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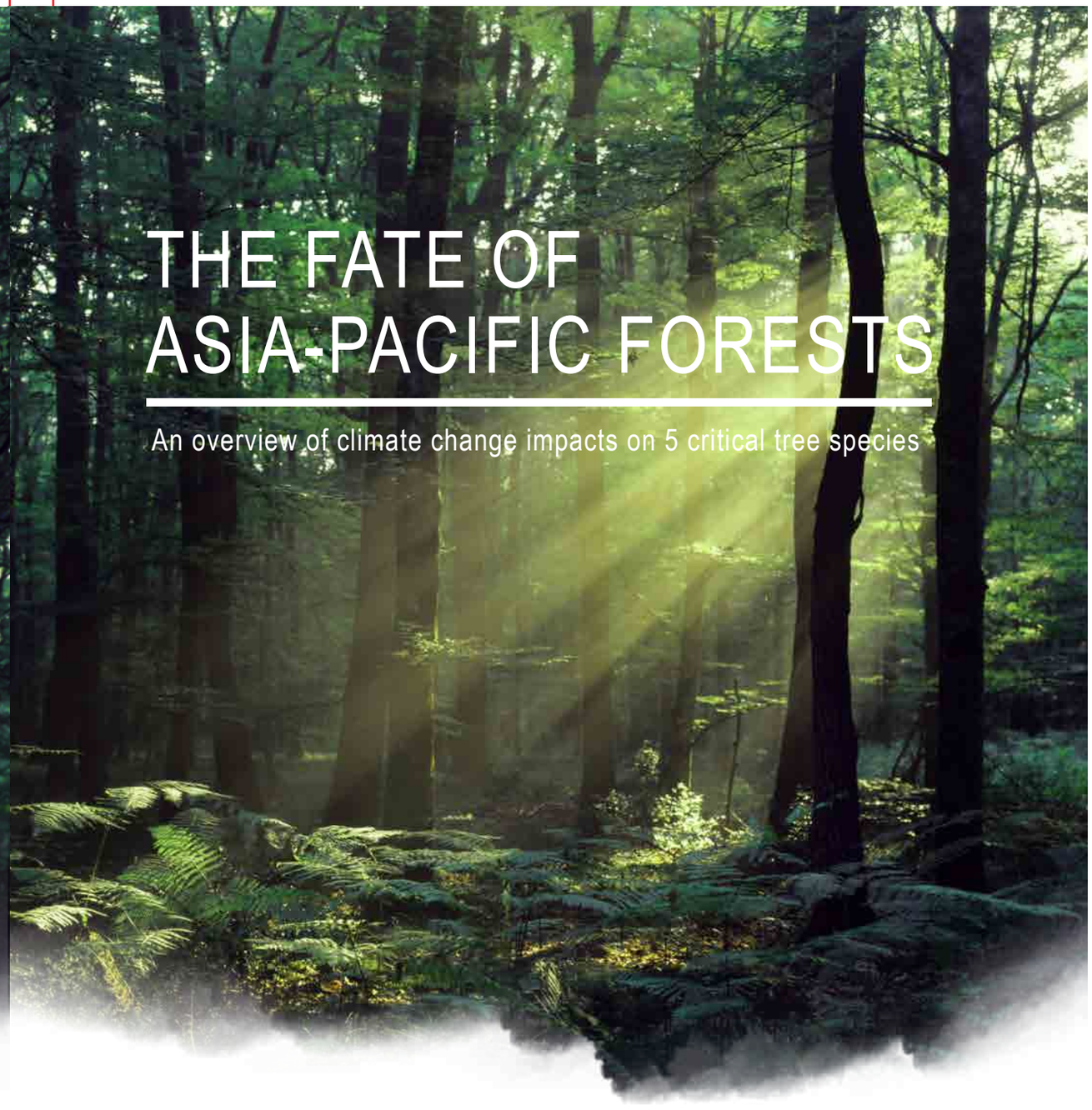
THE FATE OF ASIA-PACIFIC FORESTS

An overview of climate change impacts on 5 critical tree species



Climate change threatens the survival of our forests.

In the Asia-Pacific region, Chinese fir, Chinese pine, Masson pine, Douglas fir and Blue Gum are the five most socioeconomically important tree species.

How will the species react as global temperatures continue to rise? How should they be managed to adapt and eventually mitigate climate change? These are crucial questions to the survival of the species and ensure economic sustainability in the Asia-Pacific region.

Adaptation of Asia-Pacific Forests to Climate Change

Climate change threatens the survival of our forests. This is particularly true in the Asia-Pacific region, where air temperature increases to-date have exceeded the global average. At this rate, forest ecosystems will not be able to adapt fast enough to climate change. For the more than 450 million people in this region directly dependent on forests for their livelihood, maintaining resilient forest ecosystems is critical.

Forest ecosystems have the ability to mitigate or accelerate climate change, depending on whether they are managed to function as a carbon sink or a carbon source. Effective forest management can help mitigate the impacts of climate change, by adapting forest ecosystems to work for us rather than against us.

In the Asia-Pacific region, Chinese fir, Chinese pine, Masson pine, Douglas fir and Blue Gum [1] are the five most socioeconomically important tree species.

Understanding the climate niche of the species, or the maximum climatic conditions that the species can withstand, is one way to predict where it will be able to survive in the future.

A research project called Adaptation of Asia-Pacific Forests to Climate Change created innovative climate and ecological modeling tools and projected the future distribution of the five species, to support local forest adaptation strategies.

How will the species react as global temperatures continue to rise? How should they be managed to adapt and eventually mitigate climate change? These are crucial questions to the survival of the species and ensure economic sustainability in the Asia-Pacific region.

[1] Chinese fir (*Cunninghamia lanceolata*), Chinese pine (*Pinus tabuliformis*), Masson pine (*Pinus massoniana*), Douglas fir (*Pseudotsuga menziesii*) and Blue Gum (*Eucalyptus globulus*).

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Chinese fir

Cunninghamia lanceolata

One of the most socially and economically important coniferous species in China is disappearing.

This species is prized for its durable wood and cultural and ornamental value, but is not expected to withstand the pressures of climate change. A substantial contraction of this species' distribution will affect the massive timber industry that depends on it.

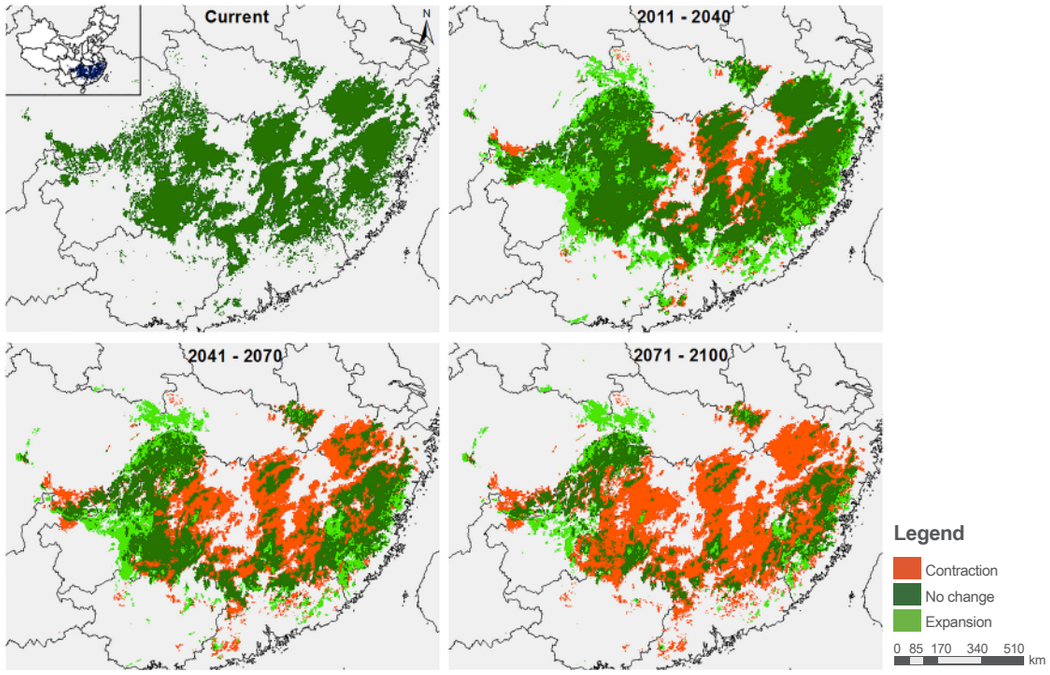
Chinese fir has been used traditionally in China for thousands of years, and continues to be harvested for timber. Known for its fragrant aroma, it is the species of choice for building temples, furniture, houses, flooring and boats. In west Hunan Province and southeast Guizhou Province, Chinese fir trees are traditionally planted upon the birth of a daughter to be harvested as a gift for her when she turns eighteen.

As well as being ingrained in Chinese culture, Chinese fir trees occupy 30% of all plantations in China and account for 25% of national commercial timber production. This makes the species extremely important for the economy.

However, it may be impossible to continue the production of this species in the future, since researchers predict that its climate niche will contract substantially with climate change. With increased temperatures, the species won't be able to survive as far south as its current distribution, but it will also be unable to spread northward due to limited precipitation. It is expected to move up in elevation, but this movement is limited by poor soils found at higher elevation. Given this prediction, strategic forest management decisions are required to minimize social and economic losses.

Climate niche

The climate niche of a species is the geographic area where climatic conditions such as temperature and precipitation are suitable for growth and survival. Mapping the climate niche of a species is an effective way to predict where it could potentially be present in the future of climate change.



Climate niche distribution of Chinese fir is expected to decrease by 34% by 2050 [1].

Researchers recommend that an alternative species, such as Masson pine [2], be considered for planting where Chinese fir will be unable to survive in the future. It is also important that current Chinese fir forests be made as resilient as possible by ensuring their health and diversity.

[1] Climate change predictions are based on consensus projections of 12 climate change scenarios from IPCC AR5 GCMs. Climate niche distribution is projected to shift by 0.1° in latitude, -0.7° in longitude and 244m in elevation by 2050.

[2] For more information, refer to the leaflet on Masson pine.

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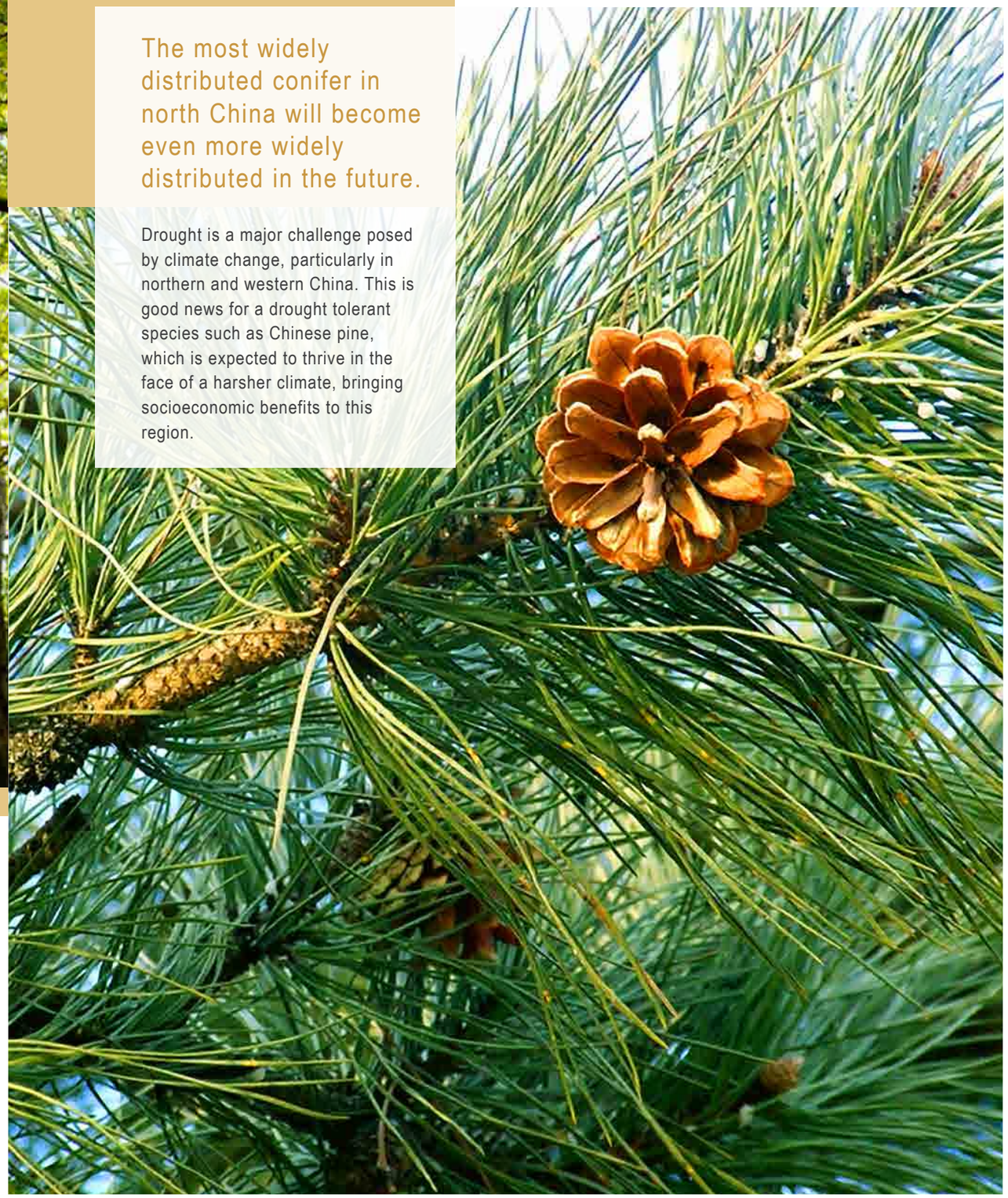
Chinese pine

Pinus tabuliformis

The most widely distributed conifer in north China will become even more widely distributed in the future.

Drought is a major challenge posed by climate change, particularly in northern and western China. This is good news for a drought tolerant species such as Chinese pine, which is expected to thrive in the face of a harsher climate, bringing socioeconomic benefits to this region.



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The value of Chinese pine extends far beyond the use of its wood for construction and furniture. All parts of the tree are valuable; its pulpwood produces resin that is used for medicine, vanilla flavoring and turpentine; its bark is a source of tannin, and its pine needles are used both medicinally and as a source of natural insecticides and dyes.

Since Chinese pine is a fast-growing, drought tolerant species that can survive in poor soil, researchers predict it will be a promising contender to climate change. “We expect Chinese pine distribution to expand dramatically westward due to the higher topography of western China, which can provide relief from warming temperatures and drought.” – John Innes, Project Leader, University of British Columbia, Canada.

This will benefit people in northwest China who can produce and harvest the species. People living in its current distribution, however, will experience a stark decline in the species. The socioeconomic impacts of this are unknown.

Climate niche

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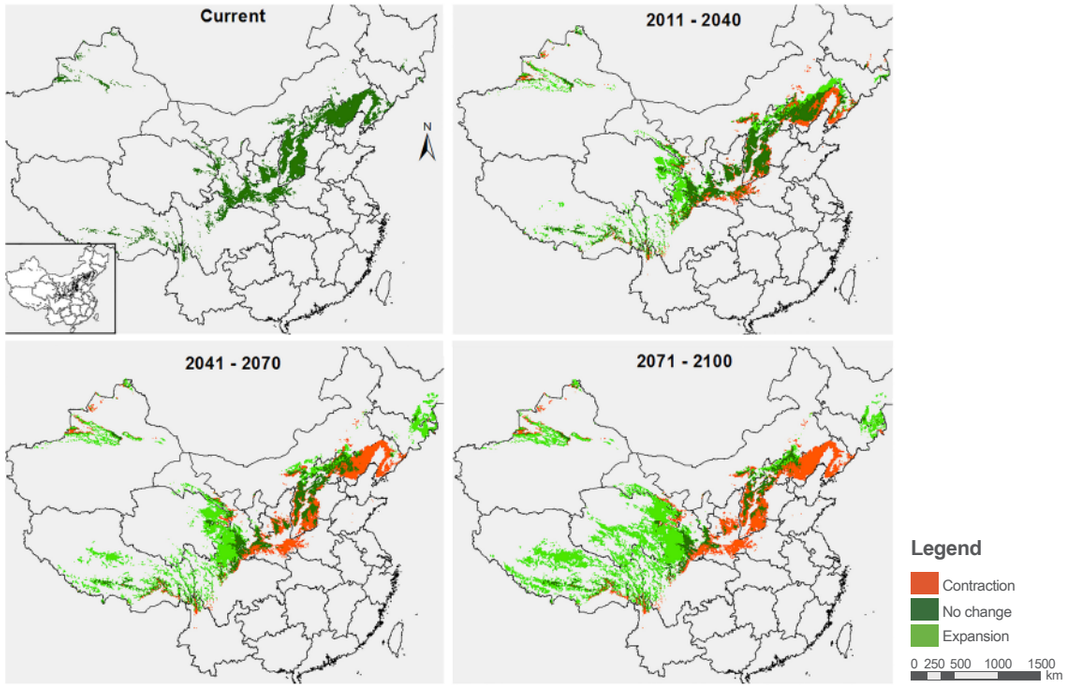

Climate niche distribution of Chinese pine is expected to increase by 50% by 2050[1].

To take advantage of the ability of this species to thrive in a warmer, drier climate, Chinese pine should be planted in afforestation and reforestation initiatives throughout northwest China. Increasing the presence of this species will help to secure the future of the forestry industry in this region.

[1] Climate change predictions are based on consensus projections of 12 climate change scenarios from IPCC AR5 GCMs. Climate niche distribution is projected to shift by -0.7° in latitude, -5.6° in longitude and 1129m in elevation by 2050.

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Masson pine

Pinus massoniana

Although this species will decline with climate change, it may be the only practical replacement for the disappearing Chinese fir[1] in the timber industry.

Masson pine and Chinese fir are the most economically important coniferous species in China, but the range of both are expected to decline with climate change. Since Masson pine is likely the best alternative to Chinese fir, safeguarding its survival will become even more crucial for local timber industries.

[1] For more information, refer to the leaflet on Chinese fir.

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Masson pine is native to a wide area in central and southern China and northern Vietnam. Its leaves are known to give black tea a distinct flavor, and the oil from its needles are used extensively in Chinese medicine. Its wood is also commonly used for shipping and in the pulp and paper industry.

Masson pine often grows in the same location as Chinese fir, and it will experience notable decrease in its distribution with climate change. But Masson pine will be a stronger survivor, due its ability to survive in poor soils found at higher elevations.

"Contraction of this species is expected to be similar to Chinese fir, but not as severe, with contractions occurring mostly at the southern end of its range, and limited expansion northward." – Tongli Wang, Chinese forestry expert, Hebei Province, China.

Climate niche

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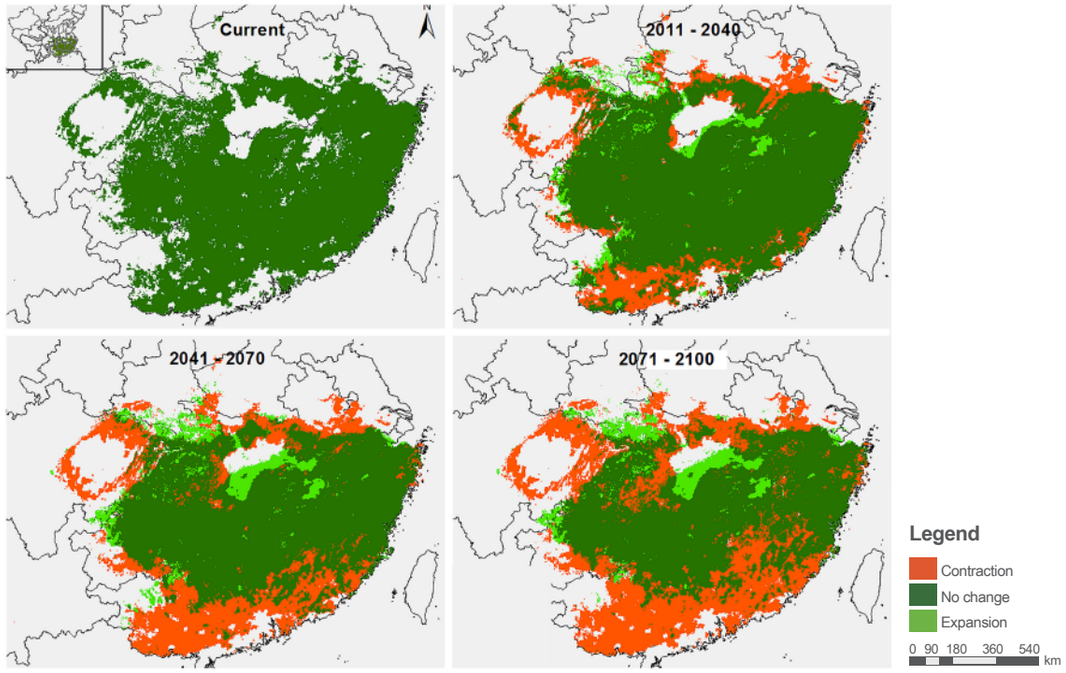

Climate niche distribution of Masson pine is expected to decrease by 17% by 2050[2].

Masson pine provides a good alternative for Chinese fir in reforesting and afforesting the higher elevation regions of China. However, the survival of this species will still be threatened by climate change, and focusing on maintaining resilient forest ecosystems will remain crucial in minimizing negative climate change impacts.

[2] Climate change predictions are based on consensus projections of 12 climate change scenarios from IPCC AR5 GCMs. Climate niche distribution is projected to shift by 0.4° in latitude, 0.5° in longitude and 61m in elevation by 2050.

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Douglas fir

Pseudotsuga menziesii

One of the largest global timber regions will benefit from climate change.

Douglas fir yields more timber than any other tree in North America, and forest managers in the region can expect increased distribution of this species with climate change, especially in British Columbia, Canada. This species may represent a positive case among the often negative impacts associated with climate change.

Douglas fir has exceptionally strong and durable wood, available in large dimensions that make it ideal for constructing trestles, bridges and commercial buildings. Its wood is also used for houses, fencing, flooring, pulp and furniture. Aside from its extensive economic importance, Douglas fir is a defining component of the North American landscape and makes up the astonishing old-growth forests on its west coast.

Climate change may provide favorable conditions for the Canadian forestry industry that depends so heavily on Douglas fir. “The climate niche of this species is expected to expand substantially, shifting northward and higher in elevation as temperatures increase.” – John Innes, Project Leader, University of Colombia, Canada

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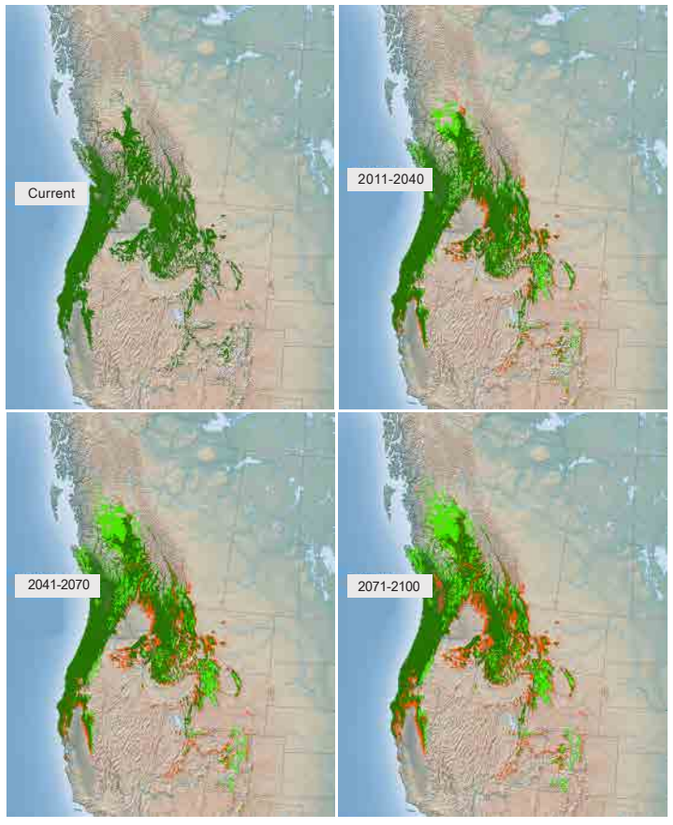

Climate niche distribution of Douglas fir is expected to increase by 40% by 2050[1].

Policy makers have responded to this prediction by changing seed transfer regulations, to mandate that Douglas fir be planted further north in British Columbia. Producing and selecting seed sources strategically are additional ways to take advantage of this opportunity.

[1] Climate change predictions are based on consensus projections of 12 climate change scenarios from IPCC AR5 GCMs. Climate niche distribution is projected to shift by 1.0° in latitude, -0.6° in longitude and 130m in elevation by 2050.

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Blue Gum

Eucalyptus globulus

The most widely cultivated native species in Australia is in danger.

Forests in this region will shrink and change dramatically as the distribution of Blue Gum contracts with climate change. The diversity of these forests will be threatened by the loss of Blue Gum subspecies and all other native plant and animal species that depend on them.

The name of this species comes from the sticky gum-like substance that it secrets. The gum is very fragrant and contains anti-bacterial and pest-resistant properties. Oils from Blue Gum leaves and shoots are used in a variety of products including soaps, candles, essential oils, and many traditional medicines. The species is also widely used in the timber industry.

There are four subspecies of Blue Gum (Gippsland Blue Gum, Spotted Blue Gum, Tasmanian Blue Gum and Southern Blue Gum) distributed throughout the southern states of Australia, including Tasmania Island. For the species as a whole, the climate niche will shift southward towards cooler conditions. This shift will be limited by the ocean, however, as the species will be unable to spread any further south.

While the degree of niche contraction will vary considerably among the subspecies, all subspecies will experience significant contraction from climate change, and some will almost completely disappear. This will lead to overall biodiversity loss, as Blue Gum is essential in providing ecosystem services for other native plant species, and shelter and food for many native animals and birds, including koalas.

Climate niche

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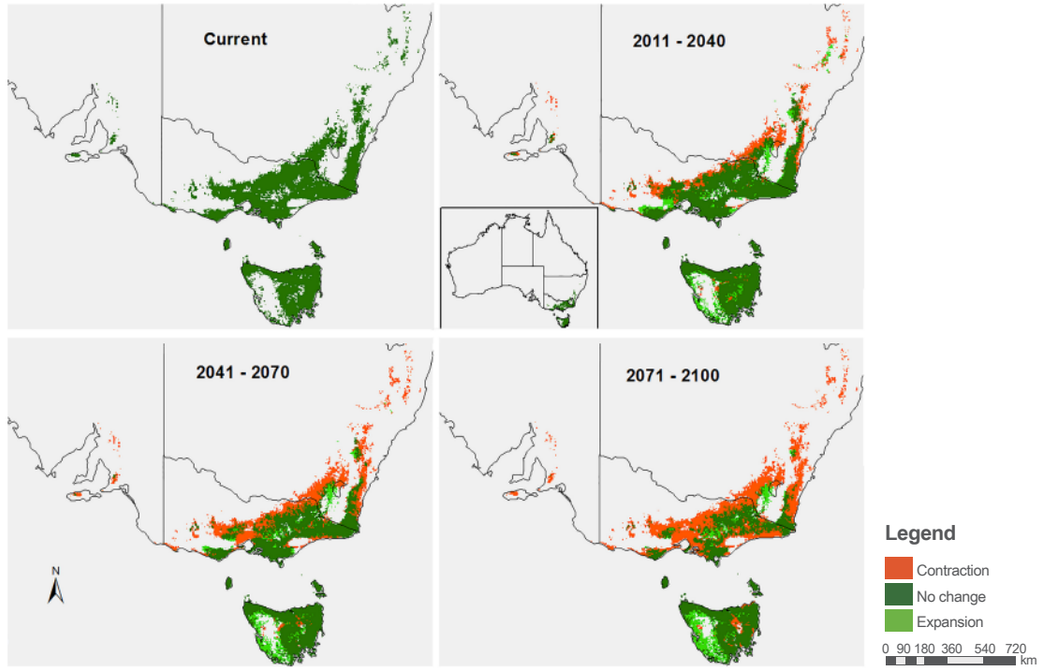

Climate niche distribution of all Blue Gum subspecies will contract by 2050[1].

Climate change will bring new challenges to maintaining the current level of biodiversity in these forests, including the diversity of Blue Gum and all living things that depend on it. Only the most resilient subspecies of Blue Gum will survive, but overall biodiversity will decline. Researchers encourage local forest managers to take this into consideration when planning the next generation of forests and the subspecies they should contain.

[1] Climate change predictions are based on consensus projections of 12 climate change scenarios from IPCC AR5 GCMs. Climate niche distribution is projected to shift by -1.2° in latitude, -0.1° in longitude and 3m in elevation by 2050.