By Fraser Los Illustration by Pete Ryan

CAN THE WHITEBARK PINE BE SAVED?

A crucial keystone species, whitebark pines are dying off due to blister rust.

A passionate team of experts is working to save them in Glacier National Park (and elsewhere) before they disappear

AFTER TURNING THE CORNER ON A REMOTE MOUNTAIN PASS NORTH OF GLACIER National Park, I stop to catch my breath and gaze upon the emerald waters of Ventego Lake — encircled by imposing mountains with Mordor-like names, including Sorcerer, Mystic and Iconoclast. The first thing that hits me is the fierce September wind, which funnels down through glacier-clad peaks and pummels the exposed lakeshore and hardy trees rooted there.

To get here, I have followed a team of ecologists along the aptly named "Heinous Traverse," a trail that cuts across steep mountain slopes under hazardous rockfall. It leads us away from our temporary home at Sorcerer Lodge — a mecca for backcountry skiers that's accessible only by helicopter.

These are the lengths ecologists will go to as they work to protect whitebark pine (*Pinus albicaulis*), an endangered species that grows high in the mountains of western North America. It is just one small part of a multi-year strategy to restore the trees throughout mountain parks. "It's conservation at the ecosystem scale, which means we're focused beyond park boundaries as well," says Natalie Stafl, a senior Parks Canada ecologist who's leading the restoration project for Mount Revelstoke and Glacier national parks. "We know what we need to do, and we know it's possible. It's just a matter of getting everyone working together to make it happen."

Whitebark pines have been decimated for years by mountain pine beetles, fire and impacts from climate change. But the main threat is white pine blister rust, a fungus introduced from Asia more than a century ago that has feasted on five-needle pine trees ever since. The disease affects every section and life stage of the tree, hindering cone production and weakening the tree in the face of other threats, such as beetle outbreaks.

Carried to new ecosystems and fresh pine victims via plant hosts, most commonly ribes species, such as currant or gooseberry, blister rust is now present wherever whitebarks grow — from small pockets in mountainous California to the top of its range across B.C.'s mid-north and in Alberta along the Continental Divide. Although whitebark pine is endangered in Canada under the Species at Risk Act, it's still under consideration to be listed in the United States. Scientists predict blister rust alone will lead to a 50 per cent decline in whitebark populations over the next century. Given other threats and the fact that whitebarks are naturally slow to reproduce, they worry the iconic tree species could go extinct unless something is done.

Stafl and her team hope to restore whitebarks here in the Columbia Mountain ranges, but their work is part of a much broader and ambitious plan underway through Parks Canada's Conservation and Restoration Program — a nationwide effort to preserve threatened species and

ON THE PRECIPICE
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WITH ECOLOGISTS AT GLACIER, YOHO, KOOTENAY, BANFF, JASPER AND WATERTON NATIONAL PARKS, THE PROJECT IS HELPING THE IMPERILLED SPECIES STAVE OFF BLISTER RUST BEFORE IT'S TOO LATE

ecosystems. Collaborating with ecologists at other mountain parks, including Yoho, Kootenay, Banff, Jasper and Waterton, and with independent ecologists working to restore whitebarks in gaps between parks, the project aims to help the imperilled species stave off blister rust and other threats before it's too late.

Stafl says they undertake a range of strategies, including collecting cones from healthy whitebarks and replanting new seedlings, protecting current whitebark stands, and improving habitat through prescribed burning and by thinning out competing vegetation. They even spread naturally occurring pheromones, such as verbenone, to protect the trees from pine beetle. (Pine beetles release verbenone to repel other beetles away from a tree that's already fully colonized.)

The collaborative restoration project just wrapped up its initial five-year funding, and in early 2019, Stafl and ecologists from other mountain parks received confirmation of another five years' funding to keep the effort going. "We've worked hard to perfect our systems for cone collection and tree planting," she says. "Now, we're looking to scale things up."

Although there is no ultimate guarantee of success, Stafl remains optimistic. "I wouldn't be doing this if it wasn't going to work," she says. "Plus, there are just so many ecosystem benefits that would be lost if nothing was done." Viewed in this way, doing nothing would be disastrous — not just for whitebarks, but for surrounding ecosystems and other wildlife as well.

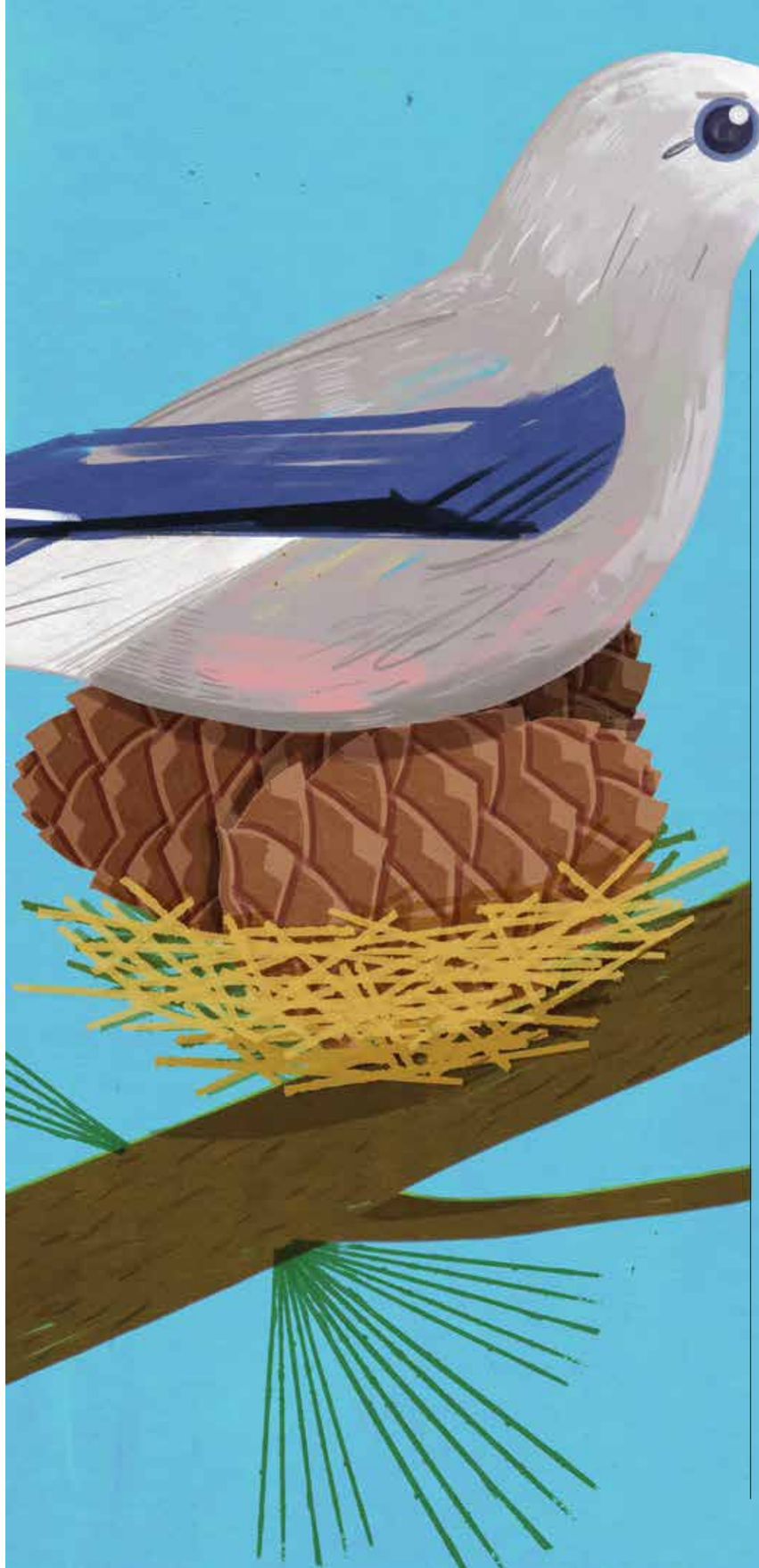
"Whitebark pine is both a keystone species and a foundation species," says Diana Tomback, a professor of integrative biology at the University of Colorado who also directs the Montana-based Whitebark Pine Ecosystem Foundation. She says whitebarks increase biodiversity because they sprout up and survive in the most inhospitable of places — tolerating drought-like conditions in rocky soils on steep slopes, battered by cold wind and buried under snow for most of the year. By growing where most trees wouldn't stand a chance, whitebarks offer shelter for less hardy conifers, such as spruce and fir, to take root. "They form new habitat for multiple organisms, including nesting birds," explains Tomback, and they provide refuge for so-called "wilderness dependent" animals that survive only in remote locations away from humans.

The tree also produces highly nutritious seeds, available in late fall when many species are fattening up for winter. Black bears will climb high in the canopy to fetch seeds before birds or rodents pick them clean, and grizzly bears raid squirrel middens to gorge before hibernation. But one bird species, the Clark's nutcracker, takes feasting on whitebark seeds to a whole other level. The resourceful corvid co-evolved with whitebark pine to form a mutually symbiotic relationship and is the tree's primary seed disperser. In fact, whitebark survival would be impossible without the nutcracker's specially adapted ability to break open whitebark cones that don't open on their own.

Tomback says the nutcracker's seed-hoarding behaviour is another major factor in whitebark reproduction. With a specially designed throat pouch, nutcrackers can carry about 100 seeds at a time and they'll bury thousands in underground caches for future foraging. Although the birds miraculously remember where to find most of their buried seeds, they'll forget some too, which means new trees sprout up in tight-knit clumps directly from buried caches.

Beyond these many connections, whitebark pine's ecological importance extends far beyond the high-elevation slopes where it grows. "Whitebarks are a major component of the treeline canopy that shades alpine snowpack from sun and wind exposure," says Tomback. This relatively thin canopy, she adds, helps to slow down snow melt through late spring and summer, reducing erosion and moderating run-off far downstream, and giving farmers and ranchers a more consistent water source.

"These ecological benefits are hugely at risk with the decline of whitebark pine," says Tomback. "We're starting to lose these ecosystem services in parts of the whitebark pine's range. And in the upper treeline,



NUTCRACKER BITTERSWEET

Whitebark pine wouldn't survive without the help of the Clark's nutcracker

Whitebark pine restoration is naturally tied with the Clark's nutcracker (*Nucifraga columbiana*), a bird that co-evolved with the tree species over a similar range across North America's western mountains. Together, they form a "mutualistic" relationship — although each species benefits from the other, whitebarks simply could not survive without nutcrackers.

Since its cones do not open on their own, whitebark pine's reproduction depends on nutcrackers' ability to pry the cones open, as well as their dogged determination to collect and bury thousands of seeds every year in caches. Some studies estimate a single bird stores close to 100,000 seeds annually, an effort aided by the bird's specially designed throat pouch for carrying seeds. Nutcrackers will somehow remember where most of those seeds are buried, even though they're distributed across the landscape in multiple caches of no more than 15 seeds each, usually less.

Luckily for whitebarks, the nutcrackers won't come back for every cache, and they also just happen to bury the seeds at a perfect depth for germination, which is why whitebark pine often grow in little clumps out of abandoned seed caches. Seeds cached by red squirrels, on the other hand, rarely germinate because they're usually buried too deep.

"Nutcrackers are the unsung heroes and keystone dispersers," says U.S.-based researcher Diana Tomback, who began her career studying nutcracker seed-dispersal behaviour. She says that as pine populations decline due to blister rust, it leads to reduced cone production, which in turn means a higher proportion of seeds are eaten by nutcrackers (and other animals) rather than being buried. That's why management intervention is required to ensure genetic resistance in whitebark pine — to some extent, it's replacing the seed dispersal services of nutcrackers.

"It may be centuries before we see full whitebark recovery," says Tomback, "But if we can get blister rust-resistant genomes out there, and then let nutcrackers do the heavy lifting, it will work."**—F.L.**

WHITEBARK PINES HAVE BEEN DECIMATED BY PINE BEETLES, FOREST FIRES AND THE EFFECTS OF CLIMATE CHANGE… AND WHITE PINE BLISTER RUST, AN ASIAN FUNGUS INTRODUCED MORE THAN A CENTURY AGO

the mortality is just starting to kick in." Just how imminent and how catastrophic the loss is a matter of conjecture, but one fact is clear: whitebarks are at risk wherever they grow.

Blister rust will often take years to kill off infected trees, says Randy Moody, a whitebark expert who has partnered with Parks Canada on this project and joined us on the trip. But he says the negative effects on whitebark distribution and population numbers are felt long before a tree dies. As our group walks along the narrow edge of a glacial moraine, he points out one tree that's been ravaged by disease. "Rust spreads along vesicles that carry sugars through the tree," he explains, tracing his way from the tree's reddened outer branches to its swollen, gnarled trunk. "This tree was killed by both beetles and rust, but you can tell the rust started on it and beetles finished it off once it was weakened."

An infected tree will finally die when cankers form and girdle the stem, says Moody, but if cone-producing branches are girdled first, as often happens, the tree's seed production will be cut off for years prior to death. And rust causes damage indirectly too, he adds, because rodents chew on cankers and remove vascular tissue, girdling cone-bearing branches even more. "When trees are up to 50 per cent dead, they'll simply stop producing cones," says Moody, "which means they're no longer a food source for animals and they're obviously not producing new trees."

Since whitebarks take up to 50 years to begin producing cones and 60 to 80 years to produce a sizable amount, the tree's natural ability to recover from major disturbances is limited and, at the least, very slow. Ecologists wonder whether whitebark populations depleted by disease will be able to recover from future disturbances, such as pine beetle outbreaks and major fires. They also worry warming temperatures will shift suitable whitebark habitat to higher latitudes and higher elevations, and the species might not be able to migrate or adapt quickly enough.

That's why ecologists are so intent on finding whitebarks that exhibit genetic resistance to blister rust, which will be used to create a new crop of resistant seedlings — they're essentially trying to speed up natural selection. "We're not necessarily going to find full resistance, but we'll find different levels of resistance," says Moody. "It's like a flu that everyone gets at some point; some will die, some will get really sick and weak, and others will fight it off relatively well."

In the forested hills that overlook remote Ventego Lake, Moody and Stafl lead the way through their 100-tree survey to find those genetic saviours. "We look for healthy trees in heavily infected areas," says Stafl, because that means there's an increased probability that they're resistant in some way. If the team finds those so-called "plus" trees, they'll come back to collect the cones, which will be sent to nurseries and replanted in protected habitat.

BEFORE REACHING THE LAKE, WE STOP AT several healthy whitebark pines along the way, which were identified for cone collection last spring. As I watch from below, Stafl and others shimmy up close to the tree tops, picking off and bagging every cone they can find. They also cut scions — essentially, short sections of the uppermost cone-producing branches — that will be grafted in nurseries to grow future seedlings as well.

Collecting the exceedingly sappy whitebark cones is not a simple endeavour. Even when healthy trees produce a good crop, as they did this past year, the prized cones are usually picked clean by nutcrackers and other animals before this time in fall. Given that competition for seeds, Stafl's team had covered the cone-producing branches with mesh cages, which they had to cut open to retrieve the cones. In all, they manage to collect about 550 cones from 21 plus trees in the area around Sorcerer Lodge. After sending the cones to nurseries, it will still take two years for the seeds to go from germination to seedlings big enough to replant.

As we edge along the mountainside closer to the lodge, I ask Stafl if she finds it hard to focus on such long-term restoration, with so many infected trees in plain view. "What we're trying to achieve is all positive and totally doable," she says, which makes things easier. And there's already a precedent for this kind of restoration, she adds, through decades of experience fighting blister rust in other white pine stands across North America.

On the steep slope overlooking a receding glacier, she points to a massive whitebark pine that likely started growing there about five centuries before — one of a few pioneer trees that sprouted up in the wake of receding ice. "It's amazing to think that our work today will lead to big, healthy trees like that generations from now," she says. "It just feels really good to be part of that kind of long-term effort. I know it's going to make a difference."