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Ari Novy[1,2,*], Sasha Eisenman[1,3] and Jason Grabosky[4]: A passion for forestry and *Metasequoia*: A tribute to John E. Kuser

Abstract John E. Kuser (1925–2008) was a Professor of Forestry at Rutgers University from 1981 to 2001. Dr. Kuser did not enter academia until he was over 50 years old, yet he made many important contributions to forestry research. Much of his research focused on *Metasequoia glyptostroboides* Hu et Cheng, which he believed showed great promise as a horticultural and economically valuable species. Here we trace Dr. Kuser's life and career and summarize his contributions to *Metasequoia* research and forestry in general.

Family, early life, and first career

John E. Kuser was born in New York City on October 17, 1925. Although he didn't formally begin his forestry research career until middle age, he was always interested in forestry and the outdoors.

Kuser came from an important New Jersey family which attained prominence in industry, agriculture, and environmentalism in New Jersey. His grandfather, Rudolf Kuser, emigrated from Zurich, Switzerland to New York City in 1837 at the age of nineteen. Rudolph moved to Newark, New Jersey where, as a mechanical engineer, he became associated with Baxter, Kuser and Thompson who manufactured the famous Baxter steam engine. Rudolph purchased a farm near Hackettstown, New Jersey and eventually made his permanent home in Hamilton, New Jersey in 1867. Rudoph had five sons. His twins, John L. Kuser (John E.'s father) and Anthony R. Kuser, both became noted industrialists and financiers. Together, they were instrumental in consolidating the gas and electric companies in Trenton, New Jersey, and were organizers of the South Jersey Gas, Electric and Traction Company and later of the Public Service Corporation of New Jersey. This pair, together with their three like-minded brothers, also started both the Peoples Brewing Company of Trenton and the Trenton Hygeia Ice Company, for both of which John L. served as the secretary-treasurer. Additionally, he served as the treasurer for Lenox Incorporated, and was the director of both the Fidelity Union Trust Company of Newark and of the Liberty National Bank of New York City (La Guardia, 1929). To this day, the Kuser family legacy remains strong in New Jersey. In several parts of the state, there are roads and parks named after the family. The Kuser family donated 57 km^2 of land to create Highpoint State Park and financed the building of a 67 meter tower to honor war veterans in the 1920s (New Jersey Department of Environmental Protection, 2010). In addition, the family still operates a community supported agriculture (CSA) farm, nursery, and environmental education center in New Jersey.

In many ways, John E. Kuser's life was a microcosm of the combined legacy of his family. Early in life Kuser was prepared to become a leader in the manufacturing industry. He received his secondary education from the Millbrook School in Millbrook, New York, whose alumni include notable industrialists, politicians, and writers. He began studies at Princeton University at age 16 in 1942, although his studies were interrupted by his service in World War II as a Lieutenant JG in the U.S. Navy. In 1946, he returned to Princeton and graduated magna cum laude with a degree in chemistry in 1948. Though he would begin a career in the chemical industry upon graduation, his interest in forestry was clearly evident at an early age. In the one page curriculum vitae included in his master's thesis in 1976, Kuser noted that he joined the American Forestry Society as a life member in 1942, the same year he graduated from secondary school. He also noted that he became interested in reforestation in 1948, the same year he graduated from Princeton, and planted eight acres of white pine (*Pinus strobus* L.) in Titusville, New Jersey. John worked for 23 years in the chemical industry with Interchemical Corporation and Tenneco. He

[1] Department of Plant Biology, Rutgers University, New Brunswick, New Jersey, USA
[2] Department of Landscape Architecture, Rutgers University, New Brunswick, New Jersey, USA
[3] Current address: Department of Landscape Architecture and Horticulture, Temple University, Ambler, Pennsylvania, USA
[4] Department of Ecology, Evolution and Natural Resources, Rutgers University, New Brunswick, New Jersey, USA
* Corresponding author (e-mail: arinovy@rci.rutgers.edu)

summed up his career in industry as follows: "Worked for Interchemical Corp. (now Inmont) and for Tenneco Chemicals as salesman, product manager, sales manager, and national accounts manager. Built sales of one resin from 0.5 M lbs./mo. in 1968 to 2 M lbs./mo. in 1971, and doubled plant capacity" (Kuser, 1976). John stopped working in industry in 1971. By 1972, he had enrolled in silviculture and forest finance management at Cook College (Rutgers University) and had weeded the white pine lot he had planted 24 years earlier.

Back to school

In 1973, John formally began graduate studies in forestry at Rutgers University at the encouragement of Dr. Jim Applegate and Dr. Benjamin B. Stout, who would become John's master's thesis advisor. Kuser received his M.S. in Forestry from Rutgers in 1976 and his interest in taxodiaceous conifers was clearly evidenced by his thesis title, "Potential Site Index of Redwoods as a Function of Climate" (Kuser, 1976). In this thesis, Kuser examined the correlations between coast redwood (*Sequoia sempervirens* (D. Don) Endl.) height and age with several climatic metrics. He used this information to determine the non-native regions of the world where *S. sempervirens* would most likely be able to grow and thrive. While pursuing his master's, John began reaching out to the general public as well as other academics. He authored several articles in popular New Jersey outdoor recreational magazines including "Multiple Use Forestry in New Jersey", "Search for New Jersey's Biggest Trees", and "Canoeing the Delaware". Throughout his scientific career John would continuously demonstrate his desire to interact with the general public at least as much as with the scientific community.

After completion of his master's degree at Rutgers, John pursued doctoral studies at Oregon State University. His doctoral thesis was titled "Provenance variation in Western Hemlock (*Tsuga heterophylla* (Raf.) Sarg.) Seedlings" (Kuser, 1980). His major professor was Dr. Kim Ching, though he also worked closely with Dr. Tom Adams. His doctoral research was published in *Forest Science* (Kuser & Ching, 1980) and the *Canadian Journal of Forest Research* (Kuser & Ching, 1981). In these studies Kuser and Ching revealed that the clinal variation of several traits along the natural range of *T. heterophylla* is determined by natural selection. They stated, "It is reasonable to assume that evolutionary response to environmental factors has been clinal. The factors causing divergent selection pressure between north and south are probably dates of first fall and last spring freezes and severity of midwinter temperature" (Kuser & Ching 1980). Their supporting data were so compelling and illustrative of clinal, geographic patterns in a tree species that they are now included as an example of this phenomenon in the textbook Forest Genetics (White et al., 2007).

Metasequoia research

In 1980, Dr. Kuser returned to New Jersey as an Assistant Professor of Forestry at Cook College, Rutgers University. Though much of his future research would involve pines and pine forests, he maintained an interest in taxodiaceous conifers and *Metasequoia* in particular. He was fascinated with the idea of growing redwood species outside of their native ranges. In 1981, he wrote a short article titled "Redwoods around the world" in which he compiled a list of significant North American redwoods growing outside of their native ranges and briefly discussed the potential for genetic improvement of growth characteristics for the genus. He even challenged foresters and researchers in other regions of the world to improve growth rates by asking, "Come on, Northwest Canada, Australia, New Zealand and France—who will be first to beat California's 362-footer?" (Kuser, 1981). In fact, Kuser was so interested in growing *S. sempervirens* that in 1984 he led a group which created a 180-clone collection of the species. Full and partial plantings of this collection have been planted in South Carolina, Oregon, California, Spain, France, Britain, South Africa, New Zealand, and Chile. In many of these cases, these collections are known as the "Kuser Collection" (Kuser et al., 1995; Saunders & McConnochie, 2007; Toral Ibanez et al., 2009).

At the same time Kuser was thinking about North American redwoods, he was preparing to delve deeper into *Metasequoia*. He had become intrigued with the story of *Metasequoia*'s introduction into the western world by the Arnold Arboretum in the late 1940's after its identification in China. In 1981, Kuser mailed questionnaires to the managers of the 50 tallest specimens of cultivated *Metasequoia* outside of China. He also sent questionnaires to everyone who he thought might have significant trees, including 45 state forestry commissions, 45 state universities, 25 botanical gardens, and 24 other institutions and individuals. He compiled the responses and reported on the locations, ages, heights, circumferences, and crown spreads of the individual trees. He recorded any reports of disease or pest issues as well as physical and mechanical properties relevant to economic forestry. He also acknowledged the possible problem of inbreeding and discussed the limitations of hybridizations with other genera (Kuser,

Fig. 1 Thirteen week old *Metasequoia* seedlings. The seedling on the left is from an isolated tree and is showing signs of inbreeding depression. The seedling on the right is from a mixed clone grove. Figure from Kuser (1983b).

1982). Kuser found the problem of inbreeding depression to be particularly interesting.

In 1981 and 1982, Kuser conducted an experiment to measure inbreeding depression (reduced seed set and lower progeny vigor) in *Metasequoia* offspring from horticultural trees that had reached reproductive maturity. It had been widely speculated that the *Metasequoia* grown in the United States may suffer from inbreeding depression due to the lack of genetic variability present in the initial Arnold Arboretum introduction of the species to North America (United States Department of Agriculture Forest Service, 1974). In a series of experiments, Kuser obtained seeds from cultivated *Metasequoia* that were reproductively isolated (i.e., must have selfed) and from trees within mixed clone groves. He found that cone length, cone weight, and number of seeds per cone showed no significant differences between groups; however, there were significant differences in the number of filled seeds per pound (a proxy for viability) and percent germination. Seedling mortality between treatments was significant as was difference in seedling height after thirteen weeks (Fig. 1). Kuser concluded that *Metasequoia* can suffer from inbreeding depression and that "variation in the amount of genetic load carried by different trees causes some to be incapable of producing fertile self-pollinated seeds but allows others to produce a few viable seeds and occasional trees to self quite well" (Kuser, 1983a).

Kuser was not satisfied with the study of *Metasequoia* solely for the purpose of academic curiosity. He was clearly interested in promoting its use in forestry. He described the tree's attributes for urban forestry in detail and laid out an agenda for future research (Kuser, 1983b). Kuser fully intended to realize as much of his research agenda as possible. Propagation technique was a logical place to continue. From 1982 to 1985, Kuser conducted a series of experiments on rooting cuttings from various sources. He noticed differences in rootability based on clone origin, found that age of source material did not affect rootability, and found that the rooted clones retain the growth characteristics of their adult sources. He also noted that high temperatures should be avoided when rooting cuttings from soft wood (Kuser, 1987).

Kuser took a long view on forestry research. He understood that plant improvement requires the gathering of germplasm and the long term evaluation of that germplasm. He also must have accepted that much of his work on genetic improvement of *Metasequoia* for forestry and horticultural use would not bear fruit in his lifetime. And so it wasn't out of character that at the age of 65, John Kuser jumped at the opportunity to create a living germplasm collection of a tree which can take over 15 years to reach sexual maturity. In 1990, Professor Li Minghe of Central China Agricultural University in Wuhan, China wrote to Dr. Kuser stating that thousands of *Metasequoia* trees had been found and that seed collection would be possible to expand the germplasm introduced into North America if Dr. Kuser could provide financial support for such an endeavor. Ultimately Kuser was able to enlist the funding support of the Dawes Arboretum, the Arnold Arboretum, The New Jersey Forestry Service, and the United States Department of Agriculture for this project. Li's students collected seeds from 52 parent trees in Hubei, Hunan, and Sichuan Provinces. Kuser received the seeds at Rutgers in April, 1991. Approximately 1400 seeds were germinated in the winter of 1992. Three hundred fifty-six (356) of these seedlings, representing the 48 seed lots that produced germinants, were planted on one of the research farms at Rutgers in September, 1992 (Fig. 2). In April, 1993 Kuser sent 344 seedlings, also representing the 48 germinating seed lots, for planting at the Dawes Arboretum in Newark, Ohio. Several other institutions also received seedlings from this collection including the Arnold Arboretum, the Holden Arboretum, Callaway Gardens, Princeton University, Save-the-Redwood League, and the University of California (Hendricks, 1995; Kuser et al., 1997).

By 1997, Kuser began to publish the results of his various experiments on his *Metasequoia* collection. He had three primary objectives in his work on the col-

Fig. 2 Kuser's *Metasequoia glyptostroboides* Hu et Cheng collection on the Rutgers University research farm in 2010. Photo by Ari Novy.

lection: 1) to broaden the genetic base of *Metasequoia* in cultivation; 2) to identify and distribute unusual selections; and 3) to determine whether all the seed from the 1947 Arnold Arboretum introduction came from the same tree. To address these issues, Kuser et al. (1997) measured the genetic variability in the 1990 germplasm collection and several trees from the 1947 introduction by allozyme assay. They also compared growth data from plants at Rutgers and the Dawes Arboretum, and several promising phenotypic mutants. Their results indicated that the 1947 collection did not originate from only one, isolated tree, a fact which was corroborated by an unpublished paper from 1948 written by Dr. Cheng (one of the discoverers of living *Metasequoia* in China) which was in the possession of Dr. Li Minghe. They further demonstrated that his new collection did contain genetic variability not present in the 1947 collection. They showed that certain seedlots were superior performers for growth rate and calculated heritability to be 0.82 for height in *Metasequoia*. Finally, they specifically identified the presence of several selections: 1) normal, upright, straight, fast-growing; 2) "curly"; 3) dwarf, weeping; 4) upright, fine needled; and 5) slow growing, often forking with coppery tipped needles, some of which are depicted in Fig. 3.

In 1999, Kuser published "*Metasequoia glyptostroboides*: Fifty years of growth in North America" in *Arnoldia* (Kuzer, 1999). He briefly retold the story of its introduction and added details from his research as well as a short discussion on the progress made in using the tree as a street tree and economically important species. In 2001, Kuser retired from Rutgers though he would continue to work as a professor emeritus. His final publication on Metasequoia was "Selecting and propagating new cultivars of *Metasequoia*" (Kuser, 2005), in the volume "*The Geobiology and Ecology of* Metasequoia" (LePage et al., 2005).

Kuser continued to communicate with all those interested in *Metasequoia* and advocate for further research well into his retirement, but failing health slowed him considerably during the final five years of his life.

Legacy

In addition to his *Metasequoia* research, Kuser conducted work on the genetic improvement of several eastern North American pine species including *Pinus strobus* L. and *Pinus resinosa* Aiton (Kuser et al., 1987; Kuser & Knezick, 1987; Kuser & Ledig, 1987; Kuser, 1990, 1992, 1994). He was also interested in the ecology and restoration of the unique New Jersey Pine Barren ecosystem (Fimbel & Kuser, 1993, 1995) as well as the ecology and horticulture of *Chamaecyparis thyoides* (L.) Britton, Sterns & Poggenb. (Boyle & Kuser, 1994; Mylecraine et al., 2004). In each of these areas, Kuser left a body of research that continues to have an impact on horticultural and management practices in many ecosystems.

Kuser was also an early shaper of the discipline of urban forestry. He recognized the need to apply the expertise generated by the science of forestry to the urban environment. He was widely regarded as one of the foremost experts on urban forestry in the northeastern United States. As such, he was asked to put together what became the standard textbook on the subject, "*Urban and Community Forestry in the Northeast*" (Kuser, 2000).

Kuser was a revered teacher and mentor (Fig. 4). His

Fig. 3 Comparative needle sizes in several of Kuser's *M. glyptostroboides* selections. Figure from Kuser et al. (1997).

Fig. 4 Dr. John Kuser as he often appeared to his students. Photo by Kristen Munafo.

dendrology class at Rutgers was legendary both for his tremendous knowledge and his high energy. Dr. Richard Lathrop, professor of environmental monitoring at Rutgers recalls, "One would see John striding across the campus trailed by a gaggle of two dozen students scribbling notes furiously as John barked out (through a cheerleader's bullhorn) facts and anecdotes about individual trees. John was definitely high energy. The students could barely keep up. At field camp, he was legendary in wearing out the students on the annual hike up Sunrise Mountain. Mind you this was when John was already well into his 60's" (personal communication, July, 2010). Kuser taught because he knew that in each class of twenty or thirty students, at least one of the students would develop a lifelong passion for forestry and the environment. Today, there are hundreds of researchers, land managers, and environmental scientists who were inspired by Kuser and continue to propagate his values.

In addition to his research and teaching endeavors, Dr. Kuser also devoted his time and expertise to environmental and forestry issues in New Jersey. In this capacity he served as Chairman of the Board of Trustees of the Stonybrook-Millstone Watershed Association and was a member of the Princeton Township Shade Tree Commission. He also served as a member of the Princeton Township Deer Committee and as Chairman of the Deer Committee Environmental Commission. In fact, Kuser was so interested in urban deer management that he presented on the subject at scientific meetings (Kuser, 1995). In addition to serving on local committees, he gave time to advise on forestry issues across the state. In this capacity, he served as director of the New Jersey Forestry Association, and was a member of the Forestry Advisory Committee for the New Jersey Pinelands Commission, New Jersey Shade Tree Council, New Jersey Shade Tree Federation, and the New Jersey Department of Environmental Protection's Community Forestry Program. He was also appointed to the New Jersey Fish and Game Council by then Governor Christie Todd Whitman.

Dr. Kuser was an exemplary researcher and educator. After his passing on August 25, 2008 at the age of 82, his family, friends, colleagues, and former students fittingly planted a small grove of *Metasequoia* at Rutgers' Gardens in New Brunswick, New Jersey. At the base of one of the trees a memorial plaque reads, "John E. Kuser, Professor of Forestry at Cook College, 1980–2001: His dedication to Cook College and his students is only surpassed by his love of trees and the outdoor environments."

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