Field studies in the ancient bristlecone pine forest

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The bristlecone pine is an atypical tree, the remains of which have been pieced together to form tree-ring chronologies that exceed biblical limits. Distinctive features of this tree include the stripbark mode of growth and the great longevity of certain trees. The crossmatching of tree-ring sequences, upon which these chronologies rest, appears to be generally valid. Not enough is known about multiple rings per year, in this tree, for immediate consideration. An alternative model, proposed by the author, posits that successive disturbances are responsible for once having caused simultaneously living trees to crossmatch in an age-staggered manner. This allows the chronologies to be considerably shortened. The stony terrain must have facilitated the progression of growth disturbances, notably earth-surface movements affecting the shallow-rooted bristlecone pines. Interestingly, remains of trees inferred to be exceptionally old (e.g. 8,000 years) do not consistently appear older than the remains of much younger trees (e.g. 4,000 years). This, at the very least, is consistent with the premise that the generally accepted difference in age is fictitious.

The bristlecone pine tree (*Pinus longaeva*, and, further east, *Pinus aristata*; hereafter BCP) is arguably one of the most unusual of trees. It is well known for its longevity that may exceed four millennia, based on tree-ring counts. It grows in many of the higher mountain ranges of the western United States. The oldest extant trees and remnants of once-living trees occur in the White Mountains (Inyo National Forest) of east-central California, the location of this field study (Figs. 1 and 2). The BCP earns its name from the small projections found on its cones (Fig. 3).

After death, BCP decomposes slowly. This fact has enabled the collection and crossmatching of both dead and living BCP trees into two long tree-ring chronologies. One of these (the Methuselah Walk chronology) is claimed to be over 8,000 years long (with some still-older 'floating' samples), and the other (the Campito Mountain chronology) is officially 5,500 years long (actually two thousand years longer, but

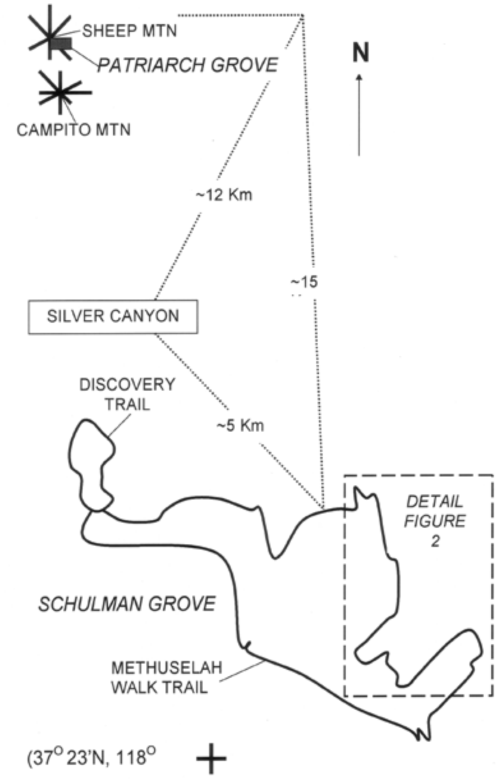

***Figure 1**. Map indicating the principal locations (in the Inyo National Forest) referred to in this report. Note that the distances between the three main clusters of locations are much greater than the sublocations that occur within them. Map not to scale.*

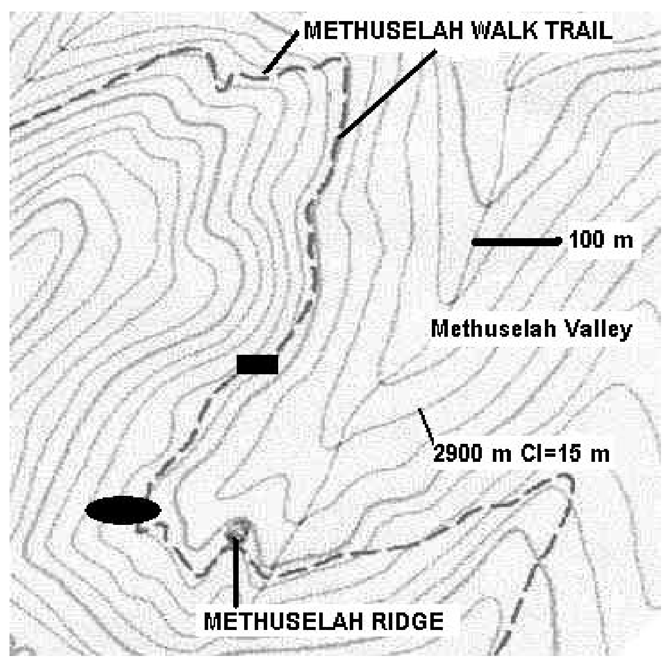

***Figure 2**. Topographic close-up map, with the indicated CI (contour interval), of the Methuselah Valley. The Methuselah Ridge is the location of the world's oldest known living BCP, named Methuselah. Most of the oldest dead wood used in the conventionally accepted 8,000-year-long Methuselah Valley chronology comes from within the valley, but some uphill locations (e.g. marked by the oval) also yield old samples. The rectangle indicates the vantage point for Figure 13, which shows a panoramic view of Methuselah Ridge.*

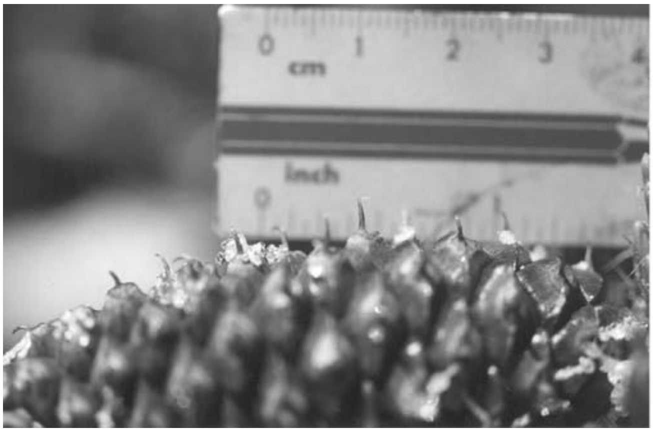

***Figure 3**. The characteristic bristles found on the cone of this tree, whence the name bristlecone pine. (Discovery Trail)*

with an insufficient number of reciprocally-crossmatching samples for obstensible certainty). These long chronologies obviously raise questions about the correctness of the biblical chronologies and the date of the Flood.

The rocky terrain on which the BCP grows is the Precambrian–Cambrian Reed Dolomite. Owing to the fact that it is fossiliferous in places,[1] it probably originates from the Flood. This means that the entire assemblage of live and dead BCP occurring in the White Mountains must be post-Flood in origin. Consequently, if the traditional date for the Flood (about 3,000 BC or later) is retained, as the present author does, the long BCP chronologies must be shortened or compressed.

This report complements a paper[2] that was presented at the Fifth International Conference on Creationism in August 2003. The latter examined the correctness of the accepted crossmatches done on hundreds of archived BCP tree-ring widths, by means of statistical dendrochronological software, and then evaluated the feasibility of compressing the long chronologies. It was concluded that the crossmatches appear to be substantially sound, albeit with some 'play' in the data. It was also suggested that multiple rings per year, while occurring in young trees and remaining a possibility for older ones, are not consistent with the *known* growth habits of the BCP. For this reason, an alternative model was developed to explain the apparently robust crossmatching seen in the two multi-millennial chronologies. According to this new model, environmental factors were responsible for perturbing the incipient tree-rings in an age-staggered, non-climatic manner, eventually causing a series of nearly contemporaneous trees to crossmatch in an artificial age-inflated sequence. Consequently, much of the long chronologies could consist of trees that, contrary to conventional dendrochronological opinion, had lived at the same time (soon after the Flood), thereby allowing the first 4,000 (or so) years of chronology to reduce to perhaps 1,000 years. In addition, the chronology collapse was shown to be fairly consistent with the rapidly increasing ^{14}C dates apparent after the Flood. This all means that the Flood itself could have occurred as recently as approximately 2400 BC.

The field work, done by this author and the subject of this report, was undertaken to complement the computer-based analysis of my earlier work.[2] Its objective was to acquire hands-on experience with the BCP wood itself, to better understand the BCP tree in the context of its actual environment, and to identify the alternative (non-climatic) factors that could have been responsible for the generation of the apparently long tree-ring chronologies. The field trip was conducted in July 2002, and consisted of volunteers interested in furthering their knowledge of this venerable tree. Tree-ring specialists from the University of Arizona Laboratory of Tree-ring Research provided guidance for the work. Direct field experience and extensive discussions with these specialists, some of whom have been studying the BCP for decades, proved invaluable.

The author made numerous sketches and photos on this trip, and a selection of them (Figs. 1–22) is included in this report. Figs. 1–3 have been explained earlier. Figs. 4–6 show specifically named still-living ancient trees, while Figs. 7–12 illustrate some of the atypical growth habits of old BCP trees. Figs. 13–15 refer to a location that contains numerous still-living ancient trees, while Figs 16-19 are related to the process of crossmatching tree-ring sequences in the field. Figs. 20 and 21 show a location where a previously discovered, solitary, dead BCP sample of inferred great age was examined and sampled on this field trip. Finally, Fig. 22 illustrates the fluctuating treeline dynamics that involve high-altitude BCP trees.

With respect to geographic locations (Figs. 1 and 2), most of the time in the field was spent at Schulman Grove, which is the general location of the oldest known extant BCP, and from which the samples originated for the (conventionally believed) 8,000-year Methuselah Walk chronology. A significant portion of this trip was also spent on Campito Mountain. Samples of very old dead wood have been collected from this mountain, during this and earlier field trips, as part of a thus-far futile attempt at extending the (conventionally believed) 5,500-year Campito chronology, further back in time, to a meaningful sample depth.

The great age of some BCP trees

Some of the BCP trees are among the oldest known living objects on Earth. These include individual BCP trees in the Inyo National Forest, which are said to be over 4,000 years old.[3] Some of these very old trees have been given individual names, including Pine Delta (Fig. 4), Pine Alpha (Fig. 5) and Methuselah (Fig. 6).[4] The latter, however, is not individually identified in order to protect it from excessive tourist traffic and potential vandalism.

The dynamics of BCP ageing and longevity are not well understood. It is interesting to note that the old BCP trees do not seem to show some typical biomarkers of aging. Older BCP trees do not appear to differ significantly from younger ones in such things as the state of the vascular system, the viability of pollen, rates of seed germination, biomass of offspring seedlings, etc.[5]

***Figure 4**. 'Pine Delta', believed to be over 4,000 years old. The White Mountains are in the foreground. Further in the background is the Owens Valley. The rectangular area within the valley is the town of Bishop, California. Furthest in the background, and outlining the sky, are the snow-covered Sierra Nevada Mountains. The ski pole, used for scale in this photo and some successive ones, is 1.1 m long. (Silver Canyon)*

***Figure 5**. 'Pine Alpha', also indicated to be over 4,000 years old. The author is pointing to the narrow strip of live bark that supports the entire live crown of the tree. Note the rocky, dolomitic terrain. (Discovery Trail)*

***Figure 6**. The grove of very old BCPs that possibly includes the 4,600-year-old Methuselah tree (not individually identified, for protection), the oldest known living object on Earth. The white pathway is the Methuselah Walk Trail itself, having been excavated within the dolomitic soil and talus. (Methuselah Ridge)*

With the exception of the fallen BCP shown in Fig. 12 (and then only by a few centuries since death), it appears that all known BCPs that have attained great ages are still alive today. Furthermore, analysis of the ring widths of the non-living trees used in the two long chronologies[2] indicates a conspicuous absence of trees, anywhere near 4,000 years of age, from earlier supposed periods. There are, for instance, no known trees that are supposed to have grown from 6000 BC to 2000 BC or from 5000 BC to 1000 BC. Experts with whom I have discussed this matter are divided as to the potential significance of this trend. Some suggest that it is an artifact from collection, while others contend that this is real. In view of the fact that hundreds, if not thousands, of samples of once-living BCP have been collected in the last 50 years, it seems difficult to envision a fortuitous failure to collect even a single 4,000-year-old sample of a BCP that died several thousand years ago. The absence of earlier long-living BCP trees, if valid, is very much in line with a Flood some five millennia ago. It also facilitates the construction of the model, discussed elsewhere,[2] which compresses the early parts of the two long BCP chronologies (from the inferred period (of pre-6000 BC to 1000 BC) to a range of about 2000 BC to 1000 BC).

Why do BCP trees, in addition to often living to great ages, also persist a long time after their demise? Part of the answer may lie with the resin ducts that are characteristic of the genus *Pinus*. Many samples of BCP wood have a strong pine smell due to the abundance of resins (which also make it difficult to perform densimetrics on the tree-rings).[6,7] The concentrated resins are believed to play a role in the preservation of dead BCP for thousands of years after death, as they tend to make the wood unpalatable to fungi.[8] However, normal pine timber (e.g. *P. radiata or P. ellioti*) is also full of resins, but does not last more than a few years out in the weather, unless treated with timber preservatives. Other investigators[9] contend that the prolonged survival of dead BCP is not the result of exceptional BCP resistance to wood-rotting fungi, but of the overall fungal-inhibiting effects of the cold and dry climate that exists for most of the year.

The BCP: a hardy tree

The BCP does not fit the usual profile of a tree. Apart from its potential great longevity, it differs from the vast majority of the other members of the *Pinus* by its manner of growth and its very ability to survive on very inhospitable

Figure 7. Stripbark growth in the extreme: Small tufts of live crown are attached to otherwise-dead trees. (Sheep Mountain)

stony mountain terrains.

One would intuitively suppose that a long-living tree would flourish under ideal growth conditions. Paradoxically, the exact opposite is the case. In fact, it is those very trees that live in the most forbidding microenvironment, which are the most likely to grow to advanced ages. For instance, the Methuselah tree, said to be over 4,600 years old (and the oldest known individual living object on Earth) grows on a dolomitic scarp known as Methuselah Ridge (Fig. 13). Close-ups of this Ridge (Figs. 6 and 14) accentuate the stoniness of the terrain, making it almost seem, to the local observer, as if the BCP trees were growing out of rock!

Compared with most other trees, the BCP usually grows very slowly. This shows in the very narrow growth rings (Fig. 19), which often makes crossmatching BCP quite challenging. Ironically, under more favourable conditions for growth (at lower mountain altitudes), the BCP 'behaves' more like a conventional pine, growing relatively rapidly and seldom living more than a few centuries. At still lower altitudes, the BCP does not thrive at all due to competition with faster-growing species (sagebrush is the main competitor in the White Mountains).

The ecological zone of the BCP extends right up to the timberline. As regional (and possibly global) climate experiences cyclic changes, the altitude of the timberline fluctuates with time, as is evident in Fig. 22. One sees the snags of old BCPs and very young BCPs, but no BCPs of intermediate age. The young BCPs have only recently begun to regrow as part of the treeline's 'migration' upward in response to warming. Other 'once-hospitable' locations have been situated above the timberline for millennia, and have never, to this day, experienced a revival of BCP. For instance, the inferred very old logs found on Campito Mountain (Figs. 20 and 21) occur at widely separated intervals on a part of this mountain that has long been too cold to support BCP growth.

There are many instances were the BCP trees grow in clusters (Fig. 9). These consist of BCPs that had begun their growth next to each other, possibly the consequence of bird droppings that had contained several BCP seeds.[10] In time, the crowded BCP seedlings grew together to form a common trunk. However, most of the BCP trees grow as individuals.

The stripbark mode of BCP growth

Beyond the first few centuries of its life, the BCP in the White Mountains usually does not grow in a radially symmetrical pattern. Instead, part of the bark and underlying cambial tissue undergo dieback. The bark around the dead cambium soon weathers away, leaving behind rather gaunt trunks and branches. At times, only a small fraction of the circumference of the BCP is left alive (Fig. 14). The reasons for the BCP (and some other trees) going into stripbark mode of growth, in harsh environments, are not fully understood. Some investigators believe that stripbarking is related to photosynthetic balance.[11] Perhaps the loss of crown volume is a strategy for survival in a nutrient-poor environment as a compensator for increasing overall tree size.

As a consequence of stripbark growth, the BCP typically adds only arcs (or crescents) of new annual cambial growth instead of monotonously adding new rings all around the trunk. With age, the BCP bole becomes more and more elliptical in shape. The asymmetry of growth is especially striking when BCP stumps themselves can be examined (Fig. 12). At times, the stripbark mode of growth leads to bizarre growth patterns at the bole itself. For instance, the living tissue may start to grow around the pre-existing trunk and stumps of once-living branches (Fig. 8).

The characteristic stripbark mode of growth is especially pronounced in the oldest trees. For example, as measured by this author, the trunk of Pine Alpha is very eccentric (long

Figure 8. A 'wraparound' pattern of growth around an area of stripped-off bark. Note the remnants of once-living branches in the dead wood sector. (Discovery Trail)

Figure 9. An extreme example of several BCP trees growing together: The Patriarch Tree. (Patriarch Grove)

axis approximately 120 cm (facing the viewer in Fig. 5), and short axis approximately 25 cm). Yet the live cambial tissue and overlying bark, which support the entire living crown, measure only 15 centimetres wide! (Index finger, Fig. 5). Furthermore, this strip bifurcates, up the branches, into still smaller segments.

The lack of symmetry of BCP growth is also true of the crown, as can be seen in most photos in this paper. In severe instances of stripbark growth, only a small tuft of the crown may still consist of live branches and needles (Fig. 7). The remainder of the tree is dead, and denuded of bark, for which reason the BCP is often called 'living driftwood'.

It is interesting to note that, for some individuals, the BCP's 'tortured' mode of life has spiritual connotations:

> 'The awakening of a tree's life has always been the occasion for religious festival. Conversely, when humans perceive the tree's trunk echoing the twisted form of Christ on the cross, they represent their own agony … Agony, for instance, seems eternally associated with the bristlecone.'[12]

Field crossmatching of BCP samples

One of the objectives of this field trip was to acquire firsthand experience with the visual crossmatching of BCP wood samples, all done under the supervision of experts having considerable experience in the crossmatching of BCP samples. The samples included both cores as well as slabs.[13]

Owing to the fact that BCP trees include very narrow rings, these can be exploited for the construction of skeleton plots.[14] The author constructed several skeleton plots in the field (Fig. 16), using a binocular microscope at 25X magnification to see the narrow rings. Although the BCP tree is a difficult one to work with owing to the minute width of most rings (Fig. 19), and this is compounded by the challenge of producing a sufficiently smooth polished wood surface (to see all the ring boundaries) under field conditions,[15] some of the samples yielded readily interpretable skeleton plots. These plots were matched against patterns in the master chronologies (a composite of skeleton plots from earlier samples), and the correctness of the crossmatches were then verified by an expert. The matches were unambiguous, and the author did not see any instances where the same pattern of narrow rings showed a strong correspondence to more than one location in the master chronology.

Frost-damaged rings can serve as an independent marker

Figure 10. The many overturned trees illustrate the shallow rooting of BCP trees in the dolomitic terrain. (Methuselah Walk Trail)

Figure 11. Fire-damaged BCP trees. The convective movement of heated gases and flame caused the charring of the uphill sides of the trees, and these carbonized segments of trunk, being weak, were subsequently removed by erosion. (Sheep Mountain)

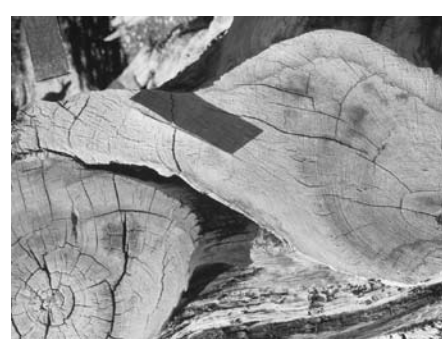

Figure 12. Stripbark mode leading to eccentric growth. The tree died in 1676 and was about 3,200 years old at the time of death. A 15-cm ruler situated edgewise, within a crack, immediately below the shadow, casts the parallelogram-shaped shadow. (Discovery Trail)

Figure 13. Panoramic view of Methuselah Ridge (centre right), an exceptionally stony terrain on which the oldest BCP trees grow. It consists of a large scarp of Reed dolomite (Precambrian-Cambrian), which, being less weathered than the surrounding dolomitic soil, looks whiter. (Methuselah Walk Trail)

Figure 14. Severe dieback and severe growth conditions at Methuselah Ridge.

Figure 15. Looking down the axis of the Methuselah Valley from Methuselah Ridge. The vast majority of the oldest once-living samples, used to construct the presumed 8,000-year chronology, originated from this valley.

for crossmatching. However, it became obvious that frost-damaged rings occur only sporadically in ancient BCP trees. I was told that they are absent in the Methuselah Walk chronology and occur infrequently in the Campito chronology. Only a few such rings were seen on this field trip (e.g. Fig. 16). Other non-ring-width wood anatomical features (e.g. earlywood/latewood patterns) are of little value in the crossmatching of BCP samples, and specialists have commented that they do not attempt to use these as part of their crossmatching procedures.[16]

The author's experience with crossmatching of BCP indicates that this appears to be a valid procedure, at least for this particular kind of tree and at this particular location. It tends to substantiate the statistically based identification of crossmatches of previously available ring width measurements for the long chronologies.[2] In order to account for this fact, the model for compressing the long chronologies, developed by this author,[2] assumes that the crossmatchings used to develop the chronologies are at least generally correct.

Gross non-climatic influences on BCP trees

The author's model[2] proposes that the BCP crossmatches, in the early part of the chronologies, were not according to annual climatic variations but according to moving disturbances. Many potential and actual agents of growth disturbance were seen on this field trip, in support of this model.

The stony terrain in which the BCP grows (e.g. Fig. 6) is itself likely to have facilitated the migration of a series of disturbances not long after the Flood. For example, while the dolomite was in the process of lithification, there were probably lithified zones that could transmit earthquake damage to BCP roots, situated next to relatively unlithified zones that tended to absorb any potential earthquake damage. As lithification proceeded, so did the deployment of conduits for escaping subterranean gases. As the conduits opened and then closed, the BCP could have experienced a migrating series of CO_2 emissions, facilitating temporary growth increases.

Other causes of growth disturbances are even easier to picture. Much of the surface of the White Mountains consists of dolomite gravel.[17] It is not difficult to visualize past instances of BCP growth having been perturbed by landslides. In fact, a variety of indicators of ground-surface movements have been identified in other studies.[18] These include the damming of rock debris, shallow mass wasting, the presence of many faults, debris flows moving at least five kilometres, and even rock streams moving separately from other debris.

BCP usually have very shallow roots. This fact becomes particularly obvious when these trees are overturned (Fig. 10). The shallow rooting makes BCP growth especially vulnerable to earth-surface movements. Relevant effects include the erosive removal of overburden as well as the extra weight on the roots imposed by a landslide.

Fire is another environmental factor affecting trees. Even though the BCPs tend to grow relatively far apart, forest fires can spread between trees. Indicators of fire damage were observed on the Methuselah Walk Trail and on Sheep Mountain (Fig. 11). The fires were usually of low intensity, and only capable of curling around the uphill sides of the trunks and partly burning them. There is no doubt that fire regimes can change with time.

What about potential biological disturbances of BCP trees? It is well known that insects, fungi, etc. that attack the trees can perturb incipient tree-rings. More research is needed on this in view of the fact that BCPs may be more vulnerable to fungi,[19] and parasitic plants such as dwarf mistletoe,[20] than previously supposed.

Finally, there are indicators of major disturbance evident in gross tree-ring sequences themselves. Growth suppressions, affecting a variable number of consecutive rings, are common in BCP. Other BCPs have rings that are all monotonously small.[21] Still other BCP series possess an assortment of ring widths, but fail to crossmatch with any other live or dead BCPs.[22] While this is indicated to be the outcome of numerous inferred missing rings, it also frequently occurs for no apparent reason.

BCP logs of inferred great age need not 'look' old

As noted earlier, one of the objectives of the trip had been to extend the two chronologies. But how does one know, in the field, whether a sample is an old one? A number of criteria had been proposed: absence of branches, high resin content, evidence of wind erosion, presence of a thick weathering rind, etc. However, a little field experience soon made it obvious that none of these, nor any other criteria, are particularly accurate in predicting which samples will crossmatch to the earlier parts of the chronologies. Perhaps these 'exceptionally old' samples are actually no older than the 'moderately old' ones!

Let us now consider some particulars in this regard. Evidence of prolonged wind-induced erosion (e.g. Fig. 18) appears to be uncommon, and was not seen on some of the samples of inferred great age. Sample 93-4, dendrochronologically dated at over 8,000 years of age, has a strong resin odour, yet its weathering rind is unimpressively thin (Fig. 17). Sample TRL 01-682 (Fig. 21) is dendrochronologically dated at over 7,000 years old. Yet one specialist told me that he did not expect this sample to be so old because of the fact that it still had so much wood material.

It would be interesting to compare the collection frequency of very old samples with their actual frequency in the field. Unfortunately, no-one has examined the overall relative abundance of (supposedly) younger and older wood. Such a comparison is hindered by the fact that a certain fraction (one specialist estimated 20%) of BCP samples are dendrochronologically undatable, owing to a profusion of inferred missing rings. In addition, there are large areas (such as parts of the north slope of Methuselah Walk) where

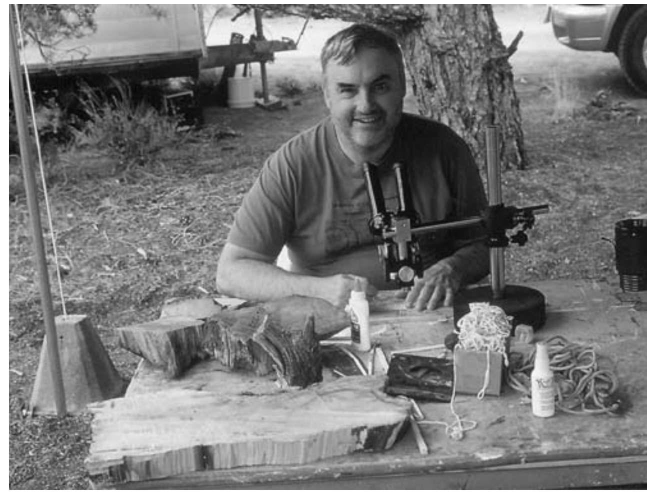

***Figure 16**. The author engaged in graphical crossmatching (skeleton plotting) of BCP samples (cores and slabs) recently gathered in the field. The sample shown is slab # 93-4, which is crossdated to the chronology near the interval 5,000–6,000 BC.*

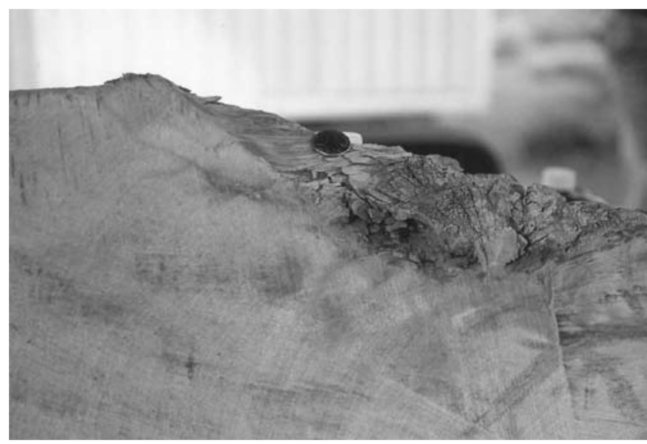

***Figure 17**. Weathering rind on bole sample 93-4. In spite of the fact that this tree is inferred to have lived some 8,000 years ago and died some 7,000 years ago, the rind is not thick. Dime provides scale. (Methuselah Walk Trail)*

***Figure 18**. Wind erosion furrows on log caused by the 'sandblasting' effects of small particles of dolomite. Scale: 15 cm. (Discovery Trail)*

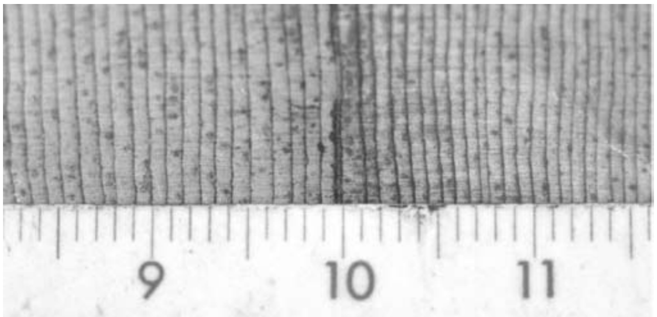

Figure 19. Possible frost damage ring (dark ring), ~7,000 years old. Note that most of the rings are narrow (only a fraction of a millimetre wide), which is typical of high-altitude BCP trees in general. This sample originates from Campito Mtn.

few live and dead BCP can be crossmatched at all (because of an estimated 30% of rings missing).

In order to get a general idea of relative abundances as a function of inferred age, I have examined an unpublished catalogue of BCP samples recovered in the last ten years. It turns out that 88% of all samples are inferred to be younger than 3000 BC, despite the fact that there has been an ongoing bias to attempt to collect older samples to extend the chronologies. This bias is even stronger for samples collected in the 2002 field season, owing to the intentional preferential collection of old samples. Based on a then-available count of samples collected from Methuselah Walk, the number of samples allocated (by growth start date) into the following nine millennia (7000 BC–6000 BC, 6000 BC–5000 BC, … AD 1000–AD 2000) is, respectively, 3, 3, 3, 9, 13, 13, 16, 14, and 2.

This distribution, which is practically the opposite of collection objectives, further underscores the fact that inferred old samples do not commonly appear different from much younger ones. This fact, while not constituting proof, does suggest that the great ages of some of the samples are exaggerations. At the very least, it is consonant with a compressed chronology (according to which, for example, BCPs from, supposedly, 6000 BC actually grew at the same time as those from 2000 BC).[2] In addition, the low relative abundance of inferred old samples makes it easier to understand them in terms of infrequently occurring disturbances, as elaborated in my model.[2] These are placed against a backdrop of large numbers of dendrochronologically undatable specimens.[23]

There is no clear-cut pattern of geographic distribution relative to the, supposedly, exceptionally old samples. Although most of the oldest samples originate from Methuselah Valley (Fig. 15), they are not confined to any specific location within the valley.[24] Moreover, a fair number of old samples are found upslope (Oval, Fig. 2). Further north, on Campito Mountain, unexpectedly old samples occur sporadically near the summit (Figs. 20 and 21). The irregular geographic distribution of dendrochronologically old samples, viewed in the light of the author's model,[2] implies that the ring-perturbing events (that eventually caused the trees to crossmatch in a time-staggered sequence) tended to occur as highly localized events.

Figure 20. Campito Mountain. Intersection of lines shows where the old sample TRL 01-682 was located. The scree slope is situated at the left side of the mountain, whereas the currently living BCPs grow on the right side of mountain. A similar photo had been published by another investigator thirty years ago.[25]

Conclusion

The BCP tree is a somewhat enigmatic one. Apart from an after-the-fact interpretation of environmental influences, little is known about the process of stripbark growth that is so characteristic of the BCP. It is this very process that enables the BCP to live to great ages, and it needs to be better understood before consideration can be made of post-Flood conditions that may have enabled a substantially different mode of BCP growth that is seen today. The latter includes the appearance of more than one growth ring per year.

The crossmatching of the BCP series appears to be valid. However, this need not imply the correctness of the long chronologies. If the incipient tree-rings were disturbed, in a time-transgressive manner, the BCP would crossmatch in an age-staggered manner.

There is, in fact, considerable evidence of BCP growth disturbance. The shallow rooting of the BCP tree in a rocky terrain makes this tree particularly vulnerable to earth-surface processes that can perturb its growth. This provides a further basis for considering a model that recognizes time-independent, repeated perturbations of tree growth that eventually produced artificially long tree-ring chronologies.[2]

Figure 21. Campito Mountain site with TRL 01-682 (dendrochronologically dated at 5,228 BC–4,068 BC). Close-up of site identified in Figure 20.

Figure 22*. Sheep Mountain timberline. Note the recent emergence of young BCPs in an area where older still-standing ones had died long ago.*

In spite of the fact that some BCP samples are, according to crossmatching in the chronology, believed to be several thousand years old, they fail to exhibit a set of morphological features that consistently appear older than those of wood samples recognized as only a few thousand years old. This observation is consistent with the premise that the BCP long chronologies are artificially inflated in terms of age.

References

1. Nelson, C. A. Lower Cambrian-Precambrian succession, White-Inyo Mountains, California, *Geological Society of America Bulletin* **73**:139, 1962. Cambrian trilobites have been found in the Reed Dolomite.
2. Woodmorappe, J., Collapsing the long bristlecone pine tree ring chronologies; in: Ivey, R.L. Jr (Ed.), *Proceedings of the Fifth International Conference on Creationism, Technical Volume*, Creation Science Fellowship, Pittsburg, Pennsylvania, pp. 491–503, 2003.
3. I did not have opportunity to view any cores from these particular trees, so I cannot comment on the correctness or otherwise of the inferred count of over 4,000 presumably annual rings per tree. Is this ring count based on a continuous section, or is it a composite of the ring counts of two or more stripbark 'lobes' of the trunk? If the latter is the case, then could the 'lobes', or 'crescents', have grown partly contemporaneously rather than successively, thus in and of itself reducing the age of the tree? However, one specialist claims to have seen a slab section from the trunk of one of the old BCPs and alleges the existence of over 4,000 rings within the same 'crescent' of stripbark growth.
4. Oddly enough, there is no Pine Beta or Pine Gamma, according to a long-term BCP specialist.
5. Lanner, R.M. and Connor, K. F., Does bristlecone pine senesce? *Experimental Gerontology* **36**:675–685, 2001.
6. Densimetrics relates to the measurement of the density of different parts of the growth ring.
7. The resins would block X-rays, unless perhaps first removed by ethanol.
8. The oldest dead BCP samples are believed by some to be the ones richest in resin, for this very reason.
9. Lindsey, J.P. and Gilbertson, R. L., Notes on basidiomycetes that decay bristlecone pine, *Mycotaxa* **18**:542, 1983.
10. Lanner, R.M., Dependence of Great Basin bristlecone pine on Clark's nutcracker for regeneration at high elevations, *Arctic and Alpine Research* **20**:358–362, 1988.
11. Schoettle, A.A., Influence of tree size on shoot structure and physiology of *Pinus contorta* and *Pinus aristata*, *Tree Physiology* **14**:1066, 1994.
12. Cohen, M.P., *A garden of bristlecones*, University of Nevada Press, Reno, p. 189, 1998.
13. The slab samples came from logs from which a slice had been cut with manual saws.
14. To construct a skeleton plot, it is necessary to sketch lines, on narrow strips of graph paper, to represent only the unusually narrow rings. The narrower the ring, the taller one draws the line. Intervals between these very narrow rings are left blank on the skeleton plot, as they serve as spacers.
15. A BCP specialist was very skilled at producing an acceptable surface by using a razor blade. Soft steel wool was then used for further polishing of the surface of the wood.
16. Two specialists opined that earlywood and latewood thicknesses do not give information independent of the ring width itself. Latewood in BCP is usually small (~10% of ring width). In those instances where it is wider (~25% of ring width), it is usually limited to wider rings.
17. It is for this reason that we hiked with the assistance of ski poles in order to prevent slipping on this gravelly surface as we walked on it.
18. LeMarche, V.C., Rates of slope degradation as determined from botanical evidence, White Mountains, California, *United States Geological Survey Professional Paper* **352-I**:340–377, 1968.
19. Tomback, D.F., Blister rust in white pine ecosystems, *Phytopathology* **91**(6)[Supplement]S155, 2001.
20. Hawksworth, F.G., Notes on *Arceuthobium* on bristlecone pine, *Leaflets of Western Botany* **10**:163–164, 1965.
21. These BCPs are thought to have grown under strongly and persistently unfavourable conditions.
22. This occurs even if, according to ^{14}C dating, the samples fall within the age range of the tree-ring chronologies.
23. According to my new model,[2] these BCP samples cannot crossmatch with any other sample, owing to the fact that they had been 'overprinted' by an excessively complex series of migrating disturbances.
24. Nor do they show indications of having been transported any significant distance since their deaths.
25. LeMarche, V.C., Holocene climatic variations inferred from treeline fluctuations in the White Mountains, California, *Quaternary Research* **3**:639, 1973.

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