The U.S. Forest Service's history of herbicide use is one that is both instructive and full of contradictions. Tasked with providing timber for the post–World War II housing boom, the agency embraced the use of chemicals to improve timber growth. However, a public that wanted timber objected to the use of those same chemicals. And even as it defoliated and burned forests in Vietnam, the U.S. Forest Service participated in projects designed to regenerate that embattled country's forests. Both at home and abroad, then, the Forest Service found itself waging a battle for hearts and minds—one that continues still.

VAST, INCREDIBLE DAMAGE

HERBICIDES AND THE U.S. FOREST SERVICE

The Douglas-fir tussock moth (*Orgyia pseudotsugata*) caterpillar is small in size, with brightly colored tufts of black hair projecting from the head and rear of its body. However diminutive and decorative, this caterpillar's fierce appetite—especially during outbreaks in the late spring and early summer—can quickly defoliate individual trees and collectively damage large swaths of that arboreal species whose name it bears. Its capacity to chew through forests gained notoriety in the 1960s and 1970s, so much so that in 1965 the U.S. Forest Service sprayed DDT mixed with fuel oil over 66,000 infected acres in the Pacific Northwest. After conducting posttreatment analysis, agency scientists proclaimed the aerial assault a complete success, achieving "a tussock moth kill ranging from ninety to one hundred percent, with an overall average of ninety-eight per cent."[1]

Less than a decade later, an even larger outbreak blew up along the Washington, Oregon, and Idaho borders, which overflights estimated had damaged upward of 500,000 acres. Although the Forest Service, along with state, tribal, and private landowners, wanted to replicate the successful control-and-eradication operations that had occurred in the mid-1960s, there was a catch. In the interim, Rachel Carson's *Silent Spring* (1962) had appeared, and her revelations of the devastating impact that indiscriminate use of DDT—what she decried as "a bright new toy"—was having on wooded, riparian, and marine habitats, and the animals that inhabited them, had led to closer scrutiny of the insecticide and related chemicals.[2] Indeed, DDT had been banned in the United States, complicating the Forest Service's managerial response to the 1973 outbreak. As then regional forester Ted Schlapfer later recalled: "We were really caught between a rock and a hard place, knowing that the only way we could positively control [the tussock moth] was to use DDT."[3]

BY JAMES G. LEWIS AND CHAR MILLER

COURTESY OF LADD LIVINGSTON, IDAHO DEPARTMENT OF LANDS; U.S. FOREST SERVICE PHOTO 50761

*Adult male of Douglas-fir tussock moth (*Orgyia pseudotsugata*). This species of moth was responsible for numerous outbreaks in the Pacific Northwest in the postwar years, which the U.S. Forest Service and other federal and state agencies attempted to control with aerial spraying.*

A legal loophole opened up just such an opportunity. DDT could still be deployed if the relevant agencies and entities determined that its use constituted a national emergency. Together, the Forest Service, the Bureau of Indian Affairs, and the Bureau of Land Management joined the Oregon State Forester's Office and the Oregon State University School of Forestry in petitioning the U.S. Environmental Protection Agency (EPA) for an exemption. Although the EPA initially denied their request, in 1974, after evidence that the tussock moth defoliation now sprawled across 1.2 million acres and in response to what historian Harold K. Steen has described as "unprecedented political pressure," a reluctant EPA granted the petitioners one-time use of the chemical that summer. The operation was only partly successful, as the outbreak may have already run its course. Yet the massive scale of the operation—it was the largest aerial spraying of DDT ever undertaken in the United States—also caused considerable concern within the Forest Service. "One of the real positive things that came out of [it]," remembered Schlapfer, was the conclusion that agency leaders reached: "We don't want to do this again. We have got to find alternative solutions to controlling [the] tussock moth." Shortly thereafter, researchers identified a nontoxic way to disseminate *Bacillus thuringiensis*, a biological agent that infects the tussock moth with a virus. The 1974 aerial spraying was the last time that DDT was applied in American forests.[4]

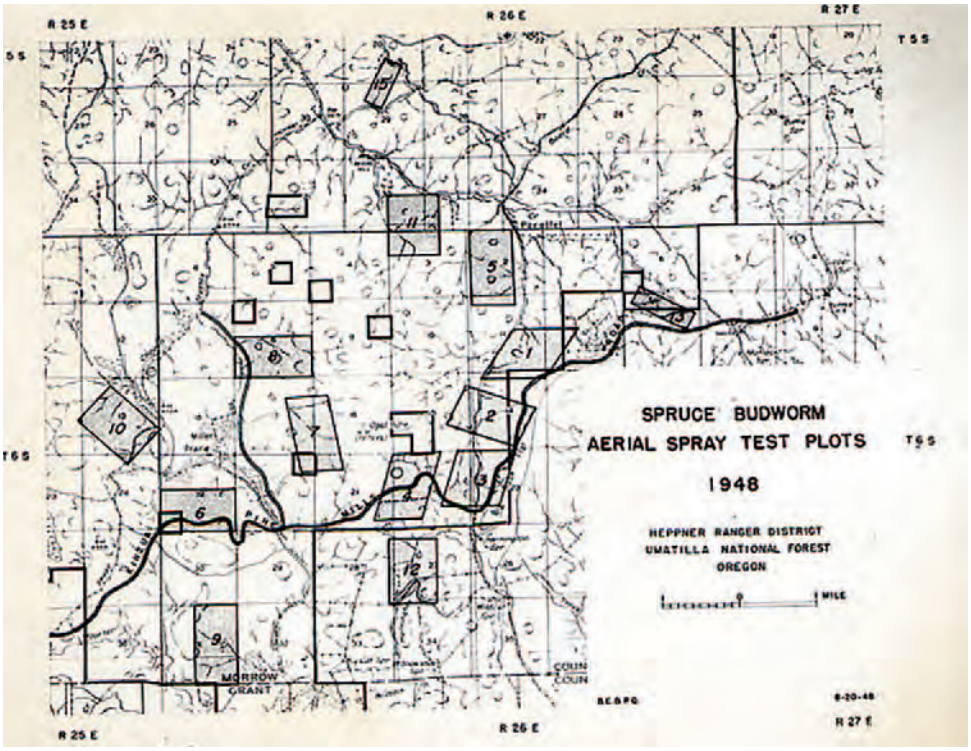
That happy outcome and the implication that policymaking, and the scientific expertise on which it depends, could come to know its limits; that postmortem analyses could lead to better science more carefully applied; and that its better application could lead to less environmentally damaging results is only part of the story surrounding the Forest Service's overdependence on herbicides, pesticides, and insecticides in the post–World War II era. In addition to the internal debates surrounding the use of DDT, outside forces exerted considerable pressure on the agency to halt its use of these toxic chemicals. Communities in and around national forests—particularly in Northern California and the Pacific Northwest—pushed back against the Forest Service's aerial campaigns. So did workers' organizations seeking to protect their members' health and laboring conditions, who did so by challenging agency science. An emboldened, post–*Silent Spring* environmental movement went to court, filing lawsuits in defense of endangered species, biodiversity, and water quality. Rather than simply demonstrating the limitations of the technological fix to land management dilemmas, then, the tussock moth incidents of the 1960s and 1970s are a reminder of the degree to which the Forest Service—the single largest agency in the U.S. Department of Agriculture, at the time employing upward of 35,000 people—dominated land management decisions at the federal level. That dominance helps explain why the Forest Service, and its peer agencies, routinely utilized chemicals whose impact on environmental and public health had not been fully assessed or completely understood—a process that has continued into the twenty-first century.

LIMITATIONS OF A CAN-DO AGENCY

The Forest Service's ready use of chemicals in the mid-twentieth century depended in good part on its leadership's firm belief that empirical science and rational planning had been the keys to its ability to resolve many of conservation's gravest problems. Chief Ferdinand Silcox's apparent success in suppressing forest fires in the 1930s gave an inkling of what could be accomplished if the Forest Service applied the right mix of personnel, technology, research, and budget. The same outcome seemed to have been true during the post–World War II era. As the Eisenhower administration came to a close, the Forest Service was reaching its peak in power and prestige, and was the undisputed leader of American conservation.[5] Its centrality was largely attributable to the agency's robust timber program. Because private industry had logged out most of its holdings by the end of the war, it turned to the national forests for timber to meet the burgeoning peacetime demand for lumber. The Forest Service willingly obliged in what it perceived to be a win-win situation. Through its ever-increasing timber yields, the Forest Service was making tangible contributions to the growing U.S. economy amid the Cold War—no small incentive for ambitious employees of the goal-oriented agency. In the age of Sputnik, scientific achievement mixed with a can-do attitude made the Forest Service a model agency. Its managerial strategy, former chief Michael Dombeck (1996–2001) declared, was reactive: "If commercially valuable timber was inaccessible, build a road. If a harvested forest on south-facing slopes resisted regeneration, terrace the mountainside. If soil fertility was lacking, fertilize the area. If pests or fire threatened forest stands, apply pesticides and marshal all hands to combat fire. If people grew unhappy with the site of large clearcuts, leave 'beauty strips' of trees along roadways to block timber harvest units from view."[6]

But when it came to timber, the postwar agency was also proactive. The Forest Service had dispelled the long-standing fear of a timber famine. *Timber Resources for America's Future*, which the agency had published in 1958, revealed that for the first time, timber

growth on all lands—public and private—was exceeding the annual cut.[7] One reason for this was the agency's fire-suppression campaign: since the 1930s, the amount of acreage lost each year to fire had steadily dropped. In the 1960s, the average annual acreage burned was 4.6 million acres, down from a high of 39.1 million acres thirty years earlier. More importantly, the national forests had become the nation's lumberyard. The amount of timber sold from national forest lands nearly quadrupled from 1950 to 1960 (3,434,114 MBF to 12,167,180 MBF), and the harvest rate in that same time span nearly tripled (3,501,568 MBF to 9,366,897 MBF).[8] Higher sale and harvest rates meant more money coming in to the federal treasury's coffers. And that was good for Forest Service careers; those who made their timber targets could expect to be promoted. But the higher rates also gave birth to what historian Paul W. Hirt has dubbed a "conspiracy of optimism"—the belief that the Forest Service could deliver timber at the levels Congress demanded now and well into the future.[9] The goals could be achieved through intensive timber management techniques that included clearcutting and artificial regeneration supplemented and complemented by an accelerating application of herbicides.



U.S. FOREST SERVICE, PACIFIC NORTHWEST REGION, STATE AND PRIVATE FORESTRY, FOREST HEALTH PROTECTION

To assess the effectiveness of aerial spraying of herbicides over extensive forested acreage, the U.S. Forest Service established a series of test plots on the Umatilla National Forest in Oregon and Washington.

The agency's continued emphasis on timber management, however, left it blind to ecological considerations and social concerns; it turned a deaf ear to rising public criticism on issues such as the impact of chemicals on human and animal populations as well as the public's changing values that favored recreation over resource extraction. One source of the agency's problems was that it suffered from groupthink. In 1960 Herbert Kaufman published a probing study of the Forest Service employees' administrative behavior. He sought to understand how field personnel operating within the agency's decentralized system, which allowed the lowest-ranking officers to make decisions without consulting superior officers, functioned at such a high level. Kaufman found that the agency recruited men with similar technical knowledge and practical skills who also had the will to conform and carry out what he called "the preformed decisions" of their superiors, which could be found in the ranger's bible, the Forest Service Manual. The agency designed the manual to do most of the thinking for its line officers, and the text laid out in full detail how to reach decisions on everything from "free-use permits to huge sales of timber, from burning permits to fighting large fires, from requisitioning office supplies to maintaining discipline."[10] The manual and the agency culture it nurtured and legitimized ensured a standard way of handling most situations or problems.

Adding to the self-scrutiny was the requirement that each ranger had to keep a diary and file multiple reports each year that would eventually reveal any deviation from accepted policy. Because personnel were rotated every two to three years, supervisors would be able to spot any inconsistencies in staff behavior or action that might be noted in their personnel record. In such an atmosphere, a forester who questioned operations might be labeled a troublemaker and place his career at risk. By handling personnel this way, the Forest Service, Kaufman asserted, "enjoyed a substantial degree of success in producing field behavior consistent with headquarters' directives and suggestions."[11]

This insularity was one reason why the agency proved particularly prickly about external criticism. In the mid-1960s, a seasoned forester told newly hired foresters: "We must have enough guts to stand up and tell the public how their land should be managed. As professional foresters, we know what's best for the land."[12] This assertion of expertise—which, as Kaufman indicated, was the result of the professionalizing nature of these employees' education and their adherence to the agency's internal mind-set—proved problematic. For as Rachel Carson had demonstrated, what the federal government had assured the public was better for humanity was not necessarily better for the environment or the species that depended on it.

In 1962 Carson, a former U.S. Fish and Wildlife Service biologist, published *Silent Spring*. Her book was a powerful indictment of the use of toxic chemical pesticides, primarily DDT, due to their poisonous impact on the food chain and the magnified threat this posed for human populations. She was highly critical of governmental agencies such as the Forest Service for their failure to test chemicals in biotic settings. In 1958, in Wyoming's Bridger National Forest, the Forest Service had taken a "shotgun approach to nature," she wrote, spraying upward of ten thousand acres of sage in response to "the pressure from cattlemen for more grasslands."[13] The intended target died, but so did "the green, life-giving ribbon of willows that traced its way across these plains" and the trout, beaver, and moose that had lived within this ecosystem's embrace.[14] A shocked Supreme Court justice-cum-conservationist, William

COURTESY OF U.S. FISH AND WILDLIFE SERVICE

Rachel Carson's Silent Spring *(1962), which closely analyzed the deleterious impact that DDT and other chemicals had on all life, profoundly influenced American environmental culture and politics and disrupted the once unquestioned deference to scientific expertise.*

O. Douglas, visited the area one year later and was appalled by what he saw, writing that "the damage is vast, incredible, awful." Visiting again a year after that, Douglas saw "more depredation by government."[15] Although the agency justified its decision based on the "improvement" it would bring to the range, Carson countered that its actions here and elsewhere were ripping apart "the whole closely knit fabric of life."[16] Her arguments, observes historian Stephen Fox, drew on the insights of ecologist Charles Elton, and with him she "argued that diversity was the key to biological health. It was imperiled by the human conceit that sorted out wild species according to their human uses and eliminated the 'bad' ones."[17]

Carson's book triggered a national controversy. Pesticide manufacturers and large agricultural organizations threatened lawsuits and attacked Carson's credibility; so did the U.S. Department of Agriculture.[18] Overlooked in the furor was Carson's call for research to determine how to use pesticides safely and to find alternate techniques for pest control; she had not urged the abandonment of pest control. Instead of following her suggestions, however, many in the timber and agricultural industries, along with the Forest Service, spent the next twenty years and countless resources arguing that they could not carry out their work without the chemicals they had on hand.[19]

By the early 1960s, for example, the Forest Service was annually conducting aerial spraying of DDT on more than one million acres of national forest lands to generate ever-higher timber yields. By the end of that decade, scientists inside and outside the agency determined that herbicides were adversely affecting wildlife and habitat. Instead of changing course or exploring alternative herbicides, however, Forest Service leaders responded to the perceived threat of Carson's work by launching an "information and education" program engineered out of its Washington office. Its publication, "The Forest Service in a Changing Conservation Climate" (1966), attempted to counter *Silent Spring* on several different fronts. The booklet's goal was to educate the public: "We need the understanding and support that comes from an informed public," Chief Ed Cliff declares in the text's epigraph. "[Our story] must be told and retold so that people everywhere will recognize and comprehend the forest patterns they see in America today."[20] Among the twenty-nine "problems" listed in the booklet is one titled "Use of Pesticides in Forestry." Strikingly, the word "herbicides" appears only once in the relevant text:

> *Judicious use of pesticides and herbicides is necessary to control several important forest pests. In fact, pesticides are the only known effective method of control for several destructive forest insects and diseases. Many persons and several organized groups, believing that all pesticides are dangerous to wildlife and to people, oppose their use under any circumstances. The Forest Service, working in close cooperation with several other agencies…, is engaged in a widespread program to insure safe and effective use of pesticides. This program includes intensified research, detailed screening, controlled field testing, careful planning of action programs, and critical evaluation of the results and consequences.*

The "objective," the agency declared, was to "develop public confidence in Forest Service decisions to use pesticides, emphasizing our equal concern that pesticides will always be used under safe, scientific, and carefully controlled conditions."[21]

The agency's literary efforts did not match *Silent Spring*'s reach, but in retrospect that mismatch in influence is less important than the Forest Service's effort to blunt criticism of its default use of pesticides and herbicides. Those who continued to oppose its actions were dismissed as being "ignorant or acting on 'misinformation,'" a dismissiveness demonstrating the agency's (almost willful) remaining out of touch.[22] Indeed, many agency foresters even advocated managing the land more intensively to achieve what they called "full utilization." Hoping to pull his colleagues back from this high-stakes gamble of defying the public interest, Charles Connaughton, who served as the regional forester for three regions from 1951 to 1971, urged his peers to take seriously the growing gap between what foresters did and public perceptions of why they did what they did when managing the national forests. In a 1966 article in the *Journal of Forestry*, he noted that the "toughest problem facing the forestry profession today results from a major segment of the public not realizing commercial forest lands can be managed without destroying their utility and appearance. Consequently, much of the public lacks confidence in foresters as stewards of the land." He encouraged his fellow professionals to adopt management objectives and techniques that "result in acceptable conditions on the land that the public can and should be shown."[23] Four years later, fellow regional forester Neal Rahm, in a letter to the journal's editor, reinforced Connaughton's point: although confident in foresters' ability to do the job, he too wondered why they failed to prioritize educating the public, suggesting that

this failure was because "we lack the will!"[24] Their urgings were too little, too late.

That their pleadings fell on deaf ears is a reminder, environmental historian Thomas Dunlap has noted, that "*Silent Spring* marked a watershed, as the private, scientific debate became a public, political issue."[25] In short order, Congress passed the Clean Air Act (1963) and the Water Quality Act (1965), which since have been amended, updated, and extended. Along with the Wilderness Act (1964) and a host of other new environmental regulations protecting endangered species and requiring public participation in land management planning, these legislative initiatives, and related concerns over quality-of-life issues, helped usher in the modern environmental movement.[26] In one sense, the movement argued that the human species no longer stood apart from the rest of the natural world. Yet, paradoxically, human survival was of growing concern. The threat of nuclear war, along with the use of chemicals to control nature domestically and abroad, when combined with photographs of Earth taken from space were reminders that despite humanity's impressive technological achievements, life on this blue planet seemed increasingly fragile.

This sense of fragility came coupled with a growing disillusionment with government policies that deepened as a result of the Vietnam War and the Watergate scandal. Swept up in this culture of distrust was the concept of scientific land management and managerial expertise—the once-unquestioned foundation of the Forest Service's mission. Historian Paul W. Hirt observed: "The same deference for scientists that contributed to public acceptance of intensive management for maximum production in the 1950s now contributed to widespread questioning of the faith in technological fixes and a growing skepticism" toward the Forest Service.[27] An agency that long had thought of itself as heroic now was perceived to be villainous.

VIETNAM AND THE HERBICIDE WARS

This perception was bound up with the Forest Service's ready deployment of herbicides. In limited use before World War II, chemical pesticide usage on the national forests accelerated in 1947, when Congress passed the Forest Pest Control Act. This legislation charged the Forest Service with preventing, controlling, or eradicating destructive pests on private and public forests. Industrial foresters and the Forest Service considered insecticides necessary to protect timber and range animals from harmful insects. Herbicides provided an efficient way to foster regeneration of economically desirable trees by killing undesirable ones, maintaining fuel breaks, and destroying noxious weeds. The agency's confidence in the findings of its researchers underscored its faith that it could effectively handle land management problems and control outcomes. Although Rachel Carson's *Silent Spring* had inspired further studies that showed how insect populations adapted to the chemicals and how pesticides killed beneficial parasites and predators along with the targeted insects, that research persuaded many Forest Service entomologists that "one hundred percent control or eradication of an insect was neither necessary nor practical to prevent economic loss." That finding notwithstanding, the agency persisted in its use of chemicals.[28] The continued reliance on such chemicals troubled some of its field scientists and also the EPA; the latter accused the Forest Service of conducting inadequate research on the impact of herbicidal spraying.[29]

After the EPA banned DDT in 1972, the Forest Service turned to other toxins—Malathion, Zectran, Sevin-4-Oil, and Orthene—that had not specifically been banned. Another herbicide of choice was 2,4,5-Trichlorophenol (or 2,4,5-T). The U.S. Army had developed it during World War II and then afterward released the formula for domestic use as a weed and brush killer. Beginning in the late 1940s, the Forest Service began using 2,4,5-T on American hardwoods to clear weeds from around shade-intolerant softwood stands. Twenty years later, the military launched widespread, aerial application of a mixture of 2,4,5-T and 2,4-Dichlorophenoxyacetic acid (or 2,4-D), called Agent Orange, over Vietnam to defoliate the hardwood jungle canopy and deny the enemy safe haven.[30] The levels of its application were extreme: the U.S. Air Force saturated the land, using twenty-seven times more herbicide per area unit than the Forest Service was spraying stateside for weed control. By 1966 studies had revealed that Agent Orange's primary active ingredient, TCDD, or dioxin, caused birth defects in laboratory animals and was suspected of causing illnesses, birth defects, and miscarriages in humans. Domestic scientists protested the use of these poisons in Vietnam as early as 1964, and their challenge accelerated across that decade.[31] The federal government soon imposed restrictions on its use at home, such as banning it for household use and on food crops intended for human consumption.

Curiously, public and private foresters were exempt from these restrictions, so although antiwar protesters succeeded in 1970 in getting the military to stop using Agent Orange in Vietnam, aerial spraying of toxic herbicides in national forests continued. The Forest Service operated under the assumption that a chemical registered for use with the federal government did not have any significant adverse effects on the environment. But it had not conducted any risk analysis on the health effects of these and related chemicals, and therefore had not considered the need for alternatives, including manual or mechanical brush removal or hand spraying.[32]

Debate over the continued use of 2,4,5-T and Silvex (2,4,5-TP), another dioxin-containing herbicide, quickly became a national issue. A teacher in Alsea, Oregon, for example, did preliminary research that seemed to link the Forest Service's aerial spraying of 2,4,5-T and 2,4,5-TP on the nearby Siuslaw National Forest with local women's miscarriages. A pair of EPA-sponsored studies appeared to confirm that significantly higher percentages of miscarriages had occurred following the spraying of these toxins.[33] On April 27, 1978, at a public forum on the use of herbicides on public lands, Assistant Agriculture Secretary M. Rupert Cutler announced that until the EPA finished its latest study, he would oversee all Forest Service decisions to use these sprays. That same day, Forest Service chief John McGuire issued a directive authorizing herbicide use only after all other alternatives had been considered. His failure to ban the chemicals sparked what one historian has called the "herbicide wars."[34]

Although Assistant Secretary Cutler cast doubt on the causal connection between the use of defoliants in the Vietnam War and their domestic application—"because of the more concentrated and volatile ingredients used in 'Agent Orange,' the Vietnam experience is not comparable to the current use of herbicides in the United States"—he knew the connection was on people's minds. As he noted at a joint EPA/Forest Service symposium: "Part of today's concerns about the use of herbicides on the environment and human health grew out of a 1969 charge that an increase in human birth defects in Vietnam was caused by 'Agent Orange,'" which was ramified when complaints "at home from people who lived near treated forest areas began to receive wide attention in the news."[35]

COURTESY OF U.S. FOREST SERVICE/FOREST HISTORY SOCIETY

This B-18, one of many military surplus airplanes that federal agencies such as the U.S. Forest Service deployed in their aerial spraying campaigns after World War II, is laying down herbicides to control a spruce budworm outbreak on the Boise National Forest (Idaho), July 22, 1955.

This issue would have received a lot more attention had Americans known the extent to which the Forest Service was involved in the war in Southeast Asia. What is known is that the agency, as historians Ronald B. Hartzer and David A. Clary observe, "conducted important programs in support of both civilian and military interests in forest management, fire control and employment, and defoliation."[36] Its personnel were also involved in tactical, strategic, and logistical decisions that they carried out on their own or in coordination with the Central Intelligence Agency, the Department of Defense, and the U.S. Agency for International Development; even years later, then chief Ed Cliff refused to speak on the record about these aspects of the Forest Service in Vietnam, because he believed the missions were still classified.[37]

One such cooperative venture involved testing whether the armed forces could integrate the use of herbicides and forest fires to degrade the environment and thus erode the enemy's capabilities. From 1965 to 1967, Forest Service scientists from the Montana and California fire research laboratories were in Vietnam advising on various projects, including Operation Ranch Hand. This operation, which began in 1962 and ended in 1971, involved the aerial spraying of Agent Orange and other defoliants to open up the hardwood jungle canopy to expose enemy movements. Poor initial test results were no deterrent. The Military Assistance Command, Vietnam ordered additional spraying using formulas with increased levels of dioxin. The military command then expanded its list of targets to include food crops, both to starve the enemy and to drive the South Vietnamese off the land and into internment camps.[38] The deleterious impact led Ranch Hand team members in Vietnam to modify Smokey Bear's motto on a Forest Service poster to read: "Only you can prevent a forest." That the Forest Service became involved in efforts to destroy forests is one of several ironies, not the least of which was that the Forest Service had for several years advised and assisted the South Vietnamese in the development of their lumber industry.[39]

Forest Service fire researchers also worked on Operations Sherwood Forest and Pink Rose, which involved chemically defoliating the jungle to create dry fuel and then dropping incendiary weapons, such as magnesium firebombs, to ignite an inferno. Sherwood Forest launched in January 1965 with the intensive bombing of Boi Loi Woods, a dense forest twenty-six miles northwest of Saigon that the U.S. military believed served as an enemy stronghold. Over a two-day period, military aircraft dropped eight hundred tons of bombs before a squadron of C-123s began dispensing 78,800 gallons of herbicide over the next twenty-nine days. Forty days later, after the canopy had fallen and the vegetation had dried, bombers dropped diesel fuel and incendiaries. The rising heat from the fires, however, triggered a rainstorm that

doused the flames. The quick return of the Viet Cong—the South Vietnamese communists fighting the South Vietnamese government forces and U.S. forces—to the area soon thereafter indicated that chemical agents alone would not deny them permanent use of the Boi Loi Woods.[40] The official U.S. Air Force historian of Operation Ranch Hand, of which the Sherwood Forest was a part, noted that the ecological conditions made it "almost impossible to set a self-sustaining forest fire in the jungles of South Vietnam."[41]

That failure did not stop the Defense Advanced Research Projects Agency from contracting with the Forest Service again to explore additional ways that forest fires could become part of the military's arsenal. Enter Operation Pink Rose, which began in May 1966 and ended a year later. Its planners decided to defoliate the targeted areas in War Zones C, D, and the so-called Iron Zone—Viet Cong strongholds in and around Saigon—and do so three times over the course of a year before attempting to ignite the desiccated vegetation with incendiary bombs.[42] The military had high hopes for Pink Rose and even sent up a planeload of journalists to watch the burn experiments. Results, however, were similar to Sherwood Forest—the heat created rain clouds that extinguished the fires. The military discontinued the firestorm experiments, which one government official later admitted was a "nutty" idea to begin with.[43] Yet defoliation operations to expose communication and travel routes the Viet Cong employed continued in South Vietnam and then expanded into Laos in December 1965 before spreading into North Vietnam in the summer of 1966.[44]

Even as it defoliated and burned forests, the U.S. Forest Service participated in projects designed to regenerate Vietnam's forested domain. In January 1967, as fighting in Vietnam escalated, the Forest Service dispatched a seven-person team of foresters to help the U.S. Agency for International Development conduct forestry operations in South Vietnam. The loan of the foresters came after Chief Ed Cliff and other forestry experts visited Vietnam in 1966 at the request of the secretary of Agriculture to study the lumber supply situation. After examining the situation, Cliff agreed to supply Forest Service personnel to help increase local production of lumber and plywood, and tapped Jay H. Cravens, a forester with nearly twenty years of experience, to lead the Forest Service team.[45] Planners hoped that locals would become economically self-sufficient and not side with the Viet Cong—yet another attempt to win the hearts and minds of this embattled people. Whatever the results of that effort, when Cravens arrived in Vietnam in late February 1967, Operation Pink Rose was in full swing, and immediately he was called on to provide technical expertise to the military's deployment of toxic chemicals. Their use was so pervasive throughout the country that Cravens, who visited all forty-four provinces of South Vietnam, later recalled that the country reeked of herbicide.[46]

Not everyone in the Forest Service supported the strategy of using chemicals to incinerate the jungle. William "Bud" Moore, who had grown up in and spent most of his career in western Montana, was serving as national deputy director of fire control at the time of the Sherwood Forest and Pink Rose operations. He was in the process of reevaluating the Forest Service's overall approach to land management, a reevaluation that found its source in his witnessing the deadly downstream consequences of a 1956 Forest Service DDT spraying operation in the Bitterroot Mountains. A decade later, he was privately questioning the agency's use of herbicides and clearcutting to meet required harvest levels; he also privately questioned the negative impacts of its fire-suppression policies.[47] In the midst of this reflective process, Moore was offered the opportunity to go to Vietnam to contribute to the agency's fire research experiments in Southeast Asia. He declined. A combat veteran in the Pacific Theater during World War II, he had seen what military firepower could do to a tropical landscape. "I didn't have any heart for blowing up the forest, you

COURTESY OF RANCH HAND ASSOCIATION VIETNAM COLLECTION, THE VIETNAM CENTER AND ARCHIVE, TEXAS TECH UNIVERSITY

The challenges and controversies surrounding Operation Ranch Hand defoliation missions in Vietnam impelled team members to alter Smokey Bear's motto on a Forest Service poster.

know, [or] the people over there," Moore told an interviewer. "I just didn't have it. So I told them, no, I'm not going to put my name in … I can fight a war if I'm cornered but I don't want to ruin a country or a lot of their important places."[48]

Environmental activists, labor organizers, community officials, and scientists did not want the Forest Service to ruin the Pacific Northwest, either. Many of them felt that that would be the end result of the agency's repeated use of herbicides and pesticides in its land management operations in the region during the 1970s and 1980s, anxiety that was compounded by the fact that the Bureau of Land Management and state forestry departments were following suit. That these agencies were spraying many of the same chemical agents that had been used in Vietnam—such as 2,4,5-T, 2,4-D, and 2,4,5-TP—in Washington, Oregon, and Northern California lent credence to the fears that the Forest Service was bringing the war home.

Certainly, the Pacific Northwest seemed like a battleground, given that environmental groups such as the Sierra Club, workers organizations like the collaborative known as the Hoedads (a progressive reforestation-workers cooperative), and at-risk mothers, among others, protested nearly every announcement of an upcoming aerial-spraying project. With reason. A number of serious, if accidental, incidents of wind drift of aerial-sprayed herbicides destroyed agricultural crops, settled over human habitations, and damaged riparian habitats. One of the most egregious was an early 1970s herbicide spill in the Alsea River watershed in the Siuslaw National Forest in Oregon; it may have resulted from Forest Service contractors brush-spraying 2,4,5-T upstream of the Alsea State Fish Hatchery. Whatever the cause, hatchery officials there suddenly noticed a dramatic fish die-off. Water sampling indicated that the "percentage of 2,4,5-T in the hatchery was the equivalent of about a 55-gallon drum of the stuff being dumped directly in the hatchery."[49] This incident, combined with wind-drift killing of resident-owned gardens as well as flocks of domesticated ducks, geese, and chickens, led Carol Van Strum, who lived within the Alsea watershed, to form Citizens Against Toxic Sprays, a grassroots organization devoted to banning the use of herbicides on public lands. It joined with the Northwest Coalition for Alternatives to Pesticides, the Oregon Environmental Council, and the Hoedads to sue to halt federal and state land management agencies' use of dioxin-laced herbicides and pesticides.

To build these legal cases, the Hoedads in particular developed alternative scientific evidence—what is now called citizen science—to challenge the (usually) uncritical acceptance of chemical applications that the Forest Service, the Bureau of Land Management, and state forestry officials favored. The Hoedads established the Herbicide Study Committee, which boned up on herbicide research, assessed the economic value of the use of chemicals, and conducted field analyses of the efficacy of aerial spraying versus manual clearing of brush. The results led the committee to "question the whole array of confident statistics which are the very underpinnings of justification for aerial herbicide use."[50] The pressure grew to such an extent that Wendell Jones, former timber manager of Forest Service's Region 6, pushed back against the regional office's decision to start an herbicide program on the Mount Hood National Forest, writing later: "My position is that herbicides were very necessary in the management of the Siuslaw, and to a lesser extent the Siskiyou and Umpqua" National Forests. But he was convinced that an herbicide program on the Mount Hood National Forest "would be met with rigorous opposition by the Portland area enviros, and we didn't need to do that and jeopardize the use of herbicides on these other forests. I was able to get the [regional office] folks to back off using that argument."[51]

However politically savvy his plea, Jones admitted, too, that by not deploying herbicides on the Mount Hood National Forest, the agency learned an important lesson in local ecology. "In later years the Ceanothus brush, that we were being pushed to treat to release young DF [Douglas-fir] trees, turned out to be protective cover for the increased elk herds who were turning to DF as a source of food in the winter."[52] Had land managers been willing to incorporate a wider managerial focus that included not just the production of timber but also the maintenance of biodiversity and other nonextractive resources—as their many critics had pressed for in the court of public opinion and the court of law—they might have avoided a number of bitter battles that ended in defeat. In 1983, responding to scientific research and public pressure, the EPA issued its final decision to stop the use of herbicides containing dioxin. In the Forest Service's Region 5 (California) and Region 6 (Oregon and Washington), where debate over pesticides had raged the loudest, the agency and the Bureau of Land Management continued to use other herbicides until March 1984. Then, at that time, an Oregon judicial ruling stated that a government body that used herbicides must fully consider potential human health problems associated with its operations, and that all potential risks associated with their use must be incorporated in the planning process under the National Environmental Policy Act.[53] The two federal land management agencies immediately suspended the use of herbicides on federal lands in Oregon; shortly thereafter, regional forester Zane Grey Smith Jr. also issued a moratorium in California on herbicides. Within five years, those who once had been eager to spray had reached a different conclusion about their once default position. "I don't foresee ever having to use chemical herbicides on this forest again," Siuslaw reforestation expert Tom Turpin observed in 1989. "We have proved that we can manage without chemicals, and we've seen that what we are doing now works better and is less expensive," a realization that Region 6 spokesman Michael Ferris seconded: "We don't want to go back to doing business as usual … We were wrong to use chemicals the way we did."[54]

The fights over herbicide use in the 1970s and 1980s forced the Forest Service and others to reconsider their approach to plant and pest control. Where once cost-effectiveness and resource extraction were the main criteria the Forest Service employed for whether to use such chemicals, internal disagreements and external pressure had forced it to weigh and evaluate herbicide-free strategies up front. Manual and mechanical cutting, along with controlled burns, are among the tools that land managers began to adopt as part of an integrated pest-management approach. Currently, where pesticides—whether sprayed from the ground or air—appear to be the best option, their use is tightly regulated and monitored, and must cover a much smaller area, a sharp contrast to the one-time, indiscriminate application of these toxins over tens of thousands of acres.[55]

This shift in the Forest Service's approach became the anvil on which the Skykomish Valley Environmental and Economic Alliance (SVENA) hammered state and private timberland managers in the state of Washington. In late December 2015, and in language reminiscent of that which Forest Service critics employed four decades earlier, SVENA, which represents an array of grassroots

organizations, residents, and businesses in the Sultan-Startup area forty miles east of Seattle, decried a troubling incident of aerial spraying on private forestlands. "There was no advance warning to the residents of this area for this huge spraying operation in our watershed," SVENA alleged. "Local citizens were horrified and upset when they observed for hours a helicopter with toxic clouds around it. This neighborhood has numerous homes, families, children, businesses, farms and organic farms, gardens and orchards. The residents are very concerned about their well water. There are many private wells in this area and most of them are shallow."[56] Because, as the organization observed, no "company or government agency performed follow-up testing or monitoring for possible drift or contamination of non-targeted properties and resources, such as air, surface water and well water," there could be no accountability for any damage to life or property.[57] This need not have happened. After all, SVENA observed, the "United States Forest Service has managed to conduct successful commercial forestry in the Mount Baker–Snoqualmie National Forest for a great many years without using chemical pesticides (herbicides or insecticides). We strongly suggest that private and state timberlands in WA could be managed in the same way, without the aerial application of chemical pesticides."[58] What SVENA demanded was that the state's Forest Practices Board align its practices with federal land managers to "protect Washington's citizens from pesticides applied to forestlands, and monitor the effects of these chemicals on the ground."[59]

Fittingly, SVENA's analysis suggests just how far the Forest Service had come since 1965, when it unleashed chemical warfare on the Douglas-fir tussock moth. Yet SVENA's concerns and those of its peers in the West also indicate that the struggle "to be free from chemical trespass" persists.[60] □

James G. Lewis is the editor of Lands Worth Saving: The Weeks Act of 1911, the National Forests, and the Enduring Value of Public Investment *(Forest History Society, 2018). One of Char Miller's most recent books is* Where There's Smoke: The Environmental Science, Public Policy, and Politics of Marijuana *(University Press of Kansas, 2018. He is the W. M. Keck Professor of Environmental Analysis at Pomona College and a frequent contributor to* Forest History Today. *Both have served as associate editors of the* Journal of Forestry. *"Vast, Incredible Damage: Herbicides and the U.S. Forest Service" by James G. Lewis and Char Miller is reprinted from* Inevitably Toxic: Historical Perspectives on Contamination, Exposure, and Expertise, *edited by Brinda Sarathy, Vivien Hamilton, and Janet Farrell Brodie, with permission of the University of Pittsburgh Press, © 2018.*

NOTES

1. Gerald W. Williams, *The U.S. Forest Service in the Pacific Northwest: A History* (Corvallis: Oregon State University Press, 2009), 234.
2. Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 1962), 69.
3. Williams, *U.S. Forest Service in the Pacific Northwest*, 234.
4. Harold K. Steen, *The Chiefs Remember: The Forest Service, 1952–2001* (Durham, NC: Forest History Society, 2004), 35–36.
5. Paul W. Hirt, *A Conspiracy of Optimism: Management of National Forests since World War Two* (Lincoln: University of Nebraska Press, 1996), 82–131; James G. Lewis, *The Forest Service and the Greatest Good: A Centennial History* (Durham, NC: Forest History Society, 2005), 136–62; Harold K. Steen, *The Forest Service: A History*. 2nd ed. (Durham, NC: Forest History Society, 1976, 2005), 246–77.
6. Michael P. Dombeck, Christopher A. Wood, and Jack E. Williams, *From Conquest to Conservation: Our Public Lands Legacy* (Washington, DC: Island Press, 2003), 29–30.
7. U.S. Forest Service, *Timber Resources for America's Future*. Forest Resource Report No. 14 (Washington, DC: U.S. Forest Service, 1958), 26–88.
8. "FY 1905–2015 National Summary Cut and Sold Data and Graphs, USDA Forest Service," http://www.fs.fed.us/forestmanagement/documents/sold-harvest/documents/1905-2015_Natl_Summary_Graph.pdf, 1. Lumber volume is measured in board feet, which is a board twelve inches wide, twelve inches long, and one inch thick. MBF is 1,000 board feet. The M is the Roman numeral for one thousand.
9. Hirt, *A Conspiracy of Optimism*, xxxii.
10. Herbert Kaufman, *The Forest Ranger: A Study in Administrative Behavior* (Baltimore, MD: Johns Hopkins Press for Resources for the Future, 1960), 153, 96, 161; for an analysis of how groupthinking shaped other federal policymaking, see Lynn Eden, *Whole World on Fire: Organizations, Knowledge, and Nuclear Weapons Devastation* (Ithaca, NY: Cornell University Press, 2006), and Jacob Darwin Hamblin, *Arming Mother Nature: The Birth of Catastrophic Environmentalism* (New York: Oxford University Press, 2013).
11. Kaufman, *Forest Ranger*, x.
12. R. W. Behan, "The Myth of the Omnipotent Forester," *Journal of Forestry* 64, no. 6 (June 1966): 398.
13. Carson, *Silent Spring*, 67–68.
14. Carson, *Silent Spring*, 67–68.
15. William O. Douglas, *My Wilderness: East to Katahdin* (Garden City, NY: Doubleday, 1961), 53. He recounts his visit to the area and the impact of the spraying program under the Forest Service's "multiple use" policy in chapter 2, "Wind River Mountains." Carson misquotes him as saying the "vast, incredible damage." Carson, *Silent Spring*, 68.
16. Carson, *Silent Spring*, 67–68.
17. Stephen Fox, *The American Conservation Movement: John Muir and His Legacy* (Madison: University of Wisconsin Press, 1986), 297.
18. Linda J. Lear, "Rachel Carson's *Silent Spring*," *Environmental History Review* 17 (Summer 1993): 23–48.
19. Lewis, *Forest Service and the Greatest Good*, 148.
20. "Forest Service in a Changing Conservation Climate: I and E Approaches to Organizational and Public Needs, 1966" (Washington, DC: U.S. Forest Service, [1966?], 1.
21. "Forest Service in a Changing Conservation Climate," 27.
22. David A. Clary, *Timber and the Forest Service* (Lawrence: University of Kansas Press, 1986), 185.
23. Charles Connaughton, "Forestry's Toughest Problem," *Journal of Forestry* 64, no. 7 (July 1966): 446.
24. Neal M. Rahm, "Education and the Environment," *Journal of Forestry* 68, no. 5 (May 1970): 257.
25. Thomas R. Dunlap, *DDT: Scientists, Citizens, and Public Policy* (Princeton, NJ: Princeton University Press, 1981), 97.
26. Samuel P. Hays, *Beauty, Health, and Permanence: Environmental Politics in the United States, 1955–1985* (New York: Cambridge University Press, 1989), 1–40.
27. Hirt, *Conspiracy of Optimism*, 219.
28. Donna M. Paananen, Richard F. Fowler, and Louis F. Wilson, "The Aerial War against Eastern Region Forest Insects, 1921–86," *Journal of Forest History* 85, no. 10 (October 1987): 185.
29. Edwin L. Johnson, "Keynote Address," in *Symposium on the Use of Herbicides in Forestry [Proceedings]* (Washington, DC: Department of Agriculture, Office of the Secretary, 1978), 13–17, passim. The symposium was held by the Forest Service and the EPA in response to the criticism and lawsuits over the Forest Service's use of herbicides, particularly those containing 2,4,5-T and 2,4,5-TP. By the late 1980s, some field scientists in the Forest Service, known as "ologists," were disenchanted enough with the Forest Service's timber program that they formed the Association of Forest Service Employees for Environmental Ethics (later shortened to FSEEE). As an internal counter to agency groupthink and whistleblowers, FSEEE challenged agency leadership's continued emphasis on timber production at the expense of other ecological values and launched lawsuits to stop timber sales and other management decisions that it believed violated federal laws, threatened biodiversity, or despoiled wilderness. Hirt, *Conspiracy of Optimism*, 283–85; and Lewis, *Forest Service and the Greatest Good*, 204–5.
30. Lewis, *Forest Service and the Greatest Good*, 188.

31. Dunlap, *DDT*, 177–231.
32. John Fedkiw, *Managing Multiple Uses on National Forests* (Washington, DC: U.S. Forest Service, 1998), 165.
33. William Robbins, *Landscapes of Conflict: The Oregon Story, 1940–2000* (Seattle: University of Washington Press, 2010), 199–200.
34. Robbins, *Landscapes of Conflict*, 199–200.
35. M. Rupert Cutler, "Keynote Address," in *Symposium on the Use of Herbicides in Forestry [Proceedings]* (Washington, DC: Department of Agriculture, Office of the Secretary, 1978), 11. The symposium was so unusual that a representative from both the EPA and the Department of Agriculture each gave a keynote address.
36. Ronald B. Hartzer, and David A. Clary, *Half a Century in Forest Conservation: A Biography and Oral History of Edward P. Cliff* (Washington, DC: U.S. Forest Service, 1981), 29.
37. Hartzer and Clary, *Half a Century in Forest Conservation*, 29. For more on the Forest Service and international forestry, see Terry West, "USDA Forest Service Involvement in Post–World War II International Forestry," in *Changing Tropical Forests: Historical Perspectives on Today's Challenges in Central and South America*, ed. by Harold K. Steen and Richard P. Tucker (Durham, NC: Forest History Society, 1992), 277–91.
38. Paul Frederick Cecil, *Herbicidal Warfare: The Ranch Hand Project in Vietnam* (New York: Praeger, 1986), 29–35. The chemicals Agent Orange and Agent White received their names from the markings on their barrels. They had been developed to retard the growth of broad-leaved weeds and for the defoliation of crops such as cotton so that mechanical pickers could work more efficiently, but the concentration levels used in Southeast Asia ensured maximum and prolonged effect on a broad range of jungle vegetation. Agent Blue was more effective on food crops but only in dry weather because it was water-soluble. Other agents included Green, Pink, and Purple, which were used between 1962 and 1964 before being replaced by Orange, Blue, and White. For more on this, see Cecil, *Herbicidal Warfare*, 225–32, and William A. Buckingham Jr., *Operation Ranch Hand: The Air Force and Herbicides in Southeast Asia, 1961–1971* (Washington, DC: Office of Air Force History, U.S. Air Force, 1982), 195–202.
39. Lewis, *Forest Service and the Greatest Good*, 193–94; and Edwin A. Martini, *Agent Orange: History, Science, and the Politics of Uncertainty* (Boston: University of Massachusetts Press, 2012), 47. Two assistance programs had been proposed in 1954. One was a loan program for purchasing equipment and the other was a reforestation and soil erosion control to stabilize sand dunes on the coast. Rufus H. Page, *Forest Industries of the Republic of Vietnam* (Washington, DC: U.S. Forest Service, 1967), 42.
40. Cecil, *Herbicidal Warfare*, 57–58; Buckingham, *Operation Ranch Hand*, 109–12.
41. Buckingham, *Operation Ranch Hand*, 112; Martini, *Agent Orange*, 46.
42. Cecil, *Herbicidal Warfare*, 77–78.
43. "U.S. Admits Move to Burn Forests," *New York Times*, July 22, 1972, 5.
44. Jay H. Cravens, *A Well Worn Path* (Huntington, WV: University Editions, 1994), 324; Buckingham, *Operation Ranch Hand*, 127; Robert Reinhold, "A Modest Proposal—'Sherwood Forest,'" *New York Times*, July 23, 1972, E2.
45. Hartzer, *Half a Century in Forest Conservation*, 263.
46. Barry R. Flamm and Jay H. Cravens, "Effects of War Damage on the Forest Resources of South Vietnam," *Journal of Forestry* 69, no. 11 (November 1971): 789; Jay H. Cravens, interview with James G. Lewis, June 23, 2005, Forest History Society.
47. At the time he was asked to go to Vietnam, Moore was thinking about land management in holistic terms and called for "ecologically enlightened change" in the Forest Service's wildfire policy. In 1972 he led a Forest Service team that conducted a pilot study on wildfires in federally designated wilderness areas. See Diane Smith, "From Research to Policy: The White Cap Wilderness Fires Study," *Forest History Today* (Spring/Fall 2014), 6. The National Park Service changed its wildfire policy in 1968.
48. James G. Lewis, "Thinking Like a File Cabinet: Eco-cruising in the Bitterroots with Bud Moore," in *The Land Speaks: New Voices at the Intersection of Oral and Environmental History*, ed. by Debbie Lee and Kathryn Newfont (New York: Oxford University Press, 2017), 244. See also Moore's memoir, *The Lochsa Story: Land Ethics in the Bitterroot Mountains* (Missoula, MT: Mountain Press Publishing, 1996), 341–52.
49. Williams, *U.S. Forest Service in the Pacific Northwest*, 277–80.
50. Erik Loomis, *Empire of Timber: Labor Unions and the Pacific Northwest Forests* (New York: Cambridge University Press, 2016), 177–78.
51. Loomis, *Empire of Timber*, 170–80; Jones quoted in Williams, *U.S. Forest Service in the Pacific Northwest*, 280.
52. Jones quoted in Williams, *U.S. Forest Service in the Pacific Northwest*, 280.
53. Gary L. Larsen, "Herbicides, the Forest Service, and NEPA," *EPA Journal* 14, no. 1 (January 1988): 38.
54. Mark A. Stein, "U.S. to End Ban on Spraying Herbicides in State's Forests," *Los Angeles Times*, February 28, 1989, 3, 21.
55. Fedkiw, *Managing Multiple Uses on National Forests*, 167. For an update and overview on early twenty-first-century use of herbicides on public lands, see Viktoria Wagner, Pedro M. Antunes, Michael Irvine, and Cara R. Nelson, "Herbicide Usage for Invasive Non-native Plant Management in Wildland Areas of North America," *Journal of Applied Ecology*, June 29, 2016, https://doi.org/10.1111/1365-2664.12711.
56. "Letter of Protest for Toxic Spray." *SVENA*, December 29, 2015, https://svena.org/ letter-of-protest-for-toxic-spray/.
57. "Letter of Protest for Toxic Spray."
58. "Letter of Protest for Toxic Spray."
59. "Letter of Protest for Toxic Spray."
60. "Letter of Protest for Toxic Spray." Similar protests erupted in Oregon in 2014: Rebecca Clarren, "Timberland Herbicide Spraying Sickensa Community," *High Country News*, November 10, 2014, https://www.hcn.org/issues/46.19/timberland-herbicide-spraying-sickens-a-community.