Storing seeds for a rainy day -- or in this case, a fire

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As mountain pine beetles march across the forests of western North America, these insects may kill millions of pine trees during a single outbreak. A rise in overall temperatures over the past several years has increased the range of mountain pine beetles, resulting in an epidemic and possibly making this mountain pine beetle infestation the largest forest-insect blight to occur in North America.

Dr. Francois Teste and colleagues from the University of Alberta in Canada have been investigating the effect of mountain pine beetle outbreaks on lodgepole pines in British Columbia. Teste and colleagues have discovered that seeds from cones on the forest floor may provide a viable seed bank for lodgepole pine regeneration following forest destruction by mountain pine beetles. Their research is published in a recent issue of the American Journal of Botany.

Lodgepole pines, a variety of the pine species *Pinus contorta*, are a serotinous species—the seeds are only released from the cones in response to specific environmental conditions, in this case fire, rather than at the time of seed maturation. The seed bank of lodgepole pines is found in closed cones, which generally are located in the canopy. Following a mountain pine beetle outbreak, dead trees with canopy cones may remain standing for 10 to 15 years. However, scientists have observed a considerable increase in closed cones on the forest floor due to an increase in branch breakage after tree death. The viability of these canopy and forest-floor seeds and the likelihood that they will be able to contribute to forest regeneration has not been known.

Using germination techniques, Teste and colleagues assessed the viability of seeds from closed cones from both the canopy and forest floor of stands of trees 3 years, 6 years, and 9 years after mountain pine beetle outbreaks. These researchers found that closed forest-floor cones had high germination capacity (over 80%), but this germination capacity dropped to 45% for cones that were partly open. Although canopy cones have a >90% germination capacity a year, on average, after cone maturation, germination capacity steeply declined after 15 years and dropped to 50% after 25 years.

"Closed resin-bounded cones typical of serotinous pines can maintain (up to about 10-15 years) viable seed on dead trees even if the cones are partly open and/or in the forest floor," Teste said, "but of course the germination capacity does slowly decline with time." This is the first study demonstrating that there is a viable forest-floor seed bank for a serotinous pine species.

The serotinous adaptation of lodgepole pines allows for the regeneration of forests decimated by fire, but may be a hindrance to forests destroyed by mountain pine beetles. Although seed in closed cones may be viable following a mountain pine beetle outbreak, it cannot contribute to forest regeneration unless it is released from the cone, a process that would generally be triggered by fire.

"We can only speculate that it is a potential source for future regeneration if a ground fire or site preparation resurfaces the cones," Teste stated regarding the forest-floor seed bank. Teste's future research may focus on the impact of fire after mountain pine beetle outbreaks, specifically whether fire can promote regeneration from buried cones.

"With novel disturbances emerges novel responses to maintain ecosystem stability," Teste said.

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More information: Teste, François P., Victor J. Lieffers, and Simon M. Landhäusser. (2011). Viability of forest floor and canopy seed banks in Pinus contorta var. latifolia (Pinaceae) forests after a mountain pine beetle outbreak. American Journal of Botany 98(4): 630-637. DOI: 10.3732/ajb.1000252

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