

Destruction of the Ecosystem

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This article examines the First World War's ecological impact and shows that protracted environmental transformations resulted more from expanded industrial modes of production than heavy combat. These developments accelerated 19th-century trends. Although battles marred the earth and pictures of devastated landscapes continue to reinforce standard narratives of environmental destruction, the frontlines recovered relatively quickly. Comparing the ecological damage along the Western Front with timber harvesting around the world, tin mining in Malaysia, oil production in Mexico, and wheat farming in the United States and Canada reveals the Great War's environmental legacy.

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Introduction

While many contemporaries mourned the fate of blasted lands along the front lines, the natural world often remains a voiceless casualty of war in current scholarship. With ravaged farmlands, charred trees, and muddy quagmires as iconic images of the conflict, we have tended to take for granted the place and role of nature. History books typically regard the environment as the backdrop for battle or as collateral damage, if they consider the natural world at all. Such is the paradox of the environment in times of war: nature is both omnipresent and invisible. Yet only by taking the environment into account can we fully understand the trauma of the Great War and how this conflict shaped the most basic levels of human existence for years afterwards.

Nature bore the brunt of industrialized [warfare](#). Familiar pictures of the [Western Front](#) tell the story. Scenes of utter devastation, ruined landscapes pitted and cracked with craters and trenches, quickly became a metaphor for the Great War's waste. Yet we must be careful with how we interpret contemporary descriptions of desolation. The war's impact on the land horrified university-educated soldiers groomed in the romantic appreciation for nature. But how appalling was this environment for those who had labored in mines, emptied brimming cesspools, bathed in polluted rivers, or slept in slums? Was the war's onslaught against nature so different from what industrialization had wrought in the years leading up to 1914? How then should we measure the war's ecological impact and define its "destruction" of the ecosystem? Examining environmental change across the globe shows that while battlegrounds endured the storms of steel, the resulting distortions of nature there were short-lived. Flora quickly recovered and fauna soon returned. Paradoxically, longer-term environmental transformations occurred behind the lines, away from the killing fields. Comparing the fate of the fighting fronts to timber harvesting around the world, tin mining in Malaysia, oil extraction in Mexico, and wheat farming in the [United States](#) and [Canada](#) reveals a far more complicated picture of the war's environmental legacy than what photographs of [No Man's Land](#) suggest.

Battlefields

Armies altered ecosystems on every fighting front. Warfare accelerated environmental change that had begun in the previous century. Soldiers in the east dined on European bison, nearly exterminating a keystone species in the great boreal forest of Białowieża. Royal hunting parties from [Russia](#) had culled the herds during the late 19th century and by 1914 the number of bison had shrunk to around 400 head. By 1918, starving troops had butchered what animals remained. The most pressing problem for men battling in [Mesopotamia](#) was not food, but water. Given the arid environment, this seems obvious. What might surprise us, however, was that soldiers complained not about a lack of water but an overabundance. Marshland and shallow ponds dotted the alluvial plains. During the spring, snowmelt in the Caucasus Mountains and the highlands of Asia Minor swelled the rivers and lakes below, which burst their banks and turned lower Mesopotamia into a morass. To prevent wholesale inundation, local civilians customarily piled heaps of loose dirt along the banks, but furious waters easily breached these earthworks. Combatants further altered the land with better-built trenches and protective dams, changing water flows and redirecting the course of rivers. Meanwhile, the mobilization of armies in the Alps intensified industrialization on the heights with the vast expansion of roads, railways, and trails. Construction took place on an unprecedented scale. To turn the peaks into functioning fortresses, engineers drilled and dug into the rock face to build army bases, set up electric stations, and establish high-altitude observation posts.^[1]

Hostilities disrupted ecologies on battlefields everywhere, but nowhere was the concentration of forces so great as on the Western Front. Trenches ran from the North Sea to the Swiss frontier and the ensuing stalemate ensured ecological upheaval. Millions of soldiers and billions of shells transformed fields and forests within the relatively narrow war zone into a wasteland. Military strategy dictated devastation. Belgian troops flooded portions of the lowlands in the hopes of stalling the German advance during the Battle of Yser in 1914. As part of [Operation Alberich](#), the German retreat to the Hindenburg Line (*Siegfried Stellung*) in 1917, orders called for scorched earth tactics so that “the enemy should find a desert” in the army’s wake.^[2] But large projectiles did the most damage. In the heat of battle, [artillery](#) units fired several hundred rounds an hour. Although their range rarely extended beyond twenty kilometers, the guns obliterated nearly everything within reach. [Chemical weapons](#) added to ecological turmoil. Chlorine, phosgene, and mustard gases asphyxiated animals and humans alike. The deformed landscape trapped the deadly vapors in shell holes and the seams of trenches. Burnt earth, rotting corpses, and craters like cauldrons with a horrid brew of mud, gore, and the green-yellow mists of stale gas struck the troops as the very image of hell.^[3]

Literate, educated soldiers on both sides depicted the war-torn landscape through a common set of tropes. The French writer [Henri Barbusse \(1873-1935\)](#) and the German novelist [Ernst Jünger \(1895-1998\)](#) fought on the Western Front and witnessed the destruction first-hand. In his dispatches, Barbusse identified battlegrounds as “fields of sterility” where “frightful loads of dead and wounded men alter the shape of the plains” and “everything appears turned over...full of rotteness and smelling of disaster.” “Where there are no dead,” he observed, “the earth itself is corpse-like.”^[4] Jünger repeatedly used the adjectives “dark,” “ravaged,” “dreary,” “savage,” “eerie,” “barren,” “devastated,” and “hideously scarred,” to describe his surroundings.^[5] Other soldiers believed that the landscape had “lost its nature” and had turned into something artificial.^[6]

These were not new sentiments. When Barbusse remarked that the sights and smells of the Western Front reminded him of a factory, he tapped into 19th-century critiques of industrial development.^[7] Observers of industrialization’s ills had spoken the same language. In his exposé of proletarian life, [Friedrich Engels \(1820-1895\)](#) portrayed working-class neighborhoods in terms that soldiers later applied to the trenches. Writing in the early 1840s, Engels saw squalor and ruin all around. “Filth and horrors” filled the rookeries in London and Manchester. “Disgusting blackish-green slime pools” flooded the alleys and deep mud covered the walkways. “Everything which here arouses horror and indignation is of recent origin,” he concluded, “belongs to the industrial epoch.”^[8] Jünger echoed this point sixty years later when he labeled the war’s “wanton destruction” as “something that is unhealthily bound up with the economic thinking of our age.”^[9] Concerned citizens expressed dismay over the new industrial landscape. Green parks were “rendered hideous by the blackness of everything within them – trees stunted, dying – flowers struggling to bloom, and sometimes their species barely recognizable,” complained one Manchester resident in 1888. London’s smoke turned the city’s trees into “scorched, blackened, and encrusted with soot” skeletons.^[10] Years later, soldiers and civilians described the devastated forests on the Western Front in precisely those terms.^[11] By borrowing the idioms of previous generations, the war’s chroniclers placed the conflict in line with industrial capitalism’s environmental costs. Degradation on Western Front represented those developments in their most violent, concentrated form.

Industrialization in the 1800s shaped views of nature that later informed perceptions of environmental destruction during the war. When belching factories made western European countries into economic behemoths, but turned cities dark with soot and grime, social commentators invoked nature as the antithesis of dismal urban spaces. A particular image of an Arcadian landscape circulated among certain classes – a genuine, fecund place as opposed to the bleak metropolis. [Propaganda](#) machines later crafted enlistment campaigns around this romantic view of nature.^[12] Soldiers transferred that idealization of nature to the Western Front. The historian [George Mosse \(1918-1999\)](#) wrote that the war led to a “heightened awareness of nature.”^[13] But most soldiers coming down from [university](#) already had this appreciation. A more accurate generalization was that the war heightened the awareness of human impacts on the natural world, particularly among those who labored little in it.

In gauging the war as an ecological disaster, upper-class soldiers used the pastoral as their baseline for measuring the conflict's environmental impact.^[14] From this standpoint, educated and literate combatants initially confronted the war with its palette of grays and browns, rather than the Arcadian hues of greens and blues. Only later did these soldiers begin using mechanical tropes and images from mines and factories to convey their experiences.^[15] Yet pastoral shades still colored how they evaluated the magnitude of environmental destruction. Even so, if they idealized nature as “pristine” then they were mistaken. Forests and fields on the Western Front had been managed and cultivated for generations. The idea of untouched wilderness was a myth in the minds of romantically inclined soldiers.^[16] Indeed, part of what made the Arcadian landscape so appealing was its human element.

Enlisted farmers and field hands held a different view of the natural world. Their rural obligations left little room for romantic musings. The pleasantries that university-educated soldiers attached to the natural world equated to toil and hardship for those who worked the land. Although [rural](#) soldiers bemoaned environmental devastation, they saw ravaged fields not as a loss of innocence but of livelihood. Ruined agriculture offered a fearful glimpse into what might befall farmlands back home.^[17] Whatever meaning soldiers associated with environmental destruction, the common trope of a desolate pastoral left later generations with impressions of utter annihilation. Even recently the photojournalist and battlefield guide Michael St Maur Sheil observed that the trenches “were places where every living thing was killed.”^[18]

Only they were not. Views from the trenches offered vistas not only of ruin but also of nature's resilience. Writing in 1916, a British company commander saw beauty all around him:

Though the actual lines are stricken and blasted by eighteen months' human madness, yet everywhere else it is lovely, the woods, the fields of richest wheat, sprinkled with cornflower and poppy, scabious and charlock, vetch and clover...the glimpses of the river through the deep woodland green, Oh! Exquisite.^[19]

Barbusse rejoiced in the “soft green grass...flowers awakening” that heralded spring. Across No Man's Land, Jünger noted how weeds and wildflowers wrapped themselves around the [barbed wire](#), recognizing the “different type of a flora taking root in the fallow fields. Wild flowers of a sort that generally make only an occasional appearance in grain fields, dominate the scene.” He awoke each morning to a choir of partridges and larks that thrived in this new shrub habitat. Most impressive to him was how untroubled the little songbirds were by the shelling. “They sat peaceably over the smoke in their battered boughs,” he remembered, “in the short intervals of firing, we could hear them singing happily or ardently to one another, if anything even inspired or encouraged by the dreadful noise on all sides.” Other soldiers gleefully (and hungrily) observed flocks of pheasants hiding in the tangled undergrowth, rabbits hopping from one shell hole to the next, or even shy moles making brief appearances. Some recalled eating ripe berries in the early summer, which tasted all the sweeter for the bullets whizzing through the air.^[20]

The Western Front's environment exemplified contradiction. The landscape appeared simultaneously gruesome, scarred with splintered trees and churned-up meadows meddled with human gore, but also pleasant, covered in bright green grass and full of colorful flowers and thriving wildlife. For soldiers, the experience could be both jarring and comforting. The same was true for being on leave. In little time, troops found themselves transported away from the strains of battle to a leisurely country idyll. Jünger's time off-duty typified the delightful disconnection that many felt. He “strolled blissfully across the fields,” where “nature seemed to be pleasantly intact...its almost excessive blooming was even more radiant and narcotic than usual.” Here, his eyes “once more appreciated the beauty of the earth.” While traveling back to the front he fixated on the “green, fertile, elevated beet fields and juicy pastures” that lined the road before reaching the “hideously scarred soil of Flanders.”^[21] Both landscapes felt the human touch. Indeed, agriculture was a much larger agent of environmental change than war. But carefully cultivated fields

conformed to peaceful pastoral aesthetics, unlike the distorted nature of industrialized battlegrounds.

Perhaps the most shocking incongruity for soldiers was how quickly devastated lands appeared to recover after the war. In 1920, [Corinna Haven Smith \(1876-1965\)](#), an American humanitarian, toured the former front lines and assessed the damage done mostly to towns and factories, as well as farmland. Smith and her husband had volunteered with the Franco-American Committee for the Protection of Children of the Frontier during the war. They lived in Paris, provided aid to families, and often assisted [Red Cross](#) relief efforts; Smith was familiar with privation. At the request of one of her French contacts, she joined a team from the Bureau for the Reconstruction of Industry, visited over 200 factories, and published her findings later that year in *Rising above the Ruins of France*. She frequently noted how farmers had already begun plowing and planting the fields. Her interviews with locals revealed the rapid return to productivity:

In 1918, with a tremendous effort, 80 hectares were sown, mostly in grain, but, unfortunately, this crop was lost when the Germans retook the region during March. By January, 1919, we had only 4 hectares sown. 496 lay idle, but now, one year later, these figures have been almost reversed, only 50 hectares unsown while 450 have been cultivated.^[22]

When driving on the Menin Road to Ypres, a track that the war-artist [Paul Nash \(1889-1946\)](#) had made famous with his surreal paintings of twisted landscapes, Smith remarked with surprise: "Is this the same plain? It does not seem possible. ...Men are working in the fields. ...Grass has grown over the shell holes and sheep and goats are grazing among abandoned tanks. ...Only the trees have kept their record of suffering." The profound transformation led her to conclude that "Nature seeming always to make an effort to cover the scars of battle as soon as possible."^[23]

Some veterans found that nature acted too soon. During the 1920s, several [veteran organizations](#) complained to the [French government](#) that dense shrubbery prevented them from touring their former posts.^[24] Writing in 1930, the British author and former army nurse, [Vera Brittain \(1893-1970\)](#), worried that "nature herself conspires with time to cheat our recollections; grass has grown over the shell holes at Ypres."^[25]

The land's seemingly swift rehabilitation begs the question of just how destructive the war was on the ecosystem. A better approach is to examine the degree to which the Great War transformed the environment. From that perspective, changes along the Western Front were significant, but nature was not permanently damaged. Ecosystems evolve and change on their own. War often makes that change more drastic, sudden, and might direct natural succession in unexpected ways.

Combat on the Western Front altered the makeup of forests and the composition of soil. Immediately following the armistice, foresters took stock of timber reserves and detailed the amount of lumber lost to the war. Some estimates ranged as high as 2.5 billion board feet destroyed or consumed. With funds from German reparations, the French government soon instituted a reforestation program. Prior to 1914, the majority of forests along the Western Front were deciduous, comprising European Beech, European Hornbeam, European Oak, and English Oak. Authorities planted the obliterated sections with Austrian Pine and Scotch Pine seedlings, fast-growing coniferous species that tolerated nutrient-poor soil. Foresters later reintroduced European Beech. Still, what were once diverse forest ecosystems became near monoculture, which made the woods more susceptible to disease and pest. Managers had attempted to increase diversity, but the size and cost of the project stymied efforts.^[26] In some areas, however, the foreign trees took over abandoned farmland, reclaiming territory for woodland creatures. Although a changed environment with a different character, forests returned to the war-torn regions.

Less visible were changes to soil composition. Natural events, such as earthquakes and windstorms, are typical sources of major soil disturbance. The advent of industrial warfare made combat a powerful agent of geomorphic change. The geographer Joseph Hupy has conducted extensive research around Verdun and has shown that the battle turned stable soil ecosystems into loose, unconsolidated sediment. The same pattern of upheaval exists all along the Western Front, where countless artillery craters have altered surface hydrology, water table characteristics, and soil development rates.^[27]

To analyze the effects of warfare on soil, Hupy introduced the term "bombturbation," the mixing of soil by explosive munitions. He defines bombturbation as a category of pedoturbation, a term synonymous with soil mixing that geologists use. Unlike other forms of pedoturbation (for example: expanding clay, ice crystals, plant roots, badger burrows, or ant colonies), bombturbation penetrates far below the surface, sometimes to the bedrock, and causes soil horizons to be upset or mixed. When the bedrock was broken, organic matter accumulated in the cracks, complicating recovery by introducing humification and microbial activity to the seam. Deep breaches might expose shallow water tables, which indirectly impacted vegetation growth and reforestation.

Cratering might also accelerate weathering, leaching, and erosion, particularly at the bottom of the basins. Shells used in the First World War were especially injurious because they detonated upon impact (unlike bombs in World War Two that used proximity timers) and therefore directed most of their blast downward into the ground. Tunneling and the use of mines also jumbled soil horizons. Explosions sent debris flying into the air and buried topsoil underneath layers of gravel ejecta. However, Hupy has found that over the years, industrious earthworms and other agents have assimilated those materials into the soil profile. Even today in sections where ordnance remains embedded in the earth and soils have developed along new pathways, flora and fauna thrive.^[28]

Behind the Lines

The drama and destruction on the Western Front dominate the scholarship on the war, and have also shaped our view of the conflict's ecological impact. Combat did transform the natural world, but only within the limits of its reach. As we have seen, ecosystems, albeit altered, quickly regenerated along the front's relatively narrow swath. Today, only a trained eye might spot the spectral traces of trenches and battlements. But the war made itself felt in other ways and places besides artillery barrages in [France](#) and [Belgium](#). Fighting forces were both social and biological entities, which depended on a "military ecology" of extraction, production, and supply. To keep armies in action, states commandeered natural resources throughout the biosphere, expanding the war's environmental footprint. The massive shift of natural resources to the war effort changed the land, transformed state infrastructure, and reoriented economies. Demand for [raw materials](#) led countries to control natural resources to an unparalleled degree. Government agencies now dictated the supply, price, and distribution of items such as timber, metal ore, fossil fuels, and food. These hybrid institutional frameworks fostered massive collusion between the government and private industry, setting an important precedent for subsequent wars.

The need for timber taxed forest reserves around the world. Armies relied on lumber in countless ways. Timber beams kept trenches from collapsing. Wood planks saved soldiers from wallowing or drowning in mud. Trees provided the basic building material for wharves where soldiers disembarked, warehouses for munitions, barracks, railroad ties, telephone poles, and key airplane parts. Pit timber for coalmines, fuel wood, and pulp for paper supplies also aided the war effort.^[29] As a result, deforestation accelerated around the world, but in an uneven fashion. Ottoman forces leveled cedar forests in Lebanon. Before 1914, Britain imported most of its lumber from Scandinavia, Russia, and Canada. But when Germany's unrestricted [U-boat campaign](#) sank supply convoys, the British faced an acute timber crisis and cut down nearly half of their productive forests, over 450,000 acres.^[30] British authorities also mobilized forest resources across the [Empire](#), especially in [India](#). Indian timber, however, usually served military needs in the [Middle East](#). Attempts to import lumber from colonies in Africa yielded little, due in large part to the British system of indirect rule, but did put in place infrastructure for future extraction. Desperate requests from London, along with major capital investment, expanded logging operations in Western Canada, in spite of German submarines. The opening of the [Panama Canal](#) in 1914 lowered the costs of imports from Vancouver. Soon British Columbia became Canada's leading timber exporter.^[31]

French and German timber stands fared better because of long-standing, institutionalized forestry practices. Nearly 90 percent of France's forests lay outside the war zones. Moreover, with manpower diverted to the army, logging rates in those departments soon fell below pre-war levels. Only with the arrival of American forestry troops, the 10th Engineering and the 20th Engineering Corps, did forests in western France sustain heavy cutting.^[32] Germans intensified timber harvesting, but did so in ways that caused little damage to the country's overall forest cover.^[33] Instead, German forces chopped down trees in occupied territories, exacting 5 million cubic meters of wood from Lithuania, nearly 5 percent of the Białowieża Forest, for use back home. Troops did receive detailed instructions for obtaining lumber. They were to first use trees that had already fallen or were stripped of bark. The men were to cut areas in a "chessboard-like fashion" and avoid making large clear cuts. To avert erosion, directives warned not to remove trees along the banks of streams. Orders expressly forbade soldiers in the Alps from felling trees along the timberline, which was a protected zone. Since lumber should not be substituted for firewood, officers were expected to familiarize themselves with the trees in their sector and know the appropriate uses for each species. Timber experts traveled to the various "impact points" and provided assistance. Despite their efforts, troops on the frontlines leveled forests anyway to prevent ambush and have unobstructed lines of fires.^[34]

Although the United States did not enter the war until 1917, American logging companies responded to rising lumber prices and

massive government subsidies much earlier. Timber firms invested heavily in new technologies and equipment to meet European demand. Mechanized labor hastened vast clear cutting efforts that had begun in the 1880s. Forests were so expansive that logging companies showed little concern for protecting timber stands, investing in reforestation programs, or practicing selective cutting. Woodlands in the southeastern United States suffered the most. Sandy soil along the coast and red clay on the interior experienced heavy erosion. Only German submarines saved the landscape from even greater destruction. The high risks of trans-Atlantic shipping caused the total export sales of U.S. lumber products to plummet by over 60 percent during the war. Yet when the Americans did enter the conflict, outfitting and housing the new American Expeditionary Force alone required an estimated 600 million board feet of lumber. Billions of top-grade board feet also went into ship construction. But few vessels sailed across the Atlantic before the war's end.^[35]

The war had transformed the global logging industry and established models of high-input, industrial timber extraction that defined the 20th century. Overcutting was also done selectively, targeting particular species for specific military needs. Reforestation programs further reduced biodiversity. Forest ecosystems felt the impacts of these developments well beyond 1918.

Tin was just as important for the war as timber. Machines and militaries used the metal so pervasively that most soldiers took it for granted. Because of its properties, tin was used as an anti-friction metal, Babbitt metal (the bearing material typically used on axles and crankshafts), and in white metal alloys. Its most extensive application, however, was in the manufacture of tinfoil. Canning perishable goods for soldiers' meal kits depended on tinfoil, 50 percent of which came from the Federated Malay States and the Dutch East Indies. The Malay Peninsula was the world's single largest tin producer. Between 1880 and 1905, export duties on tin alone comprised nearly half of the Federated States' total revenue. Chinese-owned mines produced the vast bulk of Malay's tin. In 1900, European mines contributed only 10 percent of the total tin output. Then during the first decade of the 20th century, tin operations shifted from the labor-intensive Chinese model of opencast mining to the industrialized European method of mining deep deposits.

As with armed combat and timber extraction, the Great War accelerated the industrialization of tin mining, which held severe repercussions for local ecosystems. European mines were the first to employ power-operated water pumps for hydraulic sluicing in 1892. To achieve strong enough water pressure to break down *karang*, tin-bearing earth, these mines were located on hillsides where streams at higher elevations would be dammed and the water piped to pits below. A second set of pipes suctioned the *karang* and water mixture up to the surface where the tin would be siphoned off and processed. The topographies of Perak, Selangor, and Negeri Sembilan, the leading tin-producing states, were particularly conducive to hydraulic mining. In 1912, Europeans introduced the dredge, large pontoons or barges that scooped up *karang* from the bottom of lakes or flooded basins. But the outbreak of war hindered the full deployment of these floating factories because the materials for building them were needed elsewhere, thus intensifying hydraulic mining.

Like other strategic commodities, the value of tin rose sharply during the war. Tin prices on the London market in 1916 were 43 percent higher than in 1911, leading to a massive expansion of Malay tin mining. Having lived in the shadow of Chinese mines for decades and eager to finally turn a profit, European mines expanded their operations. The increase in hydraulic sluicing caused widespread erosion that choked rivers with sand and clay runoff. Not only did extensive tin mining ruin key components of these local ecosystems, it created an artificial bubble in the tin market. Due to difficulty in transporting the metal to Europe, both the Federated Malay States and the Dutch East Indies accumulated large stocks that later caused a collapse of the tin price in the 1920s.^[36] Warped economies and wrecked ecosystems ruined Malayan livelihoods and habitats.

A similar pattern of industrialization, ecological desolation, and social upheaval took shape along the Mexican Gulf Coast, home to some of the world's most productive oil fields at that time. The discovery of [petroleum](#) in the Huasteca during the early 1900s propelled Mexico to a position of immense strategic importance a decade later. Crude deposits became an issue of national security when navies began converting warships from coal-burning to oil-fired beginning around 1912. The progression of the war accentuated the prime importance of petroleum. Oil became indispensable. It propelled military innovation – [tanks](#), [airplanes](#), and submarines – and provided basic ingredients for TNT. Petroleum's emergence as the principal power source during the war provided the Entente with an energy advantage. [Germany](#) was a leading coal producer but eventually its shortage of oil immobilized its forces. The Ottomans lacked the infrastructure to tap into their crude holdings. Russia had been extracting oil around the Caspian Sea for decades, but its rail system proved insufficient and the distances too vast to meet its allies' demands. In 1914, the [British government](#) became a majority shareholder in the fledgling Anglo-Persian Oil Company,

which had drilled the Iranian oilfields in the neighborhood of Shustar and piped petroleum over 140 miles to the Abadan Island refinery on the northern coast of the Persian Gulf. But Mexico and the United States still supplied more than 80 percent of the world's petroleum. As the leading oil exporters, they played a crucial role in the Entente's eventual victory.

Oil syndicates subjugated the Huasteca's environment. To drill for crude, companies removed the mangroves, flattened sand dunes, and drained swamps across thousands of acres. Deep pits to hold the petroleum disturbed the soil in ways that mimicked shelling on the Western Front. Oil extraction was messy. Numerous petroleum spills polluted the rainforest, rivers, and beaches with sludge. Ecological factors in Mexico made crude production especially dirty. Veracruz oil contained unusually high levels of hydrogen sulfides and had exceedingly high temperatures. Petroleum coming out of Texas and Louisiana measured around ninety degrees Fahrenheit; in Mexico it reached 150 degrees. Scalding gushers frequently scorched local ecosystems, often through terrifying blasts and uncontrollable conflagrations. The burn marks of one such colossal explosion in 1908 at San Diego de la Mar, known locally as Dos Bocas, are still visible today. A geologist toured the area in 1913 and reported what he saw:

What had been lush monte was now a gaunt specter of dead trees. The air stunk with the smell of rotten eggs. There was no sign or sound of animal, bird, or insect life. Nothing stirred in the breeze. The silence was appalling. It was eerie and frightening. ...It smelled and looked like I imagined hell might look and smell.^[37]

He might well have been writing from the Western Front; his portrayal of Dos Bocas anticipated how most soldiers described No Man's Land. In 1929, a journalist from Tampico retraced the geologist's steps. Little had changed:

Everything is charred, ashen in color...no foliage on the trees, no birds in the sky. ...All the trees have been robbed of their greenery, burned, and seem to raise up to the heavens, with anguishing contortions, their bare and gray branches.^[38]

Here the differences are telling. By the end of the 1920s, battered lands in the European war zone had largely regenerated. But in the Huasteca, environmental damage lasted for decades, even after Mexico fell from the list of the world's top oil producers. Moreover, ecological degradation upset land tenure systems and intensified labor disputes, which contributed to the [Mexican Revolution](#).

Political conditions north of the Rio Grande River were comparatively peaceful, but the ecological situation was becoming increasingly unstable. As with mechanized clear cutting in the southeastern region of the United States, industrial agriculture on the prairies in the United States and Canada increased soil erosion. On the eve of war, the Russian Empire was the largest producer and exporter of wheat, the mainstay carbohydrate for most Europeans. When the Ottomans joined the war against Russia, they blocked grain supplies from reaching Western Europe. The Entente turned to the United States and Canada as the breadbaskets to prevent starvation. Economic incentives for expanding cultivation were abundant. The U.S. government guaranteed wheat prices of over two dollars a bushel for the duration of the war. By 1919, the price of American wheat was more than twice its 1914 level.^[39] Adequate rainfall, soaring wheat prices, and bountiful harvests created bonanza farms in the United States where optimistic farmers borrowed heavily, often through second mortgages, to break sod on marginal lands and reap profits. In 1915, growers harvested wheat from 60 million acres. That number jumped to 74 million acres in 1919, a 38 percent increase over the 1909-1913 period. But those numbers are deceptively conservative. In some counties, wheat acreages expanded by 200 percent, 400 percent, or in some cases 1000 percent.^[40]

All belligerent societies attempted to increase agricultural output. Both sides faced dilemmas of feeding troops and civilians, along with countless beasts of burden. Food security was a defining feature of the war. Government agencies in Europe and the United States instituted campaigns of home gardening and conservation on the home front. Desperate to compensate for poor domestic harvests and food imports lost to the British blockade, Germans plowed up churchyards, school grounds, forest glades, and even beloved soccer fields. Officials provided incentives for turning over private property to communal cultivation. On the other side of the Atlantic, [Charles Lathrop Pack \(1857-1937\)](#), president of the National War Garden Commission in the United States, approached food production with a single-minded sense of urgency. To supplement domestic stocks depleted by European demands, he championed the virtues of small-scale farming and home food production. "Let us plant gardens as never before," he declared, "and grow munitions at home to help win the war."^[41] His organization published numerous pamphlets with advice and instructions for amateur gardeners that always emphasized gardening as a national necessity. Pack encouraged the cultivation of gardens on "every inch" of tillable land, including backyards, vacant lots, city parks, company land, school grounds, and army camps. By 1917, the Commission reported the cultivation of nearly 3 million gardens, which provided

more than 500 million dollars in crop value. When the United States entered the war in 1918, hoeing at home increased. By the end of the war over 25 percent of households had what were popularly called “war gardens.” Meanwhile, rather than enforce food rationing like countries in Europe, head U.S. Food Administrator Herbert Hoover (1874-1964) encouraged citizens to eat less with the slogan: “Food Will Win the War.” He called upon patriotic Americans to participate in “Meatless Mondays” and “Wheatless Wednesdays,” which resulted in a 15 percent reduction in domestic food consumption.^[42] Even as the war expanded patterns of exploitation, it also set standards for conservation. Overall, “war gardens” encouraged communal cooperation, consuming local produce, and preserving surplus goods.

Still, the ecological and economic consequences of widespread cultivation were severe. Agrarian policies generally favored the consumers, not the producers, and often resulted in over-exploited soil. Starvation conditions among the Central Powers, especially Germany, led to the systematic uprooting of trees, bushes and hedges for more farms, reducing biodiversity and increasing ecological imbalances.^[43] Industrial farming on the semi-arid prairies in North America reaped catastrophe. Wheat farmers plowed close to 6 million hectares across the wide flatlands, which were especially suited for gas-driven tractors, plows, and combines. Eager to turn a profit, farmers employed the one-way disc plow, which could quickly break the soil and uproot weeds. With its spinning blades, the plow pulverized the dirt and left a layer of loose sediment over the ground, inviting wind erosion and dust bowls in the following decades.^[44]

After the armistice, Charles Lathrop Pack announced: “America’s responsibility for the world’s food supply did not stop with the ending of the war. ...In peace, as in conflict,” he asserted, “this country must carry the burden of Europe’s food problems.”^[45] But within a few years, Europe’s agricultural yields approached their pre-war levels. That the fields recovered much faster than expected distorted agricultural commodities markets. In the United States, grain prices plummeted over 50 percent between 1920 and 1921, creating serious liquidity problems for indebted farmers. Foreclosure rates reached record highs. The combination of drought and the evaporation of European demand for American produce in the 1920s left hundreds of thousands destitute.^[46] Even within the context of Europe’s ecological rehabilitation, human suffering and environmental degradation elsewhere continued.

Conclusion

In 1917, Kurt Lewin (1890-1947), a German psychologist and artillery officer, penned an article while recovering from his war wounds. Titled, “War Landscape,” and later published in the *Journal for Applied Psychology*, the article discussed the mental topography of armed conflict and analyzed the difference between a “war landscape” and a “peace landscape” in soldiers’ minds.^[47] Peacetime landscapes appeared boundless, extending out as far as the eye can see. War landscapes, on the other hand, were contained, bordered by violence and danger. Terrain acquired new meanings in theaters of combat. From a psychological standpoint, Lewin’s analysis seemed fitting enough, particular given our contemporary understanding of post-traumatic stress disorder, what doctors in the First World War called “[shell shock](#).” But from an environmental perspective, his dichotomy is false; the borders between “war landscapes” and “peace landscapes” overlapped or disappeared entirely. An examination of the Great War’s ecological legacy reveals that the distinction between modern war and modern industry had, in many ways, faded. Transformations to the natural world occurred in places outside the combat zones. People far from the fighting felt the war in their everyday lives through its long environmental reach.

The select environmental transformations discussed in this article illustrate changes to ecosystems around the world. These local developments indicated broader patterns that defined the 20th century. In each instance the war accelerated trends that began with industrialization in the 19th century. While the war’s concentrated industrial destruction obliterated battlegrounds, natural processes repaired the damaged lands. Far more detrimental to ecosystems and more pervasive than combat was the spread of industrial methods and mentalities of production that hindered natural processes, upset local ecological balances, and increased human exploitation the world over. The conflict’s lasting ecological footprint reveals the hidden costs of war, in terms of both ongoing environmental degradation and human trauma. From this we see that the Great War ushered in a century whose magnitude of environmental change matched its terrible violence.

Notes

1. ↑ Schama, Simon: *Landscape and Memory*, New York 1995, pp. 65f; Moberly, F. J.: *The Campaign in Mesopotamia. 1914-1918*, volume I, London 1923, p. 14; Keller, Tait: *The Mountains Roar. The Alps during the Great War*, in: *Environmental History* 14/2 (2009), pp. 253-74. Altered battlefield environments also created ideal incubators for disease, including: malaria, [influenza](#), cholera, typhus, dysentery, and smallpox, among others. The discussion of disease and war lies outside the scope of this essay but for more on the topic see: Byerly, Carol R.: *Fever of War. The Influenza Epidemic in the U.S. Army during World War I*, New York 2005; Özdemir, Hikmet: *The Ottoman Army 1914-1918. Disease and Death on the Battlefield*, trans. Saban Kardaş, Salt Lake City 2008.
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3. ↑ For an excellent essay on the trench environment see: Brantz, Dorothee: *Environments of Death. Trench Warfare and the Western Front, 1914-1918*, in: Closmann, Charles E. (ed.): *War and the Environment: Military Destruction in the Modern Age*, College Station 2009. For more on the development of chemical weapons see: Russell, Edmund: *War and Nature. Fighting Humans and Insects with Chemicals from World War I to Silent Spring*, New York 2001.
4. ↑ Barbusse, Henri: *Under Fire*, trans. Robin Buss, New York 2003, pp. 5, 7, 138, 248.
5. ↑ Jünger, Ernst: *Storm of Steel*, trans. Michael Hofmann, New York 2003.
6. ↑ For an excellent analysis of French soldiers' impressions see: Pearson, Chris: *Mobilizing Nature. The Environmental History of War and Militarization in Modern France*, New York 2012.
7. ↑ Barbusse, *Under Fire* 2003, p. 13.
8. ↑ Engels, Friedrich: *The Condition of the Working Class in England*, New York 1987, pp. 89-93.
9. ↑ Jünger, *Storm of Steel* 2003, p. 128.
10. ↑ Holland, Robert: *Air Pollution as Affecting Plant Life*, Manchester 1888; Webster, A. D.: *Town Planting and the Trees, Shrubs, Herbaceous and Other Plants that are Best Adapted for Resisting Smoke*, London 1910, cited in: Thorsheim, Peter: *Inventing Pollution. Coal, Smoke, and Culture in Britain since 1800*, Athens 2006, pp. 34f.
11. ↑ Jünger, *Storm of Steel* 2003, p. 175; Barbusse, *Under Fire* 2003, p. 135; Smith, Corinna Haven/Hill, Caroline R.: *Rising Above the Ruins in France. An Account of the Progress Made Since the Armistice in the Devastated Regions in Re-establishing Industrial Activities and Normal Life of the People*, New York 1920, pp. 17f.
12. ↑ Mosse, George: *Fallen Soldiers. Reshaping the Memory of the World Wars*, New York 1990, p. 109.
13. ↑ Mosse, *Fallen Soldiers* 1990, p. 107.
14. ↑ Fussell, Paul: *The Great War and Modern Memory*, New York 2000, pp. 231, 235.
15. ↑ Showalter, Dennis: *Mass Warfare and the Impact of Technology*, in: Chickering, Roger/Förster, Stig (eds.): *Great War, Total War: Combat and Mobilization on the Western Front, 1914-1918*, New York 2000, p. 87.
16. ↑ For more on the issue of wilderness see: Cronon, William: *The Trouble with Wilderness. Or, Getting Back to the Wrong Nature*, *Environmental History* 1 (1996), pp. 7-28.
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18. ↑ *All Quiet on the Western Front. WWI Hell as it is Today*, in: *The Sun*, 9 November 2011.
19. ↑ *In Fields Sown with Tragedy. Flanders and Picardy*, in: *The Sunday Times*, 12 November 1989.
20. ↑ Jünger, *Storm of Steel* 2003, pp. 27f, 41.
21. ↑ Jünger, *Storm of Steel* 2003, pp. 139, 143, 158, 175.
22. ↑ Smith/Hill, *Rising Above the Ruins* 1920, pp. 57f.
23. ↑ Smith/Hill, *Rising Above the Ruins* 1920, pp. 141, 73f.
24. ↑ Hupy, Joseph P.: *The Long-term Effects of Explosive Munitions on the WWI Battlefield Surface of Verdun, France*, in: *Scottish Geographical Journal* (2006), pp. 172.
25. ↑ Mosse, *Fallen Soldiers* 1990, p. 112.
26. ↑ Hupy, *Long-term Effects* 2006, p. 170; see also: Hupy, Joseph P.: *Verdun, France. Examining the Effects of Warfare on the Natural Landscape*, in: Palka, Eugene J./Galgano, Francis A. (eds.): *Military Geography. From Peace to War*, New York 2005, pp. 457, 462, 467; Tallier, Pierre-Alain: *La Reconstitution du Patrimoine Forestier Belge après 1918*, in: Corvol, Andrée/Amat, Jean-Paul (eds.): *Forêt et Guerre*, Paris 1994, pp. 215-25. Similar issues plagued reforestation efforts in the Alps. See: Armiero, Marco: *A Rugged Nation. Mountains and the Making of Modern Italy*, Cambridge 2011, pp. 100-106.
27. ↑ Hupy, Joseph P.: *The Environmental Footprint of War*, in: *Environment and History* 14 (2008), p. 413; see also: Hupy, Joseph P./Schaetzl, Randall J.: *Soil Development on the WWI Battlefield of Verdun, France*, in: *Geoderma* 145 (2008), p. 47.
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31. ↑ Tucker, Richard: *The World Wars and the Globalization of Timber Cutting*, in: Tucker, Richard P. / Russell, Edmund (eds.): *Natural Enemy, Natural Ally. Toward an Environmental History of War*, Corvallis 2004, pp. 115ff; see also: West, *Forests and National Security* 2003, pp. 274-78.
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33. ↑ For details on Germany's forest reserves see: HStADr 10736 Folder 7396 Heereslieferungen und Arbeitsbeschaffung in der sächsischen Holzindustrie, 1915; see also: BAMA RH 61/1185 *Die Holzbewirtschaftung während des Krieges*.
34. ↑ Österreichisches Staatsarchiv- Kriegsarchiv AdTK 1931 Detusche Grp. + Kps 28.8.1915; McNeill, John R.: *Woods and Warfare*, in: *Environmental History* 9 (2004), p. 399.
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42. ↑ "Grow War Munitions at Home for 1918," and "In the Furrows of Freedom," published by the National War Garden Commission; see also: Gowdy-Wygant, Celia: *Cultivating Victory. The Women's Land Army and the Victory Garden Movement*, Pittsburgh 2013, p. 87. Avner Offer discusses the economics of agriculture during the war in his study: Offer, *Avner: The First World War. And Agrarian Interpretation*, New York 1989.
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