FOLLOWING FIRE

A RESILIENT FOREST / AN UNCERTAIN FUTURE

CHRONOSEQUENCE: Using repeat photography to track change over time

by David Paul Bayles and Frederick J Swanson.

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A Resilient Forest / An Uncertain Future

The 2020 Holiday Farm Fire roared down the McKenzie River in the western Cascades of Oregon, burning 173,000 acres of forest lands and over 450 homes. In the midst of these tragic losses, the blackened, skeletal forest exhibits a stark beauty.

In an impulsive response, while the fire still smoldered, we undertook a project in the burned forest on lands previously managed for industrial forestry, but now under conservation stewardship of the McKenzie River Trust. Within the first three to four months of our project, we noticed the process of image-making fell into four distinct photographic approaches; Chronosequence, Typologies, Landscape and Fine Art.

From an ecological view, Following Fire is driven by curiosity about what is removed by fire, what remains after fire, how those remnants of the pre-fire forest change over time, and what will be the future of the forest in a changing environment. These photographs depict the abundance of organic matter, nutrients, and life remaining in the blackened forest. But, in a few short years after the fire, the forces of climate change, invasive species, and intensive forestry have revealed the uncertainties of the future of the land.

We find the fire to have a powerful emotional dimension as well. Friends and colleagues lost homes and had their lives profoundly disrupted. The lush, nurturing sense of the rainforest abruptly turned black, but at the same time we are aware that today's old growth had its origin in events such as this. We, too, struggle with stages of grief and work to dial our emotions to a fruitful place between grief and hope.

This inquiry combines David's visual storytelling practice, with Fred's interests in the physical and biological processes that have shaped forest history and will influence its future. We find common ground in life-long engagements with forests. We anticipate passing the Following Fire project on to future generations of photographers and scientists, in keeping with the long-term approach to ecological, arts, and humanities inquiry characteristic of the nearby H.J. Andrews Experimental Forest, where we both work.

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FRR03

The View Upriver

Standing on the Finn Rock Reach (FRR) bridge and looking upstream over the McKenzie River in the Oregon Cascades, we are in the center of lands burned by the 2020 Holiday Farm Fire. On the left side, we see Highway 126 bordered by private forest lands. The floodplain forest in the center is property of the McKenzie River Trust managed under conservation objectives. The distant hillside on the right is forest industry land. Many chronosequence photo points in this collection are located in the forest on the floodplain in the center.

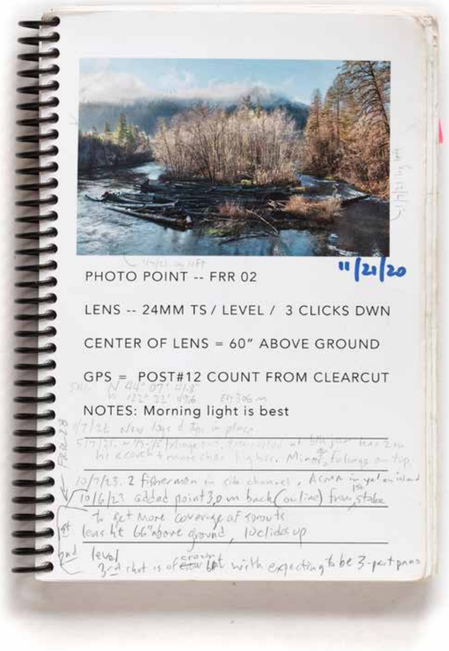
In this photograph, taken just three months after the fire, practically all of the forest structure remains, but much of it is dead. Scattered tall, green Douglas fir trees initially survived the fire. Other trees retained foliage scorched orange, but most trees have lost their foliage by either burning or shedding.

The chronosequence photographs that follow reveal details of change in living and dead parts of the forest over the first three years following the fire. Life reappears in the forms of vigorous growth of plants surviving from the pre-fire ecosystem and pioneering plants seeding in on the wind and with help by animals. Organic matter builds up on the ground surface, restoring the soil. Standing dead trees gradually shed twigs, limbs, bark, or collapse entirely. These processes bring color back into the forest blackened by fire. Some changes are abrupt while others are slow – the forest exhibits both dynamism and continuity. Our emotional responses to fire have similar complexities.

FRR02

The River, an Island, Burned Riparian Forest

Here we are looking downriver from the Finn Rock Reach bridge to a forested island fronted by a charred log jam and framed by both green and burned trees along the banks. Burned forest is in the clouds on the distant hills. This chronosequence site was picked to observe effects of many agents of change at play across an array of forest and river conditions. Fierce winds blew the fire down the valley, igniting the log jam and fanning flames in the forest.



12/20
Just three months after the fire, a few patches of green appear. Surviving Douglas firs along the river edge and downstream on the island remain green, as do a few shrubs and herbs on the gravel bar and within the hardwood forest on the prow of the island.

08/21
First summer after the fire and willows burst forth from root systems protected within the gravel bar. Shrubs and herbs cover the floodplain under the dead, leafless hardwood trees on the island. Leafy hardwoods (alder, ash) line the bank on the far left.

02/23
Well into the third winter, much more wood has floated onto the jam, two big Douglas fir trees on the right have been toppled by wind, and the fire-killed hardwoods on the island are collapsing as stems break 10-20 feet off the ground.

10/23
Maple and ash announce themselves with their yellow autumn color. Hardwoods near the prow of the island continue to break off. Shrubs and herbs cover the ground. A fisherperson wades into the channel.

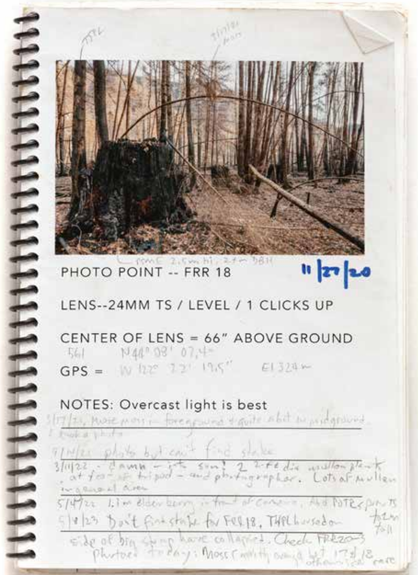
THE STORY SO FAR

Change has been rapid and, as anticipated, is taking many forms. Plants from the pre-fire ecosystem are growing quickly, most notably willows on the gravel bar, and dead wood is falling to the ground and into the river, driven by wind and wood decomposition. A rapid greening of the landscape commences. Given the fascinating dynamism of this landscape in the past three short years, we eagerly await the coming surprises.

FRR18

Old Growth Stumps in a Young Forest

Several massive, decomposing stumps stand as legacies of an old-growth forest cut nearly a century ago, setting the stage for establishment of this complex forest of conifers and hardwoods. The clearcut hillside in the distance forms a backdrop. We picked this chronosequence site to represent several stages of forest life – and death. The fire killed all aboveground vegetation and blackened the lower 5-20 feet of tree trunks, except where the small tree formerly growing on top of the big stump fell after the scorching fire had passed by. The swooping, small-diameter, maple trees did not have the strength in their stems to remain erect amidst the tall, straight conifers after the wind blew them over and the fire desiccated them, locking in these arching forms.



12/20
The color palette is black from the fire and the browns of leaves and needles that were scorched and then later fell to the ground.

03/21
A hint of green appears on the soil surface as firemoss germinated by the heat of the fire takes hold, retaining nutrients and stabilizing the soil.

08/21
The first summer, fireweed is in bloom and bigleaf maple trees are sprouting from their bases and exhibiting bright green foliage (right-center, middle distance). Several of the small-diameter trees swooping to the right have fallen.

10/23
Most of the swooping hardwood stems and a tree nursed on the left side of the big stump have fallen to the ground. The fireweed in our face is casting clouds of seed. Maple foliage is now approaching 8 feet high.

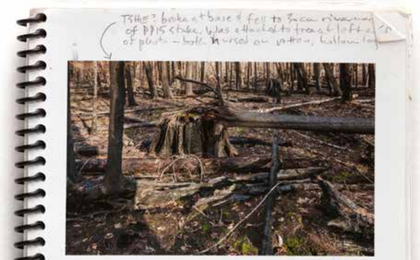
THE STORY SO FAR

The flush of firemoss in the first winter and fireweed in the first and succeeding summers plus sprouting from the base of maples are common themes in forest response to the fire across this nearly century-old forest. Change in forest structure includes collapse of the swooping tree trunks and a large tree nursed onto the big stump, heralding the inevitable complete collapse of the dead overstory trees.

FRR15

Remnants of a Past Forest

Rotting stumps and large pieces of wood on the ground are evidence of an old forest existing on this site until it was clearcut nearly a century ago. The large tree that was rooted in the rotten cedar stump toppled to the right after the fire – some of its fine roots are not charred, despite being within reach of the surface fire. Two other nursed trees (left foreground) have roots laced through a highly decomposed and charred log. We picked this site for chronosequence photography to learn how these structures and this visual composition will change over time.



12/20
Within just a few months firemoss brings a few small patches of green back into the black and brown landscape.

03/21
Quickly the firemoss spreads and puts up light green sporocarps, reproductive structures.

08/21
Fireweed in bloom and going to seed has taken over the scene.

11/22
Two years have passed and the tree nursed on a rotten log has fallen (toward the camera, lower left) and is now barely visible under the fireweed litter. The autumn yellow of cottonwood sapling leaves stand out in the forest beyond. The ferns and invasive blackberry add green to the fireweed litter in the foreground.

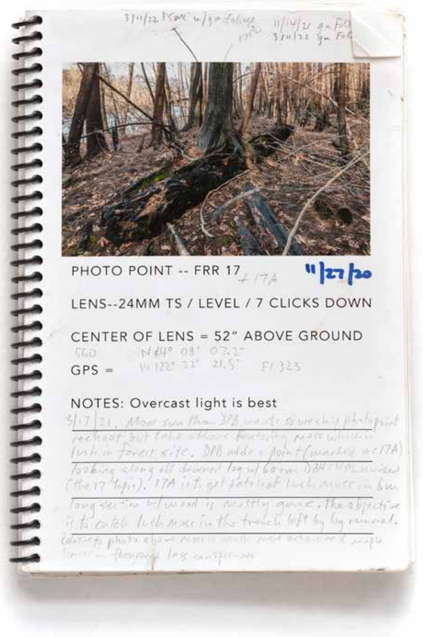
THE STORY SO FAR

Several trees collapse from their perches on decomposing logs and a stump, but trees rooted in soil remain standing. Firemoss, fireweed, ferns, and a host of other species, many of them legacies from the pre-fire forest, rapidly and vigorously take hold in quick succession. This vegetation builds the organic matter on the forest floor, retaining nutrients and rebuilding the soil. Sources of tree seeds appear to be quite distant; seedlings on the forest floor are rare and those present are buried in the accumulating litter, so we sense uncertainty about establishment of the future forest.

FRR17

Nurse Log, Flush of Firemoss, Shroud of Fireweed

Legacies of a previous forest are embodied in the highly-decomposed log, where a mature redcedar is now rooted. The wind-blown fire cleared the understory, killed the trees, and produced the swooping stems. The river and wind flow to the left. We picked this site to observe how these elements of forest history develop into the future.



12/20
Here, just a few months after the fire, a few limbs and bigleaf maple leaves have fallen from the tree tops onto the blackened ground. Already some firemoss appears.

03/21
By late winter firemoss has quickly covered the ground, but not the charred logs, with a green sheen.

08/21
Late summer and fireweed is prolific and casting clouds of seed. Bigleaf maples are sprouting from the bases of trees.

10/23
Three years after and the fireweed is in our face – a common problem in early stages of chronosequence photography in recently disturbed sites before vegetation grows above our line of sight. Most seeds have dispersed. The dark green of bigleaf maple foliage on vigorous sprouts is visible to the left.

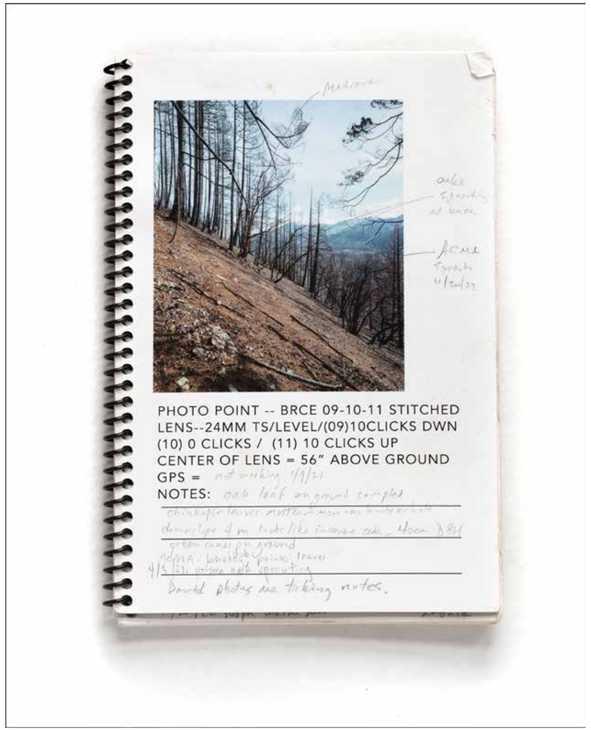
THE STORY SO FAR

Standing dead trees and their fine branching structures remain in place, except for collapse of several of the small, swooping stems. Fireweed is vigorous with each plant producing thousands of seeds. Bigleaf maple trunks have died, but multiple new sprouts have formed at their bases. Will the invasive Scotch broom hiding in the fireweed gradually take over the site, and will the distance to potential seed sources limit tree establishment?

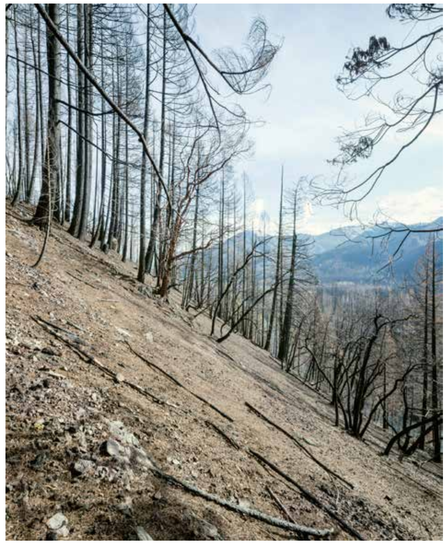
BRCE09-11

Grassy Bald with Hardwoods

This site on land called the Blue River Conservation Easement (BRCE) is a steep, hot, dry, south-facing slope with madrone, oaks, and Douglas fir fringing a grassy bald high above the McKenzie River. The irregular growth forms of oak and madrone contrast strongly with the erect stems and horizontal branches of the conifers – mostly Douglas fir in this place. In addition to the harsh, sunny exposure meager soil limits plant development. We picked this site to contrast with the wetter environment and more lush vegetation in FRR near the river; this site also brings into view several different tree species.

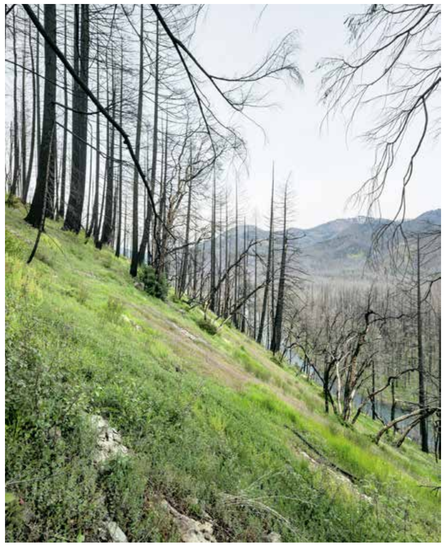


12/20
The trees all appear to be dead and there's no sign of green on the ground either.



11/21
Yellow autumn color appears in foliage on sprouts from the base of the oaks. The evergreen madrone contributes a clump of bright green foliage. Fine limbs and twigs of the trees in the top foreground seem to be dancing as changes in moisture content contort their forms.

05/22
The ground cover is lush in this second spring since the fire. Poison oak (lower left) is an unwelcome plant sprouting from the pre-fire ecosystem.



10/23
Another year has passed and organic matter accumulates slowly. The clusters of sprouts at the base of the hardwoods persist.

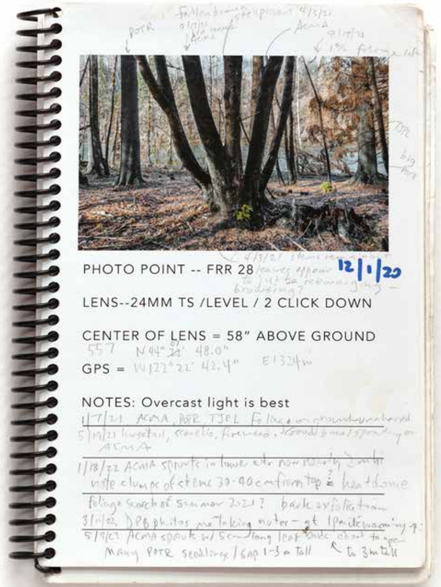
THE STORY SO FAR

Despite the harsh conditions of this place, ground cover plants green up in the first summer after the fire and the hardwoods begin to sprout from their bases. Overall, the forest structure has persisted. Change will come, but slowly in these dry conditions.

FRR28

A Cluster of Maple Trunks – a Cluster of Sprouts

A large, deeply rotten stump (lower right) indicates this place was occupied by an old conifer forest when it was logged nearly a century ago and before this cluster of large bigleaf maple trunks developed. The fire burned away the forest understory, but much of the fine woody structure of the forest remains. This layering of history attracted our interest. Thinking to the future, will the maple sprouts develop into a form similar to the mother tree?



12/20
Only a few months since the fire and a few sprouts with leaves appear at the bases of two maple trees. The redcedar (right) has been slow to shed its scorched needles.

03/21
Firemoss spreads across the ground surface and a few scattered herbs are sprouting. The sprout on the large maple has disappeared – was it consumed by an herbivore? Redcedar foliage has mostly fallen.

08/21
The maple sprouted quickly only to have the new foliage damaged by the heat dome of late June 2021. The foliage in the foreground has two colors and sizes: the dark, big leaves developed in spring, but the scorching heat triggered development of younger, smaller foliage. Herbs of several species covered the ground.

10/23
The maple sprouts reach well above our heads, and fireweed remains a component of the herb cover.

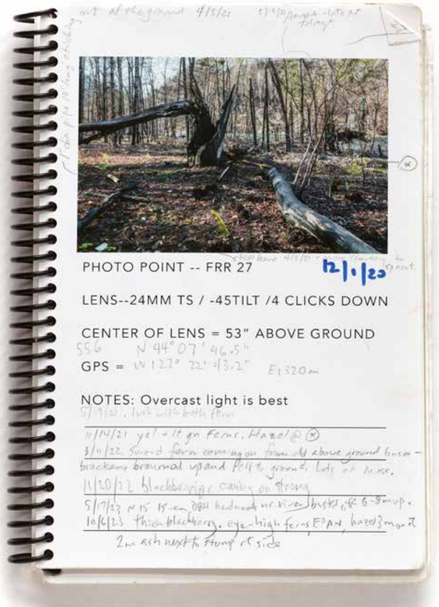
THE STORY SO FAR

Overall, the major forest structures in this place changed little over the first three years after the fire, but herbs and maple sprouts display the resilient capacities of the forest. However, scorching effects of the heat dome warn of impacts of climate change in the future.

FRR27

Collapsed Maple, Eruption of Ferns

Fire smoldered in the crotch formed by the three big trunks of this bigleaf maple tree, leading to collapse of the trunks to the left and away from and toward the camera. The fire left clumps of the charred remains of ferns standing on the forest floor. The fate of the partially collapsed tree and of the fern clumps intrigued us, so we established a photo point.



12/20
In the first winter, there's a faint hint of firemoss and a few sprigs of ferns sprout from remnants of the previous forest.

03/21
Firemoss spreads across the soil surface, but ferns are little changed.

06/21
Ferns have come on strong, and many of the riparian hardwood trees along the riverbank in the middle-distance have foliage.

10/23
Vegetation of the third growing season is lush and head high. Ferns, blackberries, and a tall hazel shrub dominate a diverse mix of species. The tree trunk toppled to the left has completed its fall to the ground.

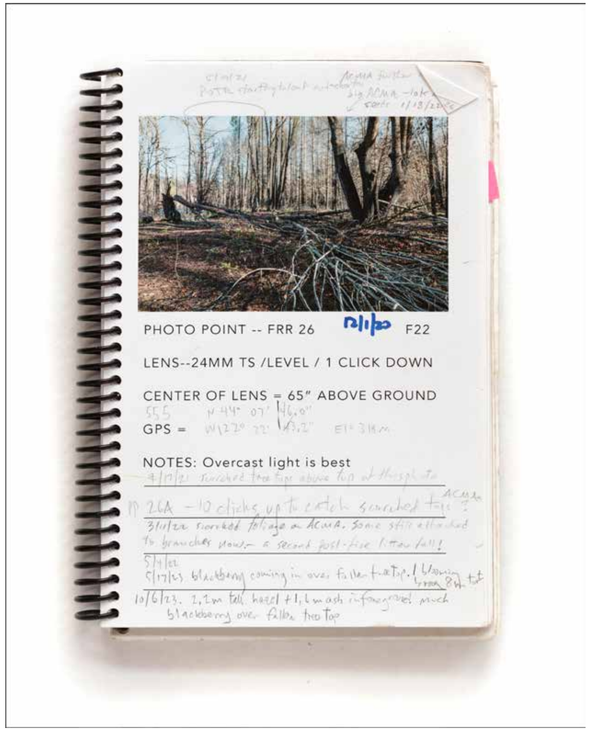
THE STORY SO FAR

As is the case with other trees nursed on decaying logs, partially collapsed trees may take several years to complete their path to the ground surface. First firemoss and then ferns dominate ground cover, but many species are present. Although sprouting from the base of mature maple trees is common in the area, not all trees do so. Perhaps the smoldering fire that caused the three stems of this tree to fall killed all the buds that would have produced sprouts.

FRR26

Bigleaf Maple Clusters – One Falls, the Other Remains Erect

Two clusters of large trunks of bigleaf maples experience different fates in the fire: the one on the right remains standing, while the one on the left suffered smoldering fire in its core, leading to collapse of the trunks. One trunk and its tree top fell to the ground at our feet. Lack of charring of this tree top suggests it fell after the surface fire swept through the area.



12/20
Just a few months after the fire and already ferns are sprouting from buried root and rhizome clumps – legacies of the previous forest. A few tufts of green foliage remain at the tops of several young Douglas firs in the distance.

05/21
Ferns flourish. Foliage appears on the tops of several maple trees (upper left).

08/21
The heat dome of late June 2021, with temperatures of 112 degrees, scorched the new, tree-top maple leaves, turning them orange, but the Douglas fir foliage remains green. Legacy forest understory plants emerge and are joined by pioneer species among the ferns.

10/23
The tops of the scorched maples no longer have foliage. Sprouts appear at the base of the large maple on the right and bark begins to peel. Ferns, hazel, and blackberries are visible in the tangle of dense understory plants. The Douglas fir trees persist, but hardwoods all appear to be dead.

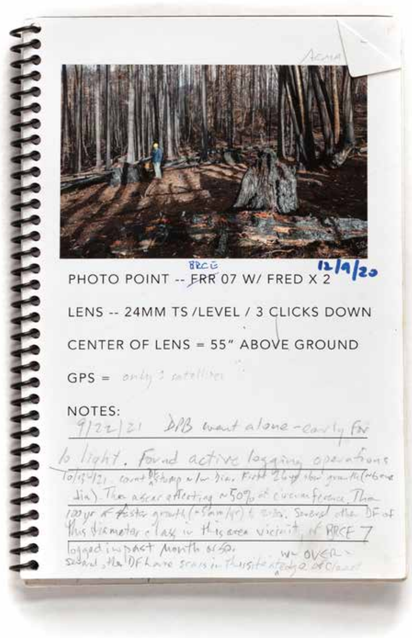
THE STORY SO FAR

In contrast with nearby sites, legacy ferns, rather than the pioneer fireweed, dominate the forest understory. The heat dome effect on the maples may be a harbinger of climate change effects to come, posing an uncertain future for this forest. Similarly, the final collapse of the partially-toppled large tree trunk highlights the persistence of the trees rooted in soil that remain upright, but those too shall reach the ground in coming decades.

BRCE07

Salvage Logging of a Complex Forest

Rotten stumps and logs on the ground are legacies of the old forest logged here many decades ago. The 2020 fire cleared the understory, revealing the complex forest of young conifers and the clump of large bigleaf maple trunks on the right. This site was chosen in part for the visual qualities of its depth of field, but, in selecting the site for chronosequence photography, we did not anticipate the dramatic change that took place a year after the fire.



12/20
Not a speck of greenery has appeared yet in this dry, upland site. The fire was hot enough to kill all the trees, but fine branch structures and even some brown foliage remain. A 6’4” human figure near and far gives a sense of scale.

08/21
A variety of herbs and ferns is returning – both those surviving from the pre-fire understory and pioneer species, such as wind-dispersed fireweed and pearly everlasting. Some plants wiggle in the breeze. The maple cluster begins to sprout from the base.

11/21
Wow! The private land owner logged this forest land. Scrap wood was left in piles for later burning to reduce the fuel load in case of additional fires and to clear the area for later tree planting, as required by forest practices rules. Some of the Douglas fir trees at the far end of the clearcut retain live canopies. The solitary figure is in the same position as in 12/20 to give a sense of scale.

10/23
Foliage of maple sprouts (right) and hazel (lower left) are starting to crowd the view, but many large clumps in their autumn yellow are in the clearcut and forest (middle distance). Several trees at the far end of the clearcut that initially survived appear to have died.

THE STORY SO FAR

Although vegetation development has been slower than in the wetter FRR area close to the river, both surviving and pioneering vegetation return quickly. We look forward to tracking change over time as we wonder, how will revegetation of logged areas compare with the unlogged forest? If the log piles are burned, how will that affect the area? If tree planting takes place, what will be the fate of those trees? Seedlings planted in nearby areas burned in this fire were killed by the scorching heat dome in June 2021. Will that be more frequent in the future?

FRR04

Tree Plantation and Salvage Logging

The smooth surface of the land, the absence of any rotting logs or stumps from an earlier forest, and the presence of a 1955 truck license plate suggest this was part of the logging camp that occupied the area before abandonment ca 1970. Later, the area was planted to a regimented Douglas fir plantation. We picked the site for chronosequence photography because we were intrigued about the future of this seemingly very simple 35-year-old industrial forest stand.

12/20
Practically all of the woody structure of the trees remains – even fine twigs. Needles scorched by the fire fell to the forest floor, suppressing development of firemoss (we could see a little bit under the cover of needles).

08/21
Late in the first summer a lush crop of fireweed blooms and casts seed to extend its role in retaining nutrients and stabilizing the soil.

11/22
The plantation is logged! Cottonwood trees in their autumn gold foliage mark the left side of the clearcut. The remaining green Douglas fir on the right form a riparian forest buffer strip along the McKenzie River. Green bushes within the clearcut and dense understory in the conifer forest are invasive Scotch broom. One orange Douglas fir crown suggests delayed mortality among the young firs.

10/23
The native fireweed (light tan plants in late stage of seed release) and the bright green invasive Scotch broom appear to be battling for supremacy over the recently cut area.

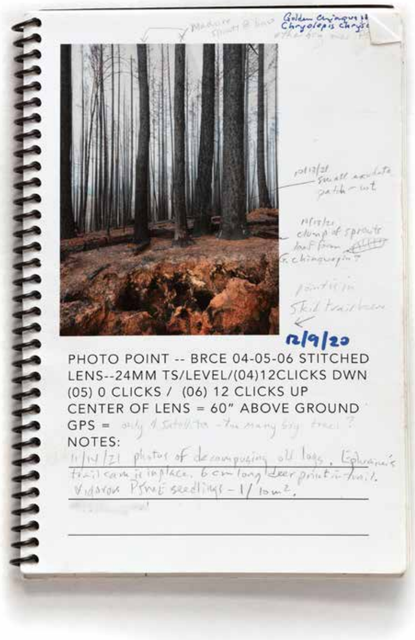
THE STORY SO FAR

This tree plantation had a simple forest structure before the fire, and most of the forest remained after the fire. Many trees were killed, but some retained tufts of green foliage at their tops (not seen in these photographs). Faint bits of firemoss and then fireweed and scattered Scotch broom plants appeared in the understory in the first summer. But two years after the fire the forest was clearcut, leaving the fireweed and Scotch broom to compete in the full sun of the clearcut. We are eager to see how Douglas fir seedlings fare in this competitive environment.

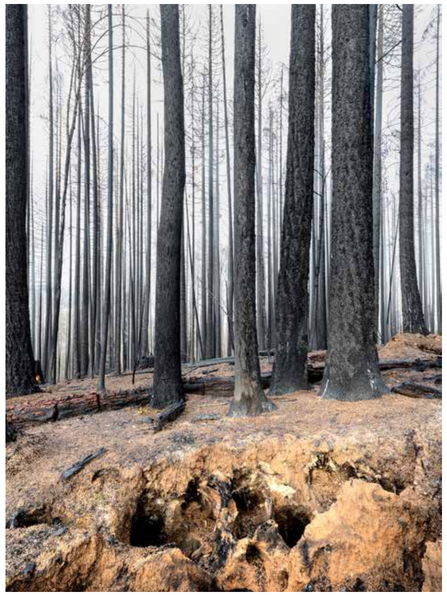
BRCE04-06

Blackened Forest over a Stump Ghost

This stark scene in a dry, upland area features a blackened, tall, trim forest looming over a stump ghost – a cavity in the ground left by decay and burning of roots of a massive old-growth tree. A solitary, decomposing log draped over the forest floor is another legacy of the old forest that formerly occupied this place. Most of the trees are Douglas fir established after several fires in the past century or so. An exception to conifer dominance is the tree at the left in the group of four large ones in the foreground – the one with a little wiggle in the trunk. It is a golden chinquapin, characteristic of dry conditions. Much of the forest structure, even thin limbs, remains, despite the complete fire kill.

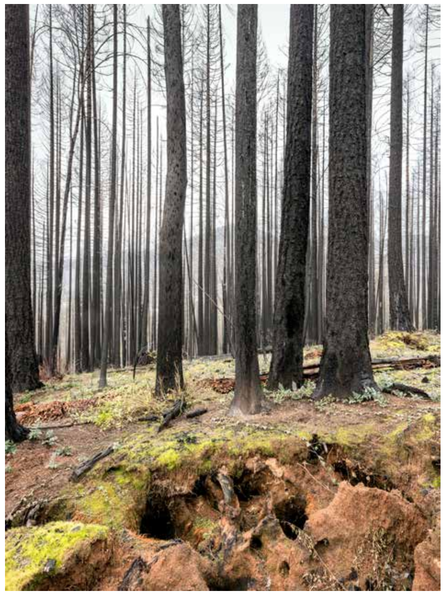


12/20
No signs of life are yet evident. A few drools of white dribble down the black bark of several of the large Douglas firs where the trees exude sap through weak spots in the bark.



05/21
Some green appears in the landscape: small patches of firemoss in the stump ghost, fern fronds and sprigs of herbs here and there, and a cluster of sprouts ringing the base of the big chinquapin tree. The prostrate log is crumbling, shedding its blackened underside, exposing red, rotten wood fragments.

01/22
In this winter view firemoss is more extensive across the soil surface. Firemoss in the stump ghost developed orange sporophytes as it matured. The log continues to fragment.



10/23
Fireweed has bloomed, contributing organic matter to the soil surface. The fine structure of the skeletal conifer forest remains in the tree tops, except for the curving limbs of maple in the upper left, which have broken.

THE STORY SO FAR

Diverse species of herbs return to this dry site and hardwood trees sprout shoots from their bases. The tops of the conifers are slower to break down than the hardwoods at the wetter site, yet, ultimately, all this forest overstory will reach the ground and contribute to soil organic matter. We wonder if this private land, held in a conservation easement by McKenzie River Trust, will eventually support a next Douglas fir forest. Seedlings are very common in the forest understory, but climate change may pose a threat to their future.

CONCLUSIONS

Change is inexorable and takes many forms fast and slow. The skeletal structure of the forest was abruptly revealed by the fire, as the fire turned the forest's typically rich green and brown color palette to black. The stark beauty lasted several months before a gradual succession of colors began returning to the forest. Many plants sprouted from legacies of the pre-fire ecosystem hidden in the soil and under protective bark, returning green to the forest. Seeds of pioneer species arrived on the wind, germinated and grew vigorously. Specialized species of fungi, moss, and herbs, notably fireweed, are adapted to rapidly occupy the landscape, holding soil and nutrients in place, adding organic matter, and leading the way for the future forest.

The forest expresses resilience in various ways. There is continuity in the forest, despite fire and other types of disturbances. Surprisingly, more than 95% of the carbon remains on site in the forms of root systems, tree trunks, large trees on the ground and canopies. Dead wood legacies of forests from centuries past have persisted. The abundance of fire-killed organic matter will decompose over coming decades and centuries, slowly releasing carbon into the soil and the atmosphere. The vast majority of nutrients are retained on the site, ready to nurture the next forest.

But signs of the uncertain future are appearing quickly – climate change, invasive species, and continued frequent, intensive logging. Operating independently and interactively, these forces can reduce the resilient capacity of the forest. Will changing environmental conditions, especially increased fire frequency and severity caused by climate change, permit forests as we've known them to return? These sources of uncertainty are all consequences of human intervention. That's a hopeful sign, because we can do something about them.

This chronosequence project has been a rather dispassionate account of how a forest changes following fire. However, working in the fire zone has been a deeply moving experience, prompted by frequent reminders of loss of forests, homes, livelihoods, and lives. A burned forest challenges us to dial our emotions to a fruitful place between grief and hope to motivate actions for environmental stewardship in a dramatically changing world. Hope gives direction and energy to go forward. Telling these stories through photographs and field observations provides an opportunity for everyone to find their own stories in the landscape.

We gratefully acknowledge the generous support of these organizations:

McKenzie River Trust
H.J. Andrews Experimental Forest
Oregon Arts Commission
Spring Creek Project for Ideas, Nature, and the Written Word
Long-Term Ecological Reflections Program

www.followingfire.com
www.davidpaulbayles.com
www.liberalarts.oregonstate.edu/centers-and-initiatives/spring-creek-project
www.andrewsforest.oregonstate.edu