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## Playing climate change leap-frog with trees...in very slow motion

January 30, 2018 By [Kathleen Wong](#)



Bristlecone pine trees grow on soils and in conditions where few other species can live. But limber pines in the Great Basin region, such as California's White Mountains, are beginning to give them some competition. Image credit: Brian Smithers

by Brian Smithers, University of California, Davis,  
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change slowly, Great Basin bristlecone pine has no equal. Its gnarled, twisted wood and famously long life span are a testament to an individual's ability to survive regardless of conditions. Bristlecone pine has survived previous climate changes by shifting its range and there is little doubt that the species will survive anthropogenic warming in the same way. However, the rapid pace of recent warming has made for some interesting changes on the landscape in bristlecone pine forests that will likely mean different looking forests in the not-so-distant future.

Treeline is the ecological transition between two very different vegetation types: forest and alpine. Trees are limited in elevation by cold temperatures. Because of this limitation, we would expect treeline to move up in elevation in response to recent warming. In recent studies (Millar et al. 2015, Smithers et al. 2017), we found evidence for treeline advance of about 20 m in vertical distance throughout the Great Basin. In the White Mountains, treeline advance was even higher with advances as much as 150 m near Boundary Peak, similar to recent findings in Millar et al. 2015. However, this treeline advance does not look like we might expect it to given the species involved.

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Small limber pines grow up where old bristlecone pine trees have died in California's White Mountains. The limber pines are beginning to grow in spaces once nearly completely dominated by bristlecone pine trees.

Bristlecone pine is the dominant tree at treeline in much of the Great Basin. It is often found in almost pure stands, especially on carbonate soils like dolomite and limestone. Limber pine is also found throughout the Great Basin but often just below bristlecone pine in elevation where the two species coexist. (In some places, like on the granitic soils of Boundary Peak, limber pine is the dominant tree at treeline but this is somewhat rare where bristlecone pine is present.) In the 2015 study (Millar et al.), high recruitment of limber pine was observed above treeline in the western Great Basin, even where bristlecone pine adults were common, leading the authors to conclude that limber pine is “leap-frogging” over bristlecone pine. Our 2017 study showed a similar phenomenon in that even where treeline is dominated by adult bristlecone pines, the majority of treeline advance is due to limber pine establishment throughout the Great Basin. This is true even, and perhaps especially, on dolomite soils which are strongly associated with adult bristlecone pine. In the treeline forest stands of the Patriarch Grove (White Mountains), there are almost no cone-bearing limber pine trees among the stand of cone-bearing

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Why is this happening? And what might this mean for the future of these forests? The first question is likely answered by looking at the two species' dispersal mechanisms. Bristlecone pine has small, winged seeds that are largely dispersed by wind, the vast majority of which fall to the ground and are eaten by rodents. Limber pine seeds have a very interesting relationship with Clark's nutcrackers. These montane relatives of jays harvest seeds from closed cones and cache them underground for winter food. Cached seeds are buried at an optimum depth for germination and, perhaps more importantly, are hidden from rodents. Many but not all of those seeds are ultimately consumed by nutcrackers. In the right year, some of those forgotten seeds will germinate, with a very small proportion of those seedlings surviving the first few years when they are most vulnerable. Clark's nutcrackers range widely and in some reports have been seen caching seeds up to 5 miles from their source. While the success of any one seedling is exceedingly low, an individual nutcracker caches thousands of seeds per year. When a bumper crop of seeds meets with a few wet summers in a row, infrequent pulses of regeneration can result. This dispersal mechanism appears to give limber pine a real advantage in occupying newly available habitat upslope of treeline.

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Gnarled, dead bristlecone pine trees, which can live to be more than 5,000 years old, stand where young limber pine grow around it. Limber pine is beginning to colonize areas once dominated by bristlecones. Image credit: Brian Smithers

The second question is more difficult to answer and requires a decent amount of speculation. The relationship between limber pine and Clark's nutcracker is not new, nor is the fact that climate changes. While current climate warming is happening very quickly relative to most climate changes in the past, there is also evidence for very rapid climate changes in the not-too-distant past that would have affected bristlecone pine and limber pine. And yet, bristlecone pine trees have adapted or persisted in the face of whatever weather can throw at them. It is unlikely that limber pine will replace bristlecone pine, but these forests are going to look different in the near future, with new stands above current treeline looking much more evenly mixed between the two species than today. In some cases, we may even see a change from a bristlecone pine-dominated treeline to a limber pine-dominated one.

It is very difficult to predict what a sub-alpine forest will look like long-term based on a 3-year study, especially when the trees involved live for thousands of years

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advantage will ultimately exclude bristlecone pine. We don't know now and won't know for thousands of years. But we do know that climate change is having an effect on forests in the White Mountains. Recent warming has opened up a real estate boom for young trees above current treeline. And so far, limber pine has been far better than bristlecone pine at taking advantage of it. What will this actually mean for the future of bristlecone pine? We will have to wait awhile to see the final results. Limber pine may have the advantage now, but in the long run, our money is on bristlecone pine. We'll have our descendants collect on that bet.

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