



### *Executive summary*

- Historical range of variability in forest disturbance is a useful guide for managers, but emulating historical disturbance regimes is not always possible because of the influence of past and current land use patterns, social expectations, and changing climate. An appropriate mission statement for managing fire and fuels in an ecosystem dynamics framework is not “return forests to pre-settlement conditions,” but rather “manage for a range of structures and processes that maintain resilient and productive forests and achieve social objectives.” Management should emphasize “desired future dynamics.”
- Because many private lands are managed primarily for economic objectives that are often incompatible with landscape-level fire patterns, perpetuating fire disturbance processes is most relevant and appropriate on federal lands. Appropriate management for future fire and fuel dynamics on private lands may include use of fire on small scales to manage surface fuel accumulation, modest reduction of stocking densities to reduce risk of fire spread, and management of older fire resistant species and trees as fuel breaks. Management should balance economic considerations and risks.
- Collaboration with federal landowners on cross-boundary fuel reduction treatments will be necessary at stand-to-stand boundaries and in complex ownership patterns within larger landscapes. Fire behaves at the stand- and landscape levels.
- Our current policy framework identifies fuel reduction needs based on coarse-grain “condition class” mapping. Finer scale analysis of plant association groups is necessary to identify vegetation communities where fuel reduction is most likely to be effective in achieving forest resilience goals.
- There are many vegetation types in Oregon where fuel reduction treatments will increase forest resistance and resilience while addressing fire risk. In other vegetation types, there is no ecological rationale for fuel treatments, but fire risk may still be a pressing policy issue because of risk to property.
- Overall there *is* an overwhelming and urgent need for aggressive fuel reduction treatments in fire-prone areas throughout Oregon. Current treatment levels do not come close to meeting this need. There will be serious ecological and social consequences if managers, especially federal managers, fail to act to meet this need. Strategic, landscape-level treatments are needed to correct past errors and adapt to future expected conditions.
- Wildfire that undermines long-term forest resiliency is just one consequence of failing to proactively treat fuels in many areas in Oregon. Other impacts include loss of certain ecologically important vegetation communities, exacerbation of drought-induced mortality, and insect outbreaks. Stand- and landscape-level treatments should be designed to address these issues as well as fuel structure.
- Fuel reduction treatments, when melded with other land management goals, will predominantly focus on creating diverse, heterogeneous landscape patterns. These

approaches are not well served by diameter limits or other one-size-fits-all treatment prescriptions. Diversity and variation should be watchwords for managers.

- Bold action is often required to implement management that responds to our emerging understanding of fire and fuel dynamics. The failure to act to appropriately manage fuels in Oregon's forests is not just a policy failure, it is a political failure that requires political leadership to resolve. Large-scale, landscape-level demonstration programs in central, eastern and southern Oregon are recommended.

### *Introduction*

This paper synthesizes information from a March 13, 2009 seminar convened by the Institute for Natural Resources (INR) to discuss management of fire and fuels in an ecosystem dynamics framework, as well as other research conducted by INR's team of Oregon University System (OUS) and US Forest Service (USFS) principal investigators.<sup>1</sup> The seminar involved 53 individuals, including the INR team, other members of the OUS community including faculty and students from a variety of fields, state and federal natural resource managers, private timberland managers, non-governmental organizations and the interested public. This was the second of four seminars INR convened for the Oregon Department of Forestry (ODF) and Department of Environmental Quality (DEQ) as part of a multi-year Dynamic Ecosystems Project that is investigating the policy implications of ecosystem dynamics.<sup>2</sup> The seminars and resulting white papers will inform the final step in this project: a policy summit and final policy paper.

Fire is a pervasive ecosystem dynamic in Oregon forests. Almost all forest types in Oregon are adapted to fire to some degree, and fire historically was critically important in maintaining the ecosystem services we expect from forests. Past management has created a situation in which future fire dynamics have the potential to significantly undermine the integrity of many forest systems and disrupt the delivery of desired ecosystem services. Recent examples of such wildfire and associated lost of ecosystem services abound in the West, and there are no simple solutions. Fuel conditions and climate patterns make fire a reality that must be addressed in a comprehensive manner.

Addressing this problem requires recognition of the diversity of forest types and fire effects, utilization of sophisticated analytical and planning tools, and intelligent decisions about use of a range of management strategies. This paper is designed to frame these choices. Failure to make these choices now is itself a choice with significant risk (Agee 2002).

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<sup>2</sup> A description of the Ecosystem Dynamics Project and INR's 2008 synthesis paper can be found at [http://www.oregon.gov/ODF/STATE\\_FORESTS/FRP/RP\\_Home.shtml#Dynamic\\_Forest\\_Ecosystems](http://www.oregon.gov/ODF/STATE_FORESTS/FRP/RP_Home.shtml#Dynamic_Forest_Ecosystems).

## ***The historical range of variability***

*“It’s impossible to protect one place for a long time. We can’t preserve nature. We can preserve processes.”*

—Hal Salwasser

INR’s Dynamic Ecosystems Project has emphasized the importance of disturbance processes in driving ecological outcomes. Trying to emulate the range of conditions and processes sites historically experienced is one strategy for designing future management. There has been considerable study of the historical range of variability in wildfire in Oregon. There have been relatively few efforts to plan management that emulates historical wildfire patterns, most notably the Blue River Landscape Plan and Study on the H.J. Andrews Experimental Forest (INR 2008).

There are many challenges in using the historical range of variability to plan future management. We may not know very much about historical processes, there may be no record of important processes, and we may have incomplete information about processes. Perhaps more importantly, future conditions and/or contemporary management goals may not allow for historical disturbances like fire. Researchers have suggested that expected future conditions inform a “future range of variability” that guides management (Johnson and Duncan 2008). The INR team recommends that forest management emphasize “desired future dynamics”—those disturbance processes that can be expected to reinforce system resiliency and create desired ecological outcomes. Desired future dynamics will vary from site to site and at different temporal scales.

Research into the social acceptability of the use of the historical range of variability may aid in achieving public “buy-in” of the ecosystem dynamics approach (Mallon 2006). Explaining “desired future dynamics” as a science-based approach to management, and inviting the public to participate in collaborative learning environments, preferably in the field, will have the best chance of gaining public acceptance. Interdisciplinary planning is also desirable.

## ***Diverse ownership and objectives***

Forests in Oregon are managed by multiple owners with diverse goals.<sup>3</sup> Historically, the pattern of fire disturbance in Oregon was a function of topography, climate, and vegetation. Today, patterns of fire disturbance increasingly correspond to ownership boundaries and management practices. It is not possible to perfectly synchronize the objectives or management practices of diverse ownerships with wildfire. But because the historical pattern of fire on the landscape was important to the provision of certain ecosystem services, it may be desirable to “soften” the ecological edges between ownerships. This could be accomplished on private lands by creating regulatory flexibility and market incentives for lower stocking levels, use of more diverse species in

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<sup>3</sup> Of Oregon’s 28 million acres of forestland, 46% is managed by the USFS, 19% by private industrial landowners, 18% by private non-industrial landowners, 9% by the BLM, 4% by state agencies, 2% by tribes, 1% by other federal agencies, and 1% by local governments.

re-planting, and maintaining older fire resistant trees. On federal lands, this could be accomplished by fuel reduction activities on large percentages of the landscape. An alternative future for public-private landscape patterns is depicted in Figure 1.

On many private industrial forestlands in western Oregon stand-replacing fire used to be a dominant disturbance process. Today, stand-replacing timber harvest is the dominant disturbance process, and the role of fire as a disturbance agent has been significantly diminished. Accordingly, most of the recommendations about landscape-level fire processes in this paper are most applicable to federal lands. Although state agencies have little or no direct regulatory or management control of federal lands, there may be increasing opportunities for partnerships between state and federal managers as federal land management budgets shrink and the ecological consequences of disrupting historical fire processes become more acute.

Although re-establishing landscape-level fire processes is most appropriate on large tracts of federal lands, historical fire patterns are relevant to managers at a series of nested scales, and different ownerships can make use of information from different scales. For example, although landscape scale (25,000+ acre) stand-replacing fire might be inappropriate for private lands, the historical role that fire played at smaller scales (<100 acre), for instance improving site productivity and regenerating native species, should and currently often is incorporated into private lands management. For another example, fire may have historically burned in particular patterns correlating with topography or prevailing winds, and the location of leave tree retention patches could be positioned to reflect these historical patterns (e.g., more severe fire at higher slope positions).

Wyden Amendment authority can be used to enter into cooperative agreements between federal and private landowners to reduce fire risk and promote resilient forest habitat on private lands.<sup>4</sup>

### ***Diverse forests***

*“There is a clear need for better information to support these high impact decisions. A one-size fits all approach is not appropriate in a complex environment.”*

—Olivia Duren

Forests in Oregon are frequently characterized as either “healthy” or “unhealthy” depending on the potential for severe fire. From a strictly ecological perspective, this type of distinction is oversimplified. Many vegetation types in Oregon are well adapted to severe fire. In such vegetation types, although thinning operations might serve other important management objectives (for instance, increasing growth and economic value) there is no ecological rationale for thinning to reduce fuels.

Current federal fuel reduction policy, specifically the Healthy Forest Restoration Act, does not account well for such diversity of forest types in Oregon. The HFRA calls for

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<sup>4</sup> Public Law 105-277, Section 323 as amended by Public Law 109-54, Section 434.

expedited thinning in forests categorized in certain “condition classes.” These condition classes are coarse-scale models that overlay large geographic areas without regard to the different forest types within those areas, which respond to fire (and fuel treatments) differently.<sup>5</sup> Federal land managers frequently use Plant Association Groups to consider land management objectives; the same fine grain information about vegetation communities can be used design fuel reduction treatments (Franklin and Agee 2003; Agee and Skinner 2005; Noss *et al.* 2006). Further fine-scale analysis will help identify which forest communities can most benefit from fuel reduction treatments.

### ***Landscape-level treatments to promote desired future dynamics***

*“The lack of disturbance has become the perturbation, the disturbance. No action has consequences.”*

—John Bailey

From an ecological processes perspective, two questions about fire and fuels management are important: First, is the lack of wildfire having significant negative influences on ecosystem function; second, when wildfire occurs will it be a disturbance agent that acts to reinforce system resilience and provide desired ecological outputs or will it undermine system resilience and create undesirable outcomes? Figure 2 graphically illustrates how fire disturbance can yield different ecological outcomes depending on past management. From a strictly ecological standpoint, managers should prioritize fuel reduction treatments in vegetation communities that have experienced significant negative effects from fire exclusion and where severe fire is likely to have detrimental effects on desirable ecological outcomes. This includes many dry, fire-prone forests managed by the Forest Service in southern and eastern Oregon.

Fire exclusion in these forests has created undesirable future dynamics, favoring fire intolerant tree species, particularly species of the *Abies* genus, which fuel larger and more severe fires. Fire suppression has significantly disrupted the spatial and temporal pattern of fire on a landscape scale, replacing fine grain mosaics of fire size and severity with larger, more homogenous patches of generally more severe fire events (Hessburg *et al.* 2005). The outcomes depicted in Pathway B of Figure 1 are becoming increasingly typical in these forests.

Forest Service researcher Paul Hessburg and University of Washington researchers James Agee and Jerry Franklin (2005) have painted a stark picture of the ecological future of these forests, which is repeated here to underscore the urgency of fuel treatments in perpetuating future desired dynamics:

Extant dry forests no longer appear or function as they once did. Large landscapes are homogeneous in their composition and structure, and the regional landscape is set up for severe, large fire and insect disturbance events. Among ecologists, there is also a high degree of concern about how future dry forests will develop, if fires continue to be large and severe.

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<sup>5</sup> It is worth noting that the condition class maps the HFRA utilizes simply mislabel the condition class of most forests in western Washington and northwestern Oregon.

To reverse these trends, we recommend that federal land managers undertake fine-grain analysis that identifies: 1) in what vegetation types fuel reduction thinning is necessary to restore structure and composition; and 2) within these vegetation types how treatments should be placed on the landscape to modify fire behavior in the most cost effective way while balancing other resource values. Good tools exist to accomplish these tasks. These tools include fire behavior models and models that optimize fuel reduction treatments for habitat protection (Agee and Skinner 2005; Omi and Martinson 2004). Many of these tools are described in more detail in INR's 2008 synthesis paper about ecosystem dynamics management (INR 2008).

Although fuel reduction might involve short-term reductions in habitat for species associated with dense, close canopied, multi-storied stands, models indicate that the long term persistence of species like the northern spotted owl may best be achieved by limiting spread of severe fire through landscape-level thinning (Roloff *et al.* 2005). Fuel treatments should create diverse, fine-scale mosaics and heterogeneous stands to be consistent with these other ecosystem management objectives. All extant older fire resistant overstory tree species should be retained during thinning operations, but diameter limits and blanket "thin from below" prescriptions will tend to create homogeneity. Among other things, a focus on heterogeneity and diversity will aid landscape-level climate change adaptation.

Modifying severe fire behavior should not be the only goal that drives thinning to reduce density in dry forest types. Past management practices that tended to homogenize stands for tree growth and continued fire exclusion to protect investments, are now susceptible to climate change-related drought and large-scale forest mortality from insect infestation and/or competition induced mortality. Thinning treatments should address these likely future mortality scenarios. Thinning could also be designed to restore habitat components such as hardwoods where they are succeeding out of forest systems due to fire suppression (e.g., in riparian areas).

Important potential negative consequences of fuel reduction treatments include spreading non-native invasive species and negative impacts to habitat, hydrologic function and other land values associated with treatment or, more commonly, from the road system used to conduct fuel reduction (Hunter *et al.* 2006; Noss *et al.* 2006). Accordingly, stand density treatments need to take a holistic approach, incorporating measures to reduce road densities, repair or decommission problem roads, and treat invasive species.

We do not know everything we might want to know about the effects of fuel reduction treatment on forest processes. But there has been more than enough research conducted on small scales to support large-scale treatments. A focus on the wildland urban interface will not meet the ecological needs of the broader landscape. A large pulse of treatments in a relatively short amount of time is generally appropriate. Approximately one-third of large watersheds may need to be treated to re-establish fire as a positive ecological process in many fire prone areas. Treating 2-4% of identified fire-prone landscapes would result in approximately one-third of a given landscape treated within 8-16 years;

some of these treatments may already be completed. Mechanical treatments followed by several cycles of prescribed fire to reduce surface fuel accumulations are appropriate in most cases. Upon completion of treatments, plans should be developed to use natural ignitions to accomplish resource management objectives where appropriate over the longer term.

### ***Fire in riparian areas***

*“If you want to integrate any meaningful restoration treatment into an area, you have to include riparian areas.”*

—Mike Messier

As noted in INR’s aquatic ecosystem management white paper, current concepts of riparian area “protection” need to be modified to reflect the important role that disturbance plays in maintaining aquatic ecosystem function (INR 2009). Fire was an important disturbance agent in many of Oregon’s riparian forests. Managers need to develop science-based methods for creating heterogeneity in riparian forests where fire was historically an important disturbance agent.

### ***Risk management***

*“We don’t know what fire protection means anymore. We need fire risk management.”*

—Ted Lorenson

Current fire management policy is still focused on preventing wildfire, but managing for the risk of fire is more appropriate. Although fire suppression in many areas is needed to protect property, current fire suppression policy is manifestly a failure from an ecological standpoint, undermining resilience in many forest systems by allowing forest fuels to accumulate. It is clear that suppression policies must change, but there are no simple or easy policy fixes to accomplish needed change. The best long-term policy solution may be to accomplish landscape-scale fuel reduction and provide for use of wildland fire within these areas. This is not a formula for eliminating risk to lives and property. An alternative future that emphasizes restoring ecological integrity and reintroducing fire as a desired future disturbance dynamic does not eliminate risk but entails substantially *less* risk than current management, at a much lower long-term cost to taxpayers. Indeed, we and the public have no other choice than to accept fire in the landscape.

Surface fuels are the most important fuel driver of large fire events, and the most effective way to treat surface fuels is with prescribed burning before a wildfire ignition. There are significant policy obstacles to widespread use of such prescribed fire, including legal liabilities and Clean Air Act standards. Again, a focus on risk management rather than risk prevention is appropriate. Although prescribed fire carries with it a certain amount of risk, it lowers overall risk by ameliorating the severe risks associated with uncontrolled wildfire in a landscape where fire has been excluded. Proactive fuel treatment can position stands and landscapes to burn more moderately during wildfire events, during normal fire spread behavior and/or with back firing suppression activities.

## *Oregon demonstration projects*

Most of the recommendations in this paper address federal lands, where management of fire and fuels in an ecosystem dynamics framework is most relevant. Federal forest managers are widely perceived to be constrained in conducting wide spread fuel reduction treatments by extensive environmental planning requirements, reduced budgets, lack of public support, lack of direction for effective ecosystem management, and other institutional problems (Teich *et al.* 2004; LaChapelle *et al.* 2003; USDA 2002a; USDA 2002b; Cortner *et al.* 1998). Whatever the reasons, it seems unlikely to our team that federal land managers will accomplish the scope of work that is needed in fire-prone forests in Oregon. Whatever the real or perceived barriers to accomplishing needed work might be, we conclude that the basic problem is political and requires a political solution.

We recommend that Oregon's political leadership petition the federal government to conduct large-scale forest restoration demonstration project on relevant sites in central, eastern and southern Oregon. We recommend 2-3 demonstration projects that would treat large geographic scales. Demonstration projects could be as large as multiple national forests, and no smaller than a fifth field watershed. One example of an appropriate geographic scale for a large landscape scale demonstration project would be the Umatilla, Wallowa-Whitman and Malheur National Forests in northeastern Oregon. These replicated demonstration projects would have the following components:

- A collaborative planning process involving scientists, managers and key stakeholders.
- Fine grain analysis of forest conditions and density/fuel reduction treatment opportunities that consider a wide range of disturbance processes including fire, disease, insects and drought.
- Planned treatments should promote landscape-level heterogeneity in structure and composition, including adaptation of treatments to individual plant community needs, areas of no treatment, spatial consideration of natural landforms and existing treatment areas, and restoration of under-represented biological communities.
- Environmental analysis that covers a 10-year implementation timeframe during which as much as one third of dry fire-prone forest types in unreserved land management allocations are treated.
- Inclusion of treatment options that restore and maintain natural stand and landscape dynamic processes in the study area.
- Simple, comprehensive monitoring activities and adaptive management mechanisms.

*Figures*

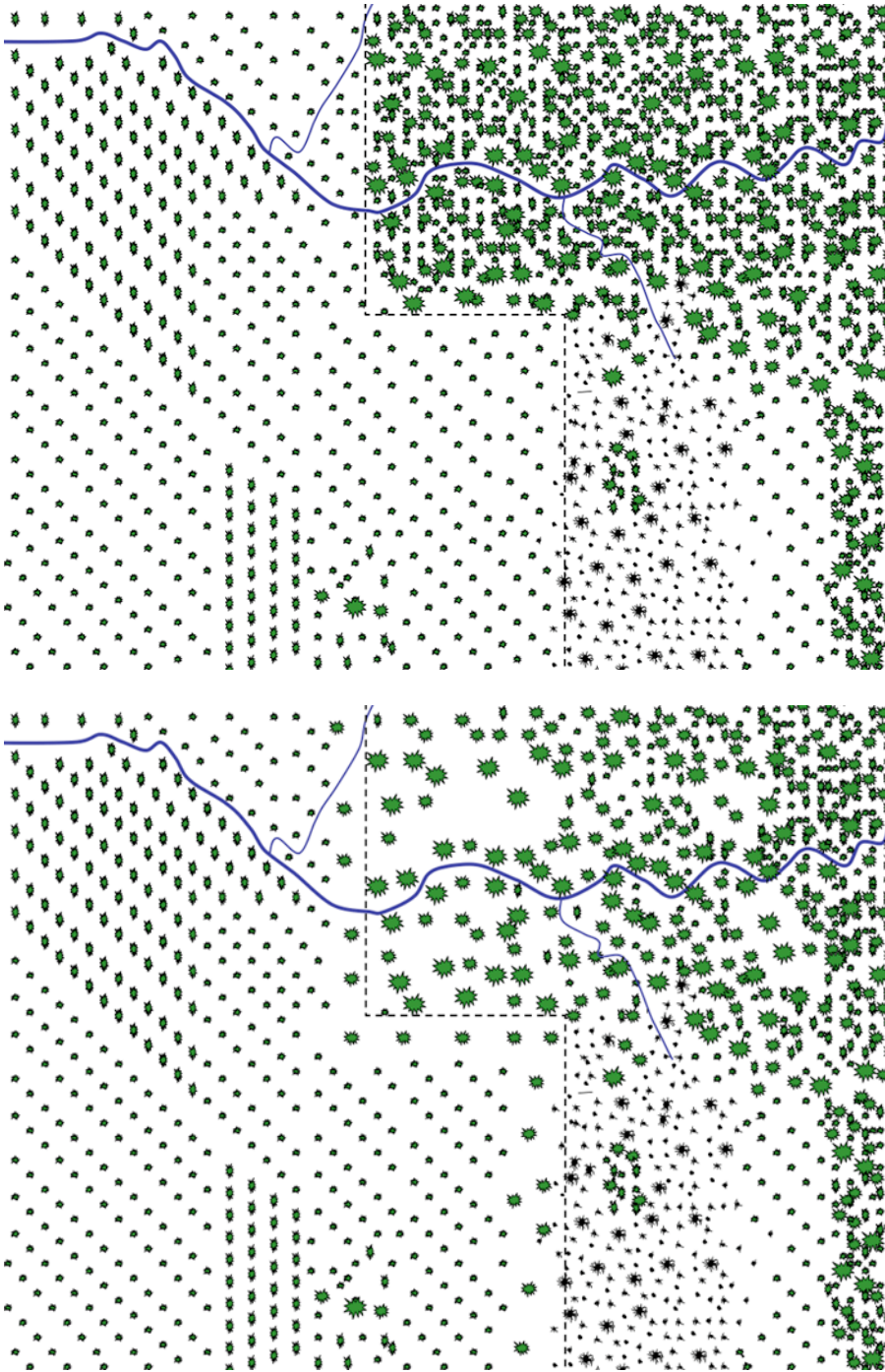


Figure 1: Alternative future for public-private lands interface. The top panel shows an increasingly typical hard ecological edge between private land (left) and federal land (right). In the bottom panel, the ecological edge is softened by collaborative fuel treatments.

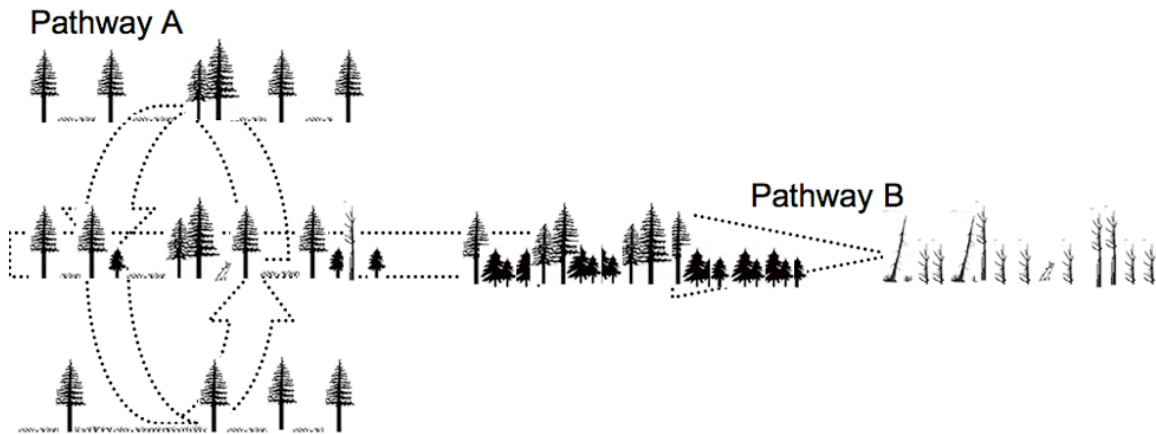


Figure 2: Fire-prone forest dynamic pathways. In Pathway A, a dry fire-prone forest is a fine-grain, low contrast heterogeneous mosaic maintained by relatively frequent, low-severity fire. In Pathway B, fire suppression leads to encroachment of *Abies* and associated fuel buildup, leading to larger, severe fire and a more homogenous, high contrast, landscape pattern.

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