready to harvest after 300 years, these dense, pruned, knot-free oaks were ideal for veneer logs



and to this day still command premium prices. The forest in this example has survived for so long, in part because the soil was too poor to farm. Elsewhere in Europe large oaks were felled primarily for ship timbers and by the mid 18th century there was scarcely any ship timber oak left.

In North America, however, the closely related white oak was still abundant and thanks to its availability the new United States was able to build a remarkably successful navy, especially its two famous frigates: USS Constitution and USS Constellation. The two ships are still afloat and in commission, although I doubt much of their original oak beams and planks still exist in their hulls.

Around Washington seven or eight species of red oak are common, as are a like number of white oak species. Both groups maintain a close relationship with grey squirrels which we all have watched eating or burying acorns in the fall. Grey squirrels are voracious in their acorn consumption and usually eat white oak acorns in the fall and cache red oak ones. To learn why, researchers analyzed the respective contents of the two acorn types. They found that red oak acorns are rich in fats, containing more than double that of white oak acorns, but the red ones have three to five times more tannins. Tannins give acorns a bitter taste, but are water soluble and can be reduced by boiling. Tannins are also concentrated in the bark and leaves, especially of red oaks, and serve as an internal way for trees to repel insect foliivores. Squirrels are thus faced with a tough choice: either a low fat, good tasting acorn (from white oaks) or a high fat, bad tasting one (from red oaks). When given a choice experimentally, squirrels ate the fatty ones, unless the low fat white oak acorns were so numerous that it was not advantageous for the squirrels to seek out the less numerous, high fat, red oak acorns.

It is logical that squirrels cache red oak acorns because they will not germinate until spring. Caching white oak acorns could be futile because they normally germinate shortly after storage and any nutrients the acorn contained would be transferred to the growing tap root on germination. However, squirrels can avoid this white oak acorn characteristic by biting off its bottom end where the embryo is located, thereby preventing germination. The acorn so treated is then cached.

Besides being eaten by squirrels, deer, woodchucks, turkeys and numerous other vertebrates, acorns are also used by acorn weevils as a place for their larvae to grow. In the spring females of various species of this insect drill a small hole in the ripening acorn and deposit an egg. When the larva hatches inside, it consumes the acorn and in the fall chews an exit hole from which it emerges to spend the winter on the forest floor where it

eventually pupates, leaving in the spring as an adult beetle. Infested acorns are usually easy to identify because they float, whereas intact ones sink. When squirrels were offered both infested and whole acorns, they consistently cached the latter and immediately ate the infested ones, probably to enjoy the high protein larvae inside.

From all these details one can appreciate that oaks and other trees in the course of their evolution select elaborate ways to insure their survival. For example, even after defoliation by gypsy moth larvae, oaks will put out a second flush of growth in late June. Growing a second set of foliage takes extra energy, but to reduce the odds of being defoliated for two successive years, oak leaves produced in the spring following the defoliation year often contain much higher levels of tannin, which helps repel gypsy moth larvae. Storing up energy for an occasional big mast crop allows the oaks to flood the forest. So many acorns will be cached that many will not be eaten during the winter, and under good spring conditions enough seedlings will germinate to offset the loss from deer grazing as oak sprouts are a favorite deer food.

Finally, the distance a squirrel carries acorns away from the fruiting tree has a direct bearing on how far or fast an oak forest can reestablish itself in areas where it once thrived. This is particularly topical today when we consider global warming. As the north temperate zone becomes warmer, will oaks via their squirrel partners be able to advance fast enough into new sites beyond their original northern limits before they can adapt to new, higher temperature conditions in their old habitats? Even more worrying is what effect on oak blossoming will be the change in the ratio of daylight to dark as you go north? Many plants have reproductive cycles that are determined by photo period -- the length of the dark period during the year.

There is still much to consider about how oaks survive and spread. For me they are the most magnificent of all the broad-leaved trees. My favorite would have to be the white oak (Quercus alba), a number of which have grown to remarkable proportions. The Wye Oak on Maryland's eastern shore is probably the most famous for its size and age. Its wood is "tight" and thus used for wine barrels and also frequently for church pews as it withstands wear well and has few splinters when properly finished. Finally, for those readers who are or were US Naval officers, white oak leaves decorate the bill of a high ranking officer's hat; more familiarly known as scrambled eggs. White oak leaves embroidered on the sleeves of the Navy's Supply and Medical Corps distinguish them from line officers who wear a star above their rank stripes.

Take note of this great American tree which is relatively common in the tree-covered eastern US; its leaves, fruit and timber are firmly ensconced in our culture. Among the other oak species, white oak, in my opinion, leads them all. America has been richly blessed by its abundance and variety of forest trees. We must be vigilant, guarding them against the greatest predator of all -- man and his unbridled urge to alter the landscape, often with unforeseen results for subsequent generations.

David Challinor
202/673-4705
202/673-4607 FAX