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Saving the Ancient Pines by Reducing our Global Footprints

This past summer I had a wonderful opportunity to visit Lake Shrine, the Aztec exhibition at the Los Angeles Guggenheim Museum and lunch at Gladstone's with one of my mentor's Emeritus Prof Roger Sands. I was intrigued to learn that economists were in the process of valuing Nature, globally.

In early October, a former banker, Pavan Sukhdev placed a price tag on the worldwide network of environmental assets in an attempt to halt destruction of coral reefs, wetlands, rainforests, prairies, deserts, lakes, rivers and the oceans. Healthy global ecosystems are worth at least \$5 trillion a year to humankind.

In California alone, world-class state parks attract tourists who spend in excess of \$1.2 billion annually, marveling at our unique ecosystems including the tallest, largest and oldest trees on the face of the Earth.

Although placing a dollar value on wild ecosystems may seem trite, it is actually the first step towards global conservation. Once our ecosystems have been assigned a monetary value then their importance become apparent to everyone.

The second step to protecting our planet is to halt habitat destruction from senseless and careless human harvesting. There are at least 26,000 species around the globe threatened by extinction, occurring now at a rate that is almost 1,000 times faster than the great extinction of the dinosaurs some 65 million years ago.

The United Nations meeting in Nagoya, Tokyo with delegates from 193 countries (sadly the United States was missing) has agreed to protect 17 percent of the world's land areas and 10 percent of the oceans by 2020.

The third step to ensuring a healthy and habitable planet for our grandchildren is to address rising greenhouse gases, which are irrefutably fueling global warming. Conservation biologists and ecologists study nature's patterns across the landscape. And our trees, whose progenitors have been on the Earth for about 400 million years, are showing those that are looking numerous signs of stress induced from rising global temperatures.

For the past decade and a half I've been making an annual pilgrimage to my favorite trees on the planet -- the Great Basin bristlecone pines (*Pinus longaeva*) of California's White Mountains. It's there at an elevation of over 11,000 feet that the oldest, non-clonal tree -- Methuselah resides. He's 4,846 years old and has witnessed over 1.77 million sunrises. It is rather fitting that he lives on sedimentary soils of sand, mud and shells dating back to 600 million years ago.

Tree growth in stressful environments such as rocky soil, along cliff faces or at the top of mountains is very sensitive to environmental factors and displays excellent variations in ring-to-ring growth -- known as variation sensitivity. It's these tree ring patterns that scientists, including myself, study.

Tree rings from 678 Great Basin bristlecone pines taken from the White Mountains, and Mount Washington and Pearl Peak, NV have shown scientists that rising temperatures are having a profound impact on the slowest growing, ancient pines on the planet. That is, the past 50 years of tree ring growth has been the fastest in the last 3,700 growing seasons. Fortunately for these high elevation champions, the 20th century was one of the wettest in the last millennium. However, all 22 climate-models that I have seen indicate that rising temperatures this century will bring the most severe droughts, unprecedented in modern times.

Great Basin bristlecone pines are breathtaking for a number of reasons. Unlike any other known living thing these trees and the ancient cliff cedars (*Thuja occidentalis*) of the Niagara Escarpment show no sign of the degenerative aging process. In fact, many of them live over two miles above the Earth yet they exhibit no mutations as they stoically enter their 49th century of life despite being bombarded by extreme cosmic radiation. Gerontologists are awed; there are no signs of any chromosomal changes, including shortening of their telomeres, or tips, as the trees age.

High elevation bristlecones thrive in such harsh, frigid conditions that insects, fire and disease cannot get a toe-hold to harm these venerable beauties. Incidentally, some years Great Basin bristlecone pines awaken in late June, discern (exactly how remains a mystery) that pending summer conditions will be inhospitable; drop back into dormancy drawing upon meager sugar reserves, enabling them to

survive for another sleepy 12 months: Giving an entirely new meaning to *Fastina lente* or make haste slowly.

Tragically, the very environment that Great Basin bristlecone pines have so splendidly adapted too is under siege. All across Western United States temperatures are rising between 2 and 5 degrees Fahrenheit. In addition, in California the time it takes for snow on the ground to melt has decreased 16 days between 1951 and 1996. In order to prosper in their environment, with rising global temperatures, bristlecone pines are attempting to move higher up the mountain. The past couple summers I've observed seedlings slightly in front of the existing treeline. Yet in reality they are very near the top of the mountain and have little new ground to conquer.

As temperature's rise bark beetles are able to climb the mountain into otherwise uninhabitable high elevation forests. Also an introduced European fungus, white pine blister rust, appears after a century of decimating other North American pines to be gradually ascending the western mountains nearing the Great Basin bristlecone pines.

Ultimately, it's the rising temperatures and droughts associated with global warming that will significantly impinge upon Nature's finest masterpiece -- the near-immortal Great Basin bristlecone pines. Each of us can help these exquisite beings, and all LIFE forms, by reducing our carbon footprints.

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