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REFERENCE ARTICLE

The American Civil War: An Environmental History

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Abstract

The American Civil War was an ecological event that reshaped human life, transformed landscapes, and influenced military strategy. The war brought together microbes, crops, and animals in ways that altered both people and nature. Examining the war through an environmental lens reveals the interconnections among health, weather, animals, terrain, and the agricultural ecosystems that fed soldiers and civilians on both sides. The conflict was a struggle over resources; a human health crisis; a catastrophe for horse, pig, and cattle populations; and a source of remarkable devastation for the natural and built environments. At the same time, wartime experience advanced knowledge in medical care, animal husbandry, land management, and weather forecasting. The environment shaped the course and outcomes of military campaigns, while the actions of the armies also altered southern forests, farmlands, and cities for generations to come.

Keywords: Civil War, environment, health, agriculture, armies, terrain, disease, weather, drought, flood

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Examining the Civil War Through an Environmental Lens

Since the beginning of the 21st century, environmental historians have studied the American Civil War, viewing the conflict as a struggle for resources; a crisis in health for soldiers and civilians; a disaster for horse, pig, and cattle populations; and a source of widespread destruction to natural and built environments. The war was an ecological event that brought together a combination of germs, crops, and animals that transformed both people and nature and had important implications for military actions. An examination of how the environment affected the Civil War must encompass health, weather, animals, terrain, and the agricultural ecosystems that provided food for civilians and soldiers in both armies.[1]

Environmental history as a discipline has been around since Roderick Nash wrote *Wilderness and the American Mind* in 1967, but the methodologies of that emerging field of study did not penetrate scholarly treatments of the Civil War until the 21st century. Jack Temple Kirby's highly influential essay for the National Humanities Center in 2001, titled "The American Civil War: An Environmental View," transformed the field. Kirby noted that "military historians preoccupied with combat on specific landscapes *almost* do environmental history," while he lamented that "more than three decades of accumulated literature in environmental history barely touch the Civil War." Kirby's impressionistic piece demonstrated ways that military and environmental historians could engage one another to develop a greater understanding of the war. Scholars have heeded his call to action since 2000, publishing a profusion of environmental examinations of the war.[2]

Lisa M. Brady published an environmental analysis of the Union strategy of targeting southern ecosystems, *War upon the Land*; Kathryn Shively Meier in *Nature's Civil War* examined how terrain affected soldiers' health; Andrew McIlwaine Bell in *Mosquito Soldiers* and Margaret Humphries in *Marrow of Tragedy* further explored how environmental factors created a health crisis. Erin Stewart Mauldin in *Unredeemed Land* analyzed the long-term environmental effects of the war on southern landscapes, while Kenneth W. Noe in *The Howling Storm* provided a comprehensive analysis of how weather influenced both military campaigns and agricultural conditions throughout the war. A plethora of other studies on agriculture, animals, health, and terrain emerged as well. Judkin Browning and Timothy Silver closely followed Kirby's directive to merge environmental and military scholarship into a comprehensive but concise synthesis that viewed the war as an ecological event in their *An Environmental History of the Civil War*. More fine works of scholarship come out annually, demonstrating that environmental analyses of the war continue to yield new ways of viewing the much-studied conflict.[3]

The Civil War as a Human Health Crisis

When war erupted in the spring of 1861, soldiers from scattered rural communities crowded into training camps to learn the arts of war, creating ideal conditions for the spread of disease. The first outbreak to strike new recruits was usually *rubeola*, or measles. Many of those who rushed to join up, especially from the South, had not been previously exposed to the virus. A single infected soldier could introduce measles into a camp full of non-immune men, where it spread with explosive speed. Measles quickly became a scourge of Confederate training camps. Thousands fell ill; in some camps, as many as 50 percent of the population were infected at one time. The constant movement of unexposed men, however, ensured that the danger did not end with the initial musters and encampments. A second round of measles broke out in early 1863 as the Union Army began training African American troops, many of whom lacked immunity to *rubeola*.[4]

Smallpox, or *Variola major*, became more prevalent in the South during the first years of war and proved especially devastating. An epidemic that probably began among former slaves who fled to Union camps in Washington, D.C., in 1862 spread into the Deep South and the western territories by 1868, where it also wreaked havoc among Native Americans. Union officers required soldiers to be inoculated or vaccinated in their home regions before they arrived in camp. Southern officers feared that Union forces might use smallpox as a biological weapon against their highly susceptible rural soldiers.[5]

Soldiers contracted other diseases by consuming contaminated food and water, something easy to do in the fly-infested, unsanitary army camps. Weakened soldiers often relieved themselves near their tents, allowing bacteria to thrive close to cooking fires. Rain then carried human waste into nearby streams and groundwater, sustaining a deadly ecological cycle of disease. One such scourge was typhoid fever, which stemmed from the presence of bacteria known as *Salmonella typhimurium* and *Salmonella paratyphi*. Resistant to human stomach acid, the bacteria multiply for up to two weeks and escape into the bloodstream, producing a rash, aches, fever, and severe digestive issues. The most acute cases often led to death from kidney failure.[6]

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A wide range of illnesses produced the most common symptom shared by armies on both sides: diarrhea. The most pernicious such illness was dysentery, marked by bloody stools. While it could be caused by amoebic parasites, dysentery more often resulted from bacterial infections such as *Shigella*, *Escherichia coli*, and various forms of *Salmonella*. Every soldier in both armies likely suffered from bowel maladies at some point in their service. Union medical records document nearly 1.75 million cases of diarrhea or dysentery over the course of the war, with approximately forty-five thousand soldiers dying from the disease. Although Confederate records are not as comprehensive, southerners probably suffered at comparable—or even higher—rates.[7]

War and military life also created nearly ideal conditions for the spread of syphilis and gonorrhea. Human beings in motion and changes in their sexual behavior—both common in wartime—are crucial to creating biological conditions that allow the microorganisms to proliferate. The only missing ecological element was a reservoir of potentially infectious bacteria, unwittingly provided by the numerous prostitutes who plied their trade in and around the army camps. Before the war ended, Union medical authorities officially recorded nearly 80,000 cases of syphilis and more than 117,000 cases of gonorrhea. Tens of thousands more went unreported. The devastating effects of those infections endured long after the war ended, as infected men carried their diseases back home to spread to their wives, causing untold misery. Venereal disease killed nearly one-third of all men who died in Union and Confederate veterans' homes in the decades after the guns fell silent.[8]

Mosquitoes presented another danger, carrying parasites that caused malaria—either the milder *Plasmodium vivax* or the more deadly *Plasmodium falciparum*. The disease rendered thousands of men unfit for battle throughout the conflict. By 1860, military officers and surgeons were very familiar with the disease, although they did not understand its cause. They associated it with foul air emanating from swamps or stagnant water, a view reflected in the disease's name, derived from Italian words for "bad air." A soldier bitten by the female parasite-carrying *Anopheles quadrimaculatus* experienced fever spikes, chills, sweating, and nausea. This pattern of acute symptoms, recovery, and relapses often continued for years. Malaria became so common that by the end of the war, approximately 1.3 million Union soldiers (or nearly 60 percent of men who wore blue uniforms during the war) had contracted the disease.[9]

Mosquitoes carried a much deadlier disease as well: yellow fever. This malady results from a virus injected into the human bloodstream by the female *Aedes aegypti*. Attacking cells in the kidneys and liver, the virus disables the immune system, bursting blood vessels, and causing massive internal bleeding. Yellow fever often proved fatal and was characterized by an infected person vomiting a vile black substance, which was coagulated blood. The worst epidemic occurred at Wilmington, North Carolina, in 1862, although severe outbreaks also occurred at Charleston and New Bern. Concern about the disease proved a powerful deterrent to northern invasion plans. In 1862, Union authorities opted not to initiate attacks along the coasts of Texas, South Carolina, or at Wilmington, because they feared losing thousands of soldiers to the dreaded "black vomit."[10]

Civilians faced significant health issues when armies larger than many American cities clashed in confined rural landscapes, bringing to them all the sanitation and waste problems of urban life. Rural communities relied on outhouses and privies and had no water carriage systems to dispose of an army's collective waste. Dry summer conditions often left rivers and creeks running low and without steady rain flushing them out, local water sources became highly vulnerable to contamination. In Sharpsburg, Maryland, for instance, sickness plagued the region for months after the Battle of Antietam in September 1862. Only the spring rains of 1863, which cleared streams and replenished groundwater, finally brought relief from the worst of the sickness.[11]

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Medical Treatments

When soldiers or civilians got sick, they found a lack of effective treatment for most illnesses. Many soldiers attempted to heal themselves by falling out of ranks and seeking food, rest, or assistance in quiet areas or civilian homes. Known as "straggling," this was often a form of self-care that the sick or weary soldiers employed to avoid a visit to a medical professional. When they were admitted into a hospital, they encountered doctors who primarily prescribed three drugs to treat the myriad ailments of their sick patients. By far the most prescribed drug was opium, which proved to be an effective, although highly addictive, pain reliever. Soldiers ingested over ten million opium pills during the war. They also drank it in a mixture with alcohol—known as laudanum—or took morphine either as a powder or injected by hypodermic syringe. Many soldiers remained addicted to the drug for decades. By the turn of the century, two hundred thousand opium addicts lived in the country.[12]

Doctors also commonly prescribed the highly toxic calomel, or mercurous chloride. Known as "blue mass," calomel pills were given to soldiers for constipation, diarrhea, venereal diseases, typhoid fever, malaria, yellow fever, and just about any other malady that ailed them. It was an effective purgative or laxative, but its side effects could be lethal. Some patients salivated at enormous rates, experienced violent vomiting or bloody diarrhea, or had their teeth and hair fall out. Some unfortunates developed mercurial gangrene, a hideous illness in which the soft tissue of the mouth rotted and fell out. Recognizing its pernicious effects, the US Surgeon General banned the use of calomel in May 1863, but many doctors continued prescribing it because they believed it worked.[13]

The third-most common drug was quinine, which proved to be an effective treatment and preventative for malaria. Derived from the bark of cinchona trees, native to South America, quinine had a bitter taste, which soldiers ameliorated by consuming it mixed with whiskey. Because it proved highly effective at reducing fever and relieving the pain of malaria, doctors began prescribing it for almost any illness. The drug became so popular that by the end of the war, Union soldiers had ingested more than a million ounces of quinine and other derivatives. Southern doctors desired the medicine as well, but the Union blockade inhibited their acquisition of it. The North's ability to deny the medicine to their enemy further reduced Southern manpower.[14]

The war profoundly shaped the development of medical care as physicians learned how to treat the devastating wounds inflicted by new weapons. The conflict forced doctors to experiment, adapt, and implement more effective procedures and systems of care. Civil War rifles fired the Minié ball, a large, heavy, conical, soft lead bullet that flattened and tumbled when it hit a human body, ripping tissue apart and shattering bones. Such injuries demanded swift action to prevent deadly infection. Surgeons especially feared gangrene, a rapidly spreading bacterial infection marked by inflammation and oozing pus, usually caused by the bacteria staphylococci or streptococci. The most effective treatment was amputation of the infected limb. Union doctors performed nearly thirty thousand amputations during the war, and Confederate surgeons likely carried out a comparable number. While the mortality rate for amputees was 26.3 percent—high by modern standards—it was less than half of the prewar rate. Doctors quickly learned that the sooner a damaged limb could be removed, the greater the chance of the patient's survival. In one study of nearly twenty-four thousand amputees, those operated on within forty-eight hours of injury had a 23.9 percent fatality rate, compared to 34.8 percent for those whose surgeries were delayed beyond that window (figure 1).[15]

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Figure 1. A Union field hospital at Savage Station, Virginia, June 1862.

Source: Library of Congress.

The war also prompted the Union army to develop a professional ambulance corps, improve evacuation techniques, and establish a series of field hospitals at the front and rear areas to treat the wounded. Armies on both sides hired large numbers of surgeons to treat the ever-growing number of sick and wounded soldiers. These reforms enhanced a soldier's chance of survival from war wounds. During the first year of the war, the death rate from wounds had been over 25 percent, but by 1864, it had decreased to only 9.5 percent. Hospital care improved as well, as physicians learned through experience which treatments were effective and which were not. Approximately one million Union soldiers received hospital care during the conflict, and fewer than 10 percent of them died. The lessons surgeons learned during the war fundamentally transformed and professionalized medical practice in the decades that followed. European armies later adopted the American hospital system and modeled their medical services on innovations developed during the war.[16]

The Influence of Weather in the Civil War

Weather influenced military campaigns and the daily provision of sustenance to the nation's soldiers and civilians. The war occurred in a prolonged period of unusually dry conditions in the United States. Between 1856 and 1865, the West and South endured substantially diminished rainfall, creating conditions so abnormally dry that climatologists refer to the period as "The Civil War Drought." Scientists debate which climate oscillation prevailed at the time—El Niño or La Niña—but it resulted in drier, hotter conditions in the southern half of the United States. With less precipitation to cool the environment, soldiers clad in wool uniforms and marching with heavy packs experienced excessive heat during many campaigns of the war, which affected their health. The most common heat-related ailment was heat exhaustion, which occurred when excessive sweating reduced blood volume, lowered blood pressure, and caused fainting. Far more dangerous was heat stroke, which set in when the body's temperature-regulating systems failed. Without quick intervention, extreme heat caused the brain, lungs, and kidneys to swell, often resulting in death.[17]

Excessive heat helped determine the course of several battles and skirmishes. At the Battle of Wilson's Creek in August 1861 in southwestern Missouri, soldiers reported a temperature of 105 degrees, and water proved nearly impossible to find. Desperate soldiers drank from slimy hog holes and squeezed moisture out of clumps of dirt. When Union General Nathaniel Lyon fell mortally wounded, his exhausted army beat a hasty retreat to St.

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Louis. Dehydration proved a serious problem in the scorching deserts of New Mexico during campaigns from July 1861 to May 1862. In 1861, Confederate authorities developed a plan to conquer New Mexico, Arizona, and eventually take California. A small group of Texans ventured into New Mexico in July 1861 to capture Fort Fillmore, near the Texas border. When Union forces attempted to retreat through a desolate land of giant gypsum dunes and alkaline soils with no fresh water in temperatures north of 95 degrees, heat stroke prostrated many of the troops. Nearly 20 percent of the five hundred soldiers and one hundred civilians died on the march from heat-related maladies. The remaining survivors surrendered to Confederates.[18]

When Confederate forces continued their advance in the spring of 1862, capturing Albuquerque and Santa Fe, they were forced to turn back when a scrappy Union force destroyed their wagon trains at the Battle of Glorieta Pass in northern New Mexico. Unable to carry food and water supplies with them through the arid western deserts to California, the Confederates began a retreat in which they suffered tremendously from heat and lack of fresh water. They eventually retreated all the way to San Antonio, Texas, having lost more than half of their three-thousand-man force to exposure to the elements and dehydration.[19]

Drought conditions affected campaigns farther east as well. Confederates under General Braxton Bragg launched a loosely coordinated plan to invade Kentucky in the late summer of 1862, threatening Cincinnati and the major supply hub of Louisville. The campaign forced one Union army to abandon its advance on Chattanooga to confront the Confederate menace. Drought conditions made life miserable for men in the ranks of both armies. Bragg eventually established a defensive position near Perryville, Kentucky, a small village in the center of the state, because it had one of the few viable watering holes in the incredibly dry region. On October 8, the Battle of Perryville began in earnest as Union and Confederate forces contested the precious water supply. After a tactical stalemate, Confederate forces, disillusioned with their experience in the state, retreated. Both armies would have suffered many more casualties to heat stroke and dehydration if heavy rain had not saturated the region two days later, replenishing the very resource that had triggered the confrontation.[20]

Ironically, despite the long-term drought, the first half of 1862 proved to be unusually wet across the country. In January, an atmospheric river rolled off the Pacific Ocean and emptied its contents onto California for forty-five consecutive days. Thirty-seven inches of rain fell in San Francisco, 102 inches in the Sierra Mountain village of Sonora, and 66 inches fell on Los Angeles, submerging much of the Mojave Desert. In California's Central Valley, floodwater covered three and a half million acres, turning the state's most fertile fields into a six-thousand-square-mile inland sea. The rain hindered Union forces who sought to march east to challenge the Confederate advances in New Mexico. Meteorologists referred to the cataclysmic tempest as an ARkStorm ("AR" for atmospheric river, "k" for one thousand, as in a one-thousand-year event), suggesting that it contained a volume of water equivalent to fifteen Mississippi Rivers![21]

The unusually rainy pattern in early 1862 continued over the eastern half of the United States. In Tennessee, heavy rains forced the Tennessee River out of its banks in February, submerging Fort Henry and allowing Union forces to capture that Confederate bastion without much of a fight. Ten days later, Union forces captured Fort Donelson, only twelve miles away on the flooded Cumberland River, capturing fifteen thousand Confederate soldiers. As forty thousand Union troops under General Ulysses Grant moved south along the Tennessee River, they camped in early April at Pittsburg Landing, the only high ground above the flood zone. They awaited a juncture with General Don Carlos Buell and his army of thirty thousand troops before advancing into Mississippi. Trying to shift the South's fortunes, Confederate General Albert Sidney Johnston planned to launch his own offensive on Friday, April 4, before the Union forces could unite. However, the incessant rain delayed his attack by two days. In the ensuing Battle of Shiloh, Johnston fell mortally wounded on the first day of battle, which looked like a Confederate success. But that evening, Buell arrived with thirty thousand more troops and helped drive the Confederate Army away on April 7, securing a Union victory in a battle that foreshadowed the grim fighting to come.[22]

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In Virginia, the wet weather also shaped the outcome of Union General George McClellan's campaign to capture the Confederate capital of Richmond and end the war in the spring of 1862. After landing a formidable army of 110,000 men and 250 pieces of artillery at Fort Monroe at the eastern tip of the Virginia Peninsula, McClellan intended to advance quickly and besiege Richmond. But as he began marching, he encountered unexpected Confederate resistance and enormous amounts of rain. Rain fell on sixteen of the thirty days in April, and thirteen out of fourteen days in mid-May, turning the roads and landscapes into swampy quagmires. McClellan's forces managed an exhausting slog through the mud to advance to within five miles of Richmond. Along the way, his troops fell ill with the various maladies carried by mosquitoes or associated with drinking contaminated water. Confederate forces under General Robert E. Lee launched a counterattack against the physically weakened enemy and its mentally fragile leader, driving them away from the capital. By the end of the campaign in July 1862, a higher percentage of soldiers (40 percent) in the Army of the Potomac were sick than in any other month of the war. Nearly twenty thousand men were completely incapacitated with diarrheal ailments alone. Rain played an important role in several other military campaigns as well: annoying the advances and retreats in the Tullahoma Campaign of southern Tennessee in the summer of 1863; rendering the fighting more nightmarish at Spotsylvania Court House, Virginia, on May 12, 1864; and slowing General William Sherman's march through South Carolina in January 1865, when so much rain fell that locals referred to it as "Sherman's Flood" for years afterward.[23]

Cold weather influenced military events as well. An arctic cold snap bringing sleet and snow outside of Fort Donelson in February 1862 led soldiers—many of whom had foolishly discarded their blankets on the unseasonably warm march the previous day—to suffer hundreds of cases of frostbite, and many died from hypothermia. Intense cold made conditions miserable for soldiers fighting in Tennessee at Stones River in December 1862 and Franklin in November 1864. The freezing conditions were equally trying for those Union troops charging hopelessly into the Confederate fortified line at Fredericksburg, Virginia, on December 13, 1862. Seeking to regain some measure of strategic advantage after his humiliating defeat there, General Ambrose Burnside attempted a winter offensive in January 1863, encouraged by several weeks of unseasonably mild weather. Almost as soon as the army began to move on January 20, a cold, miserable mix of rain and snow set in and continued for nearly thirty hours. The relentless storm soaked the men, doused campfires, mired horses hauling artillery, and quickly turned the Virginia roads into impassable seas of mud. Burnside abandoned the advance two days later, and his despondent troops trudged back to their winter camps, bitterly dubbing the campaign the "Mud March" (figure 2).



Figure 2. Sketch of the Union Army of the Potomac on the move in abysmal weather, January 21, 1863.

Source: Library of Congress.

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Depression sapped men's morale as the Union army suffered its highest rate of desertion during the war that winter. The ill-fated trek also ruined the soldiers' health; one medical historian has suggested that, once diseases had run their course, the "Mud March" claimed as many lives as the battle of Fredericksburg itself. The war taught Americans that they needed a better way to understand and predict the weather. President Ulysses S. Grant, acutely aware of the importance of weather to military campaigns, signed a law in February 1870 establishing a series of weather stations across the country. One hundred years later, the core of that same organization became the National Weather Service.[24]

The Supply and Scarcity of Food in the Civil War

Weather also severely affected the production of food. The heavy rains of early 1862 swamped farm fields from Louisiana to Virginia. The levels of the Mississippi, Yazoo, and Ouachita Rivers reached fifty-year flood heights, breaching levees and ruining thousands of acres of productive lands. The incessant rains throughout April and May across the South left the land too wet to plow, delaying the planting of food crops, and creating ideal conditions for stem rust, a fungus that devastated the southern wheat, potato, and oat crops in 1862. As the wet spring gave way to summer drought, southern corn crops baked and withered in their parched fields. In Virginia's Shenandoah Valley, corn production fell 60 percent by 1863. With children hungry and no relief forthcoming, some southern women resorted to violence. Riots over the cost and availability of food broke out in dozens of cities across the South, with the most renowned one occurring in Richmond, Virginia, in April 1863. The actions of these hungry women forced state and local governments to institute relief programs in what one historian calls the first welfare system in the United States.[25]

Confederate laws also made food production more difficult. In April 1862, conscription moved able-bodied white farm laborers to the army. While it boosted the number of men in the ranks, it reduced the amount of food produced for soldiers. In March 1863, the Confederate Congress enacted an impressment law, allowing the armies to seize food and pay a price set by the government. A month later, the Confederate Congress followed up with the tax-in-kind law. Based on the church tithe system, the new measure allowed farmers to reserve a minimum amount of food for their own use but demanded 10 percent of all remaining produce. These laws, intended to produce more food for the nutrition-deficient armies, often proved counterproductive as citizens were disinclined to produce as many food crops as possible if their harvests were only to be impressed for reduced prices by the authorities.[26]

Armies on both sides contributed to the scarcity of food. By the summer of 1862, Union forces began targeting the agricultural ecosystems that kept the Confederacy fed. Wherever armies went, soldiers cleared out smokehouses, storehouses, barns, and fields of grain. Troops took horses, wagons, and fence rails, which became fuel for campfires. In the summer of 1862, Union armies abandoned the policy of conciliation and began deliberately targeting southern agriculture. General John Pope's army wreaked havoc in northern Virginia that summer. Union forces in Mississippi, Tennessee, and northern Alabama confiscated or destroyed millions of pounds of bacon and bushels of corn. Grant had his soldiers feed themselves from the Mississippi farms in the Vicksburg campaign of the spring of 1863. General William Sherman targeted Georgia farms during his "March to the Sea" in 1864, while at the same time General Phil Sheridan deliberately ravaged food supplies in the Shenandoah Valley to deny sustenance to Lee's army besieged at Richmond.[27]

With a much larger population than the South, the North could better withstand the labor lost when some of its men went to war. In addition, new technologies compensated for lost manpower. John Deere's self-polishing steel plow, Cyrus McCormick's mechanical reaper, and Obed Hussey's invention of a horse-drawn reaper made planting and harvesting wheat and other grains more efficient. At nearly the same time, John and Hiram Pitts of Maine invented a mechanized threshing and fanning machine that allowed for the quick and efficient processing of the harvested grain. As a result, agriculture spread from northern states to the prairies of the

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Upper Midwest, and the new technology helped farmers make the most of heretofore untilled soils. Advances in food preservation, such as sterilized canning, allowed the Union army to take advantage of the agricultural bonanza.[28]

Food shortages affected military campaigns as well. Lee's Army of Northern Virginia fought the Battle of Chancellorsville in May 1863 without one-quarter of its forces, which the general had sent to southern Virginia to collect desperately needed supplies. While the battle was a stunning Southern victory, Lee's ability to exploit it was limited by his lack of manpower. The desire to acquire more food served as a primary motivation for Lee's two invasions of the North, which resulted in the Battles of Antietam and Gettysburg. Most famously, Grant turned food into a weapon in the campaign to capture Vicksburg, Mississippi. He cut himself off from his supply line and fed his army from local farms. Over a three-week stretch in May 1863, Grant's men marched 180 miles, fought five battles, and only had to draw five days' rations from the army's commissary. Grant pushed thirty thousand Confederate troops into defensive lines at Vicksburg and starved that army into submission. After the first five days of the siege, the Confederate garrison had to reduce its daily fare to one-quarter of its normal rations. By June 28, soldiers received only a pittance of their meat and flour rations. One officer noted that fewer than half of the army could have offered resistance if Grant had launched another attack. Some Confederate soldiers wrote to General John C. Pemberton, asking him to surrender the army for lack of food, which he did on July 4, 1863. With the surrender, the states west of the Mississippi River were largely cut off from the rest of the Confederacy, denying their supplies of corn, pork, and beef to the soldiers and civilians further east. By the end of 1863, Confederate food production had been further reduced because Union forces controlled or denied access to one-third of all cultivated acres in the South.[29]

The Importance of Animals in the Civil War

Horses, mules, and oxen powered every wagon, artillery piece, and ambulance used by military forces. Cattle, hogs, and even chickens accompanied the troops, providing a mobile source of meat for hungry soldiers. Like the men they served, these animals had to be drawn from civilian life and prepared for war. In 1861, the United States was home to 1.1 million mules and 6.25 million horses. Because both sides had to rely on whatever animals they could muster from the home front, the South, with only half as many horses and mules from which to draw, faced an immediate disadvantage. The federal government was able to efficiently purchase serviceable horses at reasonable prices and establish horse depots to process and rehabilitate them. The 625-acre Giesboro Depot, located on the eastern bank of the Potomac south of Washington, D.C., could accommodate up to thirty thousand equines at a time. Over the course of its existence, 170,654 cavalry horses matriculated through the Giesboro facility. Other smaller depots aided in getting horses and mules from suppliers to the battlefields. The South was unable to create any similar depots that could come close to matching those of the Union.[30]

Horses and mules required plenty of feed. A mature horse required an average of fourteen pounds of hay and twelve pounds of grain per day. Horses also needed salt, preferably fed at least three times a week. Large herds could easily devour all the available grass around an army encampment. To keep the animals fit for battle, their rations had to be transported along with other supplies and delivered to them at the front. Lacking satisfactory organization or infrastructure to supply their men or animals, Confederate armies often allowed their horses to forage while on the move. They also relocated half-starved horses to areas far from the front, creating local supply shortages, as cavalry officers frequently commandeered civilian grains for animal feed. Confederate agents even confiscated scarce corn to feed their animals, although it is not suitable for long-term horse health. In addition to forage, equines required horseshoes, saddles, blankets, bridles, bits, harnesses, and other tack. The Union proved far more capable of providing the iron and leather necessary for these items.[31]

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Like humans, animals also faced constant threats from organisms that caused disease. Crowded together at supply depots, corrals, hayricks, and battlefield encampments, animals that had once lived in relative isolation from various contagions became ideal hosts for bacteria and viruses brought to the front. Greased or "greasy" heel was a skin inflammation caused by a variety of microorganisms and parasites that usually afflicted a horse's lower legs. Without treatment, animals developed serious lesions that exuded pus or a clear liquid (the "greasy heel" of its name) and could eventually go lame. Much more serious equine diseases were an incurable respiratory infection commonly called glanders and a disorder of the lymphatic glands known as farcy. Both resulted from infection by bacteria called *Pseudomonas mallei*, an organism easily passed between animals via shared forage grounds, watering troughs, and even grooming brushes. Both forms of the infection could kill, and neither could be cured, but glanders nearly always proved more serious. An animal diagnosed with glanders usually had to be put down to limit further infection within the herd. The contagion killed at least 248,000 Union horses between 1861 and 1863 and may have devastated even more Confederate animals. Although records of horse mortality are not comprehensive, scholars estimate that as many as 75 percent of Southern military horses died every year. The war proved to be a horse holocaust, as approximately 1.2 million horses and mules died in service during the war, or one out of every six equines in the country. The South bore the brunt of the loss. By 1870, six southern states still only had two-thirds as many horses and mules as they had before the war began (figure 3).[32]



Figure 3. Dead horses from the 9th Massachusetts Artillery at Gettysburg, July 1863.

Source: Library of Congress.

Hogs also suffered from a terrible disease: hog cholera. Confinement of so many hogs in a relatively small space probably allowed for mutation and development of more malicious strains of the virus, which manifested in fever, vomiting, and diarrhea. The disease destroyed more hogs than Union raids. This was devastating for the Confederacy because most of the animal protein that kept the infantry moving came from pigs, usually in the form of salt pork and bacon. Hogs, omnivores with simple digestive systems and large stomachs, convert nature's stored energy matter into meat suitable for human consumption as effectively as any creature. They convert their food into meat more than three times faster than cattle, and they reproduce more rapidly. Pork

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proved easier than beef to preserve by salting or smoking, making it an ideal food for troops on the move. It had been a staple of the southern diet for decades, as one study concluded that a typical southerner ate 150 pounds of pork per year in the antebellum period. By 1860, southerners raised two-thirds of the nation's hogs.[33]

But the war changed that situation rapidly. By summer 1862, northern armies controlled all of Kentucky and two-thirds of Tennessee, two states that had once provided large numbers of hogs traded in the South. A year later, northern troops captured Chattanooga and Knoxville, depriving the Confederacy of hogs shipped from east Tennessee. Union forces who wreaked havoc on the southern landscape frequently targeted pigs, destroying millions of pounds of pork and bacon in northern Alabama, Tennessee, and Mississippi in 1862 and 1863. The additional losses from hog cholera only exacerbated the food crisis in the South. During the war, hogs fared the worst of all livestock. Reduction in hog imports from the Midwest, Union depredations, and hog cholera led to a 70–80 percent decline in most southern states by the end of the war, with South Carolina suffering a staggering 85 percent loss.[34]

Military actions, weather, and disease also decimated cattle. As southern cows foraged in forests and grasslands, they inevitably became infested with a variety of ticks, some of which carried protozoa that affected cattle much like malarial parasites affect people. The most serious group of microorganisms, protozoa known collectively as *Babesia*, lived in tick saliva. The infection, Babesiosis, can kill an otherwise healthy cow in less than ten days. In a herd of previously unexposed animals, overall mortality can run as high as 90 percent. Another less lethal group of tick-borne parasites, *Anaplasma marginale*, caused a condition known as Anaplasmosis, which produced similar but less severe symptoms and was usually lethal only among older cattle. The same Union raids that targeted hogs also killed cattle, undermining the ecological foundations of southern subsistence. Additionally, the floods of 1862 drowned thousands of cattle, and a brutal winter of 1863–1864 struck Texas, killing 50–90 percent of the cattle on some Lone Star ranches.[35]

Whether suffering from microbes or weather, the animals could not be treated medically because adequate veterinary care was nonexistent. There was not a single veterinary school in the United States when the conflict began. During four years of war, the federal government spent roughly $100 million to acquire horses and mules for the armies but less than one-tenth of 1 percent of that total ($93,835) on medical personnel to treat the valuable animals. However, the war did impart significant lessons for animal husbandry. The federal government created the Department of Agriculture in 1862 and the American Veterinary Medical Association in 1863, which finally began to study the extent and effects of various animal epidemics. After the war, nearly two dozen land grant colleges established courses of study that included animal health. By 1879, Iowa State had the first publicly supported college of veterinary medicine. The war led directly to the development and professionalization of veterinary medicine and education.[36]

The Role of Terrain in the Civil War

Terrain, or the land's topography, proved important to military strategy. In the spring of 1862, the Great Appalachian Valley, a long level corridor underlain by limestone, proved vital to Confederate offensives. As General George McClellan approached Richmond from the east with a large army, General Robert E. Lee ordered Stonewall Jackson to create havoc in the Shenandoah Valley in western Virginia to prevent any more Union troops from reinforcing McClellan's army. Beginning in May 1862, Jackson hid his army behind the ridges and used the valleys as highways to surprise and defeat elements of three Union armies. In late summer 1862, Lee again used the Great Appalachian Valley to move a portion of his troops out of Virginia to Sharpsburg, Maryland, and the region along Antietam Creek. The Battle of Antietam took place in the northern reaches of the Great Valley, where uneven erosion of sandstone, dolomite, and limestone had created a landscape of shallow depressions, hollows, and gentle rocky ridges that shaped the defensive terrain of the battle.[37]

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Six months later, terrain played a vital role in the outcome of the war's most famous battle. Using the Blue Ridge Mountains to conceal his troops, Robert E. Lee moved into Pennsylvania, hoping to capture Harrisburg and achieve a key victory that might end the war. Learning that the Union Army of the Potomac was rapidly closing on him, Lee reunited his army at the centrally located town of Gettysburg, which lay in a geological basin atop limestone and shale formations. The rocky outcroppings and elevated ground of Little Round Top, Devil's Den, Cemetery Ridge, and Culp's Hill provided the defensive anchors that allowed the Union army to turn back repeated, determined Confederate attacks. In surveying rock formations associated with the conflict's twenty-five bloodiest campaigns, modern military geologists note that a quarter of those battles—all of them engagements with enormous casualty counts—occurred on ground underlain by limestone, whose propensity to erode faster than the surrounding terrain created the uneven ground on which so many soldiers died.[38]

The terrain of the western theater, with its many rivers, swamps, and bayous, presented myriad challenges for both armies. The high bluffs of the fortified city of Vicksburg proved impossible for Union naval gunboats to subdue in the summer of 1862. General William Sherman's forces were decimated in the Chickasaw Bayou in December 1862 while trying to take the city through its watery northern approaches. Grant unsuccessfully tried to reroute the Mississippi River in the winter of 1863 before finally settling on a plan to cross the river south of Vicksburg and ultimately besiege the city. Nine months later, when Union General Nathaniel Banks led a combined army and navy force west to capture Shreveport, Louisiana, Confederate forces effectively utilized the swamps and rivers to narrow his approach, defeat his army in two battles, and force its retreat. Southern forces also dammed portions of the Red River, lowering water levels so dangerously that the entire Union naval force was nearly stranded. Only herculean efforts on the part of naval engineers allowed several of the vital Union gunboats to escape.[39]

While terrain shaped how generals fought their battles, armies also altered the terrain. Notably, deforestation—resulting from the insatiable demand for wood to supply campfires, corduroy roads, build winter cabins and fortifications, or fire salt and iron furnaces and locomotive engines—occurred rapidly. When soldiers had consumed all the wood fences and farm buildings in a region, they turned their broad axes on the forests. For their cooking and heating fires, troops much preferred hickory and oak, which burned more slowly and provided steady heat over longer periods. Those trees, along with hemlock from the southern uplands, also provided the best wood for buildings and road construction. As a result, hardwoods quickly grew scarce around army encampments. Considering the amount of wood needed for numerous reasons, scholars conservatively estimate that at least four million acres of trees fell during the war.[40]

War also changed the terrain in ways that endured for decades. One of the best examples of long-term change engendered by the Civil War can be seen in the prominent southern city of Atlanta, Georgia. During the war, as Atlanta's military importance increased, its population doubled to more than twenty thousand, which created many environmental problems. The city's privies could not handle the massive influx of human waste, creating sanitation problems, and there was barely enough potable water to supply the city's increased demands. The arrival of General Sherman's army in July 1864 created an ecological crisis. Unrelenting summer heat and drought had reduced the city's marginal water supply, allowing uncontrolled fires caused by Union artillery shelling to burn 90 percent of the city's houses. The bombardment destroyed most of the city's wells and cisterns and wrecked all but one of its water pumps. After the war, civic officials who sought to rebuild Atlanta faced the dilemma of providing water for a heavily populated urban center. They made sure that the city's reconstruction reflected their segregation politics. Wealthy whites built their new residences on the higher ground in the city center and channeled their sewage out of downtown onto the surrounding lower-lying terrain, where freedpeople who migrated to the city were forced to live. When it rained, the marshy land flooded and became awash in sewage, ravaging Black neighborhoods with disease. As the high ground of the central city filled up, wealthy whites moved out to other elevated regions like Druid Hills and Ponce de Leon Springs with healthier lands and better water, leaving Black residents to fend for themselves in the polluted

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lowlands. In many ways, Sherman's siege set in motion patterns of segregation and environmental racism that plagued Atlanta for decades to come.[41]

After Appomattox, white southerners of sufficient means began a relentless drive toward producing cotton and other staples, which led to a dramatic increase in soil erosion from overworked and unrepaired fields. Recently emancipated freedpeople had no interest in performing maintenance tasks without additional compensation, and landowners refused to pay them for it. Wealthier landowners also compelled state governments to pass enclosure laws, requiring farmers to fence in their remaining cattle and hogs so that the animals might be more easily fattened for market or local consumption. Such stock laws had the overall effect of denying poorer southerners, Black and white, access to both land and animals. Lacking those necessities and without adequate federal assistance, former slaves and poorer white southerners became trapped in the postwar labor systems of tenant farming and sharecropping. Additionally, dead and maimed soldiers could not return to farm their fields. One out of every four southern soldiers died in the war, and likely a similar percentage returned home physically unable to perform much of the manual labor they had before the war. As a result, total acres of cultivated land decreased throughout the South. In the eleven Confederate states, between 1860 and 1870, the amount of improved land decreased by 9.85 million acres, a loss of 17 percent. The lack of manpower also led to reductions in the harvesting of food crops in the years following the war.[42]

The American Civil War was a biological event that affected humans, altered the physical environment, and shaped military actions. The symbiotic relationship between the Civil War and the environment requires a thorough understanding of health, weather, animals, terrain, and the agricultural ecosystems that fed people. The conflict created health crises for humans and animals and proved devastating for natural and built environments. The knowledge gained from the war improved medical care, animal husbandry, land management, and weather forecasting, and reshaped the social geography of the South. Not only did the environment play a role in the development and outcomes of military campaigns, but the actions of the armies also altered the forests, land, and urban areas of the South for generations to come.

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