

**Special Section:**

Rhythms of the Earth: Ecological Calendars and Anticipating the Anthropogenic Climate Crisis

**Key Points:**

- Literary sources illustrate that Roman farmers measured time by listening to birds and by watching insects, plants, celestial movement
- Mosaic representations portray time as measured by sensations associated with agricultural labors that followed a natural rhythm
- Weaving together the natural archive with text and image allows us to reconstruct human-environment interactions across changing conditions

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# Warm Soil, Westerly Wind, and Wet Feet: Feeling and Measuring Ecological Time in the Roman World

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**Abstract** Although climate change, pollution, and environmental degradation are contemporary problems, these are also challenges with deep historic roots in antiquity. 2,000 years ago, during the Roman Climate Optimum, a period of unusually warm, wet, and stable temperatures in the Mediterranean from roughly 200 BCE to 150 CE, the Romans altered the natural environment so greatly that they produced a level of pollution that was unparalleled until the Industrial Revolution. It is precisely in this contradictory time of unusually productive growth and destruction that we discover a blossoming of textual and visual ecological calendars illustrating how the Romans experienced the changing Mediterranean seasons. Roman agricultural treatises instruct us on specific agricultural tasks based on celestial movement, the arrival of particular winds, and on corporeal sensations, such as the warmth of the soil. Literary texts from the period portray kinship and shared corporeality between farmers and plants, with parent farmers listening to and assisting plant-children in achieving their desires. The concept of measuring time by means of the human body and its sensations is most explicit in the agricultural mosaics of the Late Roman period, which depict enslaved workers laboring, sweating, stomping, plowing, and performing seasonal tasks. While much of the conceptualization of indigenous ecological calendars is framed within the context of modern states, juxtaposing ancient predecessors and contemporary practices offers a new perspective on this topic.

**Plain Language Summary** This paper investigates human-environment interactions in the Roman era, specifically during the period of the Roman Climate Optimum (an especially warm, stable, and moist period from about 200 to 150 CE) and during the following centuries, which were characterized by greater climate instability.

## 1. Introduction

Pollution, environmental degradation, and climate change are often assumed to be strictly contemporary problems of the post-Industrial Revolution era. However, in an attempt to contextualize these contemporary problems within the *longue durée* of climate history, paleoclimatologists over the last decade have illustrated that countless ancient societies, such as the Maya in Mesoamerica, the Han and later dynasties in ancient China, the Oyo Empire in West Africa, and the Romans in the Mediterranean not only faced similar challenges, but that in fact the cultural history of these peoples was directly informed and impacted by environmental change (Beach et al., 2015; Chen et al., 2020; McMichael et al., 2017; Monroe & Ogundiran, 2012; Turner & Sabloff, 2012). This paper focuses on a single ancient society, the Romans, and how they measured ecological time through a phenomenological perspective. Of the many ancient societies, the ecological milieu of the Romans offers an especially fruitful comparative model because of the intersection of three dynamics: (a) an unusually stable, warm, and moist period from about 200 BCE to 150 CE (referred to as the Roman Climate Optimum), which facilitated (b) a level of production of anthropogenic pollution that was unparalleled until the Industrial Revolution, and was followed by (c) a period of great climate instability from roughly 200 to 600 CE (Harper & McCormick, 2018; Hughes, 2014; McCormick et al., 2012; Preunkert et al., 2019). The changing ecological conditions of the Roman world thus provide an opportunity to investigate an earlier period where we might expect to find compelling evidence for well-established, annual ecological patterns as well as later material where there may be literary or material culture evidence of environmental changes. My analysis is focused on primarily three types of data: primary literary sources (particularly from the period of the Roman Climate Optimum), floor mosaic representations of the months and seasons from the third and late fourth centuries CE, and the natural archives (the proxy data from tree rings, ice cores, lake sediments, etc.). Responding to the theme of this special edition collection, the discussion begins by asking whether it is appropriate to conceptualize the Romans as “indigenous,” suggesting that we instead consider them through the lens of the Latin word *indigenus*, the historic root of the modern

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word “indigenous,” meaning “to sprout from the Earth.” I then unearth and illuminate ecological calendars in Roman agricultural treatises and in poems, where we find Roman farmers listening to plants, examining the heavens, feeling the arrival of winds, and looking for insects to mark the passage of time. I then reinterpret mosaic calendars with scenes of monthly labors, of festivals, and of the four seasons through a phenomenological approach—focusing on the depicted sensations, such as the wet feet of grape pressers, the smell of freshly tilled soil, or the hotter air of the fourth century CE.

## 2. *Indigenus*: Sprung From the Earth

Let us begin with a simple question: were the Romans “indigenous”? The concepts of settler-colonialism and indigeneity within the ancient Mediterranean belong to a rich, growing field that cannot be fully explored here. However, even a brief attempt to answer this question illustrates the challenge in applying the term “indigenous” to a population who, through conquest, created one of the largest empires in world history, spanning at its peak nearly 2 million square miles and comprising between 10% and 20% of the ancient global population (Roymans & Fernández-Götz, 2015; Stoddart, 1999; Williams, 2022). Most importantly, the answer to this question is dependent on who is asking, where, and when. In the modern world, we find conflicting opinions. In formerly conquered European lands where the Roman past has been weaponized and utilized to forge a national identity, such as in England, the Romans are depicted today simultaneously as both indigenous ancestors and as foreign invaders in school curricula, museum exhibits, television series, and political debates (Hingley et al., 2018; Mattingly, 2006). On the one hand, television series with titles such as “Meet the Ancestors” and “What the Romans Did for Us” take ownership of Roman presence on English soil and naturalize and indigenize Roman colonizers. On the other hand, pro-Brexit voters likened the domination of the European Union to that of the Roman Empire, claiming that “the last time Britain faced imperial rule was in the days of the Roman Empire” and that “Britain is being bullied to join this ‘roman empire’ with no constitution in place” (Hingley et al., 2018). But of all the modern nations, the Italians express the greatest kinship to the Romans. Newspaper stories on various quotidian issues commonly refer to the Romans as “*i nostri antenati*,” our ancestors (Maresca, 2022). The phrase is especially popular in cookbooks and news reports about recent archeological discoveries about the Roman diet (Feresin, 2021; Franchetti, 2017; Longo, 2017). There is a sense that despite nearly 2,000 years of migrations, immigration, and long periods of foreign rule, food sprouted in Italic soil directly joins modern Italians to their ancient ancestors, making them both indigenous to the place.

In contrast, scholars of the ancient Mediterranean world have historically eschewed the term “indigenous,” favoring phrasing such as “ancient inhabitants.” This is because, as Hingley, Bonacchi, and Sharpe argue, the study of the ancient world is dominated by binaries: barbarity-civilization, religious-secular, public-domestic, indigenous-mobile (Hingley, 2000; Hylene, 2020; Webster, 2001). The difficulty here is that if mobility is the opposite of indigeneity, to be indigenous must mean to be rooted, sedentary, and immobile. By that definition migratory populations (be they human, animal, or plant) cannot be indigenous. Yet the Romans were just that, migratory from the very moment Aeneas, the mythological progenitor of the Romans, fled Troy and established the settlement that would become the city of Rome (Virgil, 2001, *Aeneid*). As the Roman era is characterized by mobility, forced and voluntary migration, and the movement of peoples, concepts, and things (Casco & Tacoma, 2016; Dench, 2005; Dommelen and Knapp, 2010; Stark et al., 2020), it has been conceptualized as the antithesis of rootedness, and thus of indigeneity.

Instead, I propose that we consider the Romans as *indigeni*, a compound Latin word that is the root of our modern term, indigenous, and was composed of *indu-* meaning “in” and *genus*, “to be born, or sprung from the Earth” (Apuleius, 1996, *Metamorphoses*, 1.1; Juvenal and Persius, 2004, 13.38; Livy, 2019, 2020, 23.5.11, 21.30.80; Pliny the Elder, 1945, *Natural History*, 14.72; Virgil, 2001, *Aeneid*, 8.314). Let us begin afresh then: were the Romans conceptualized as having sprung from the Earth? There is a long history of entanglement between cultivated plants and their caregivers in the Mediterranean world that preceded the Romans, illustrating how closely both plants and humans were connected to the soil that bore them. We find evidence of this concept in some of the most famous texts from antiquity. For example, in Homer's eighth-century BCE Greek epic, the *Odyssey*, Odysseus proves his identity to his elderly father upon returning from his 10-year journey by describing the most intimate knowledge about his own body, and by extension, the family estate:

“And resourceful Odysseus answered him and said: ‘This scar, first, let your eyes take note of, which a boar gave me with his white tusk on Parnassus when I went there. It was you who sent me, you and my

honored mother, to Autolycus, my mother's father, that I might get the gifts which, when he came here, he promised and agreed to give me. And come, I will tell you also the trees which you once gave me in our well-ordered garden, and I, who was only a child, was following you through the garden, and asking you for this and that. It was through these very trees that we passed, and you named them and told me of each one. Pear-trees you gave me, thirteen, and ten apple trees, and forty fig trees. And rows of vines, too, you promised to give me, even as I say, fifty of them, which ripened one by one at separate times—and upon them are clusters of all sorts—whenever the seasons of Zeus weighed them down.” (Homer, 1919, *Odyssey*, 24.330-347, trans. G. E. Dimock)

It is deeply illustrative that Odysseus' father faints only after hearing Odysseus describe the trees, figs, and vines, the “true tokens” of his identity. The scar marking his own flesh is less evocative. Forster suggests that “only a garden-lover, I think, would have placed this scene in a garden and treated it just in this way” (1936). But the relationship is deeper than that. There is a sense of a corporeal familiarity, as if the plants placed in Odysseus' care are a part of him, as if they are both products of familial Earth. This concept is articulated again in Homer's *Iliad*, when the goddess Thetis describes her son's, Achilles, childhood as like that of “a plant in a rich garden plot,” thereby collapsing the boundary between parenting and cultivating (Forester, 1936; Homer, 1925, *Iliad*, xviii, 57). The concept of a parcel of soil as a place of family and of origin becomes an even more pronounced concept in the Roman world, where one established both cities and gardens by first marking a boundary in the Earth, thereby enacting ownership and creating provenance for plants, animals, and humans (Cato, 1934, *On Agriculture*, 1.15.1, 46.1; Columella, 1941, *On trees*, 18.1; Koortbojian, 2020). This theme of kinship between plants, living beings that literally sprout from the Earth, and humans blossoms in the first centuries BCE and CE across literary genres and takes many different forms, in the form of myths of humans transformed into plants, descriptions of plant children and human parents, of humans who sprout from tilled land, and tales of shared lives between human and plant bodies (Cicero, 1914, *On Good and Evil*, V.40; Ovid, 1916, *Metamorphoses*, 10.1109, 13.646, 10.158, 8.1119, 4.388, 4.415, 10.202, 1.806, 9.561, 2.498, 10.317, 2.498, 9.554, 11.102, 10.754, 3.739, 2.498, 8.1119, 14.797, 4.415, 1.1035, 15.588; Pliny the Elder, 1945, *Natural History*, 15.26; Suetonius, 1914, *Galba*, 1.1). Of particular interest is a recurring Roman literary motif in which trees feature as progenitors of early Italic people, underscoring the chthonic origin of people. The concept first appears in Virgil's epic poem, the *Aeneid* (29–19 BCE) but is repeated by Statius in the *Thebaid* (second half of the first century CE) in a passage describing the origin of the Arcadians:

“To him the Arcadians an ancient people, older than the moon and stars, give trusty cohorts; they were born (*stirps*), 'tis said, of the hard trunks of forest trees (*nemus*), when the wondering earth first bore the print of feet; not yet were fields or houses or cities or ordinance of marriage: oaks and laurels suffered rude (*crudus*, bloody, immature) child-birth (*puerperium*), and the shady mountain-ash peopled (*creo*) the earth, and the young (*viridis*, green, young) babe (*puer*) fell from (*excido*) the pregnant (*feto*) ash-tree's womb. 'Tis said that, struck with terror at the change from light to murky darkness, they followed far the setting Titan, despairing of the day.” (IV.275-284, trans. Mozley, 1928)

The presence of three different kinds of parents is suggestive of different communities of humans (Gower, 2011; Myers, 2005; Newlands, 2004; Schildgen, 2013). And indeed, in the following lines, Statius tells us that although the Arcadians are all one race, they each have their own habits or customs, some on high mountains, some in forests, some in the countryside, some in windy places, some on snow-topped peaks. On the one hand, the description of the different locations illustrates the various Arcadian settlements as well as their great number, but on the other hand, Statius' description reads as a list of native habitats of plants. The poet Juvenal expands on the theme in Satire VI (late first or early second century CE), explaining that:

“For in those long-ago days, when the world was young, and the skies were new men (*homines*) born (*rumpo*, burst) of the river oak, or formed from mud (*compositive luto*, arranged of smeared mud), lived differently from now, and had no parents (*parentes*) of their own.” (VI.10-20, trans. S. M. Braund, 2004)

The chthonic origin of humans is unambiguous in Juvenal. Not only are trees portrayed as progenitors of the human race, but Juvenal builds on the theme and describes people being wrought from the very Earth itself, further collapsing the boundary between plants and humans.

The connection between perceived origin, soil, and the blurring of plant and human bodies is perhaps most explicit in Pliny the Elder's *Natural History*, a first-century encyclopedic text. Writing about the triumphal

procession after the Roman conquest of Judea, Pliny builds upon the arboreal, familial relationship presented in Virgil, Statius, and Juvenal, and presents balsam trees (native only to Judea) as natural born and naturalized subjects, interchangeable with their colonized humans:

“It is a remarkable fact that since the time of Pompey the Great that we have *led* (*duximus*) even trees in triumph. This tree [balsam] is now a slave (*servit*); it pays tribute (*tributum*) together with its race (*cum sua gente*)...Now it is the public treasury that grows it, and never before was it more plentiful.” (Pliny the Elder, 1945, *Natural History*, 12.111-113, trans. Totelin, 2012)

These few words are dense with significance. Pliny's word choice, *ducere*, meaning to lead, is unusual in that it is only used to describe the movement of animals and prisoners, beings with legs capable of locomotion (Östenberg, 2009; Totelin, 2012). The application of this verb to trees suggests that they somehow move themselves in the procession. Pliny's verb choice also ensures that the reader identifies the trees with the other ambulatory and animate procession participants such as the captured human slaves from Judea who were also displayed in the triumph. As in the case of Odysseus, where his trees, vines, and figs served as an extension of his very flesh, the balsams for Pliny and his contemporaries acted as interchangeable simulacra for the people of Judea; both the trees and the people were grown out of the same, shared Earth. The notion that trees move themselves as living beings suggests that the landscape of which they are signifiers is itself processed. When Pliny describes the procession of balsam trees, the trees *carry* the association of King Herod's groves where they previously grew and stand in place of the conquered land. Consequently, the planting of such a tree in one's garden is, in fact, a transplanting of that conquered land. A garden, then, becomes not a mere collection of plants, but a collection of lands and their peoples (Macaulay-Lewis, 2008; Marzano, 2014). Pliny also tells us that the enslaved and tribute paying balsam trees are now Roman political subjects, and equally important, it is this new political affiliation that has fostered a greater level of fecundity. In other words, the trees have been naturalized and made *indigeni* by means of their transplantation into Italic soil. This passage suggests that to be placed into or onto the soil of a place is a powerfully transformative action for plants and humans alike. It also illustrates that Roman imperialism, at least through the eyes of conquering Romans, facilitated a fluid and encompassing concept of indigeneity. Plants and people could retain identities associated with their place of origin, while simultaneously being transplanted, assimilated, and naturalized (Wallace-Hadrill, 2008).

### 3. Knowing the Winds and the Varying Moods of the Sky

During the course of the roughly 1,300 years of the Roman civilization, from the eighth century BCE to the fifth century CE, the means of measuring time and structuring a calendar changed repeatedly, and often featured competing, dissenting models (Stern, 2012). The calendrical legacy of the Romans is keenly felt today, as our 12-month Gregorian calendar is a direct descendant of the reforms put in place by Julius Caesar in 46 BCE. Yet an examination of Roman agricultural treatises and other literary texts (sources that provide insights into Roman perceptions rather than accurate depictions of phenomena) illustrates that Roman farmers and gardeners moved seamlessly between two methods of reckoning time, one based on a 365-day, 12-month calendar, and another founded on measuring time by feeling, hearing, seeing, and smelling their environment. Notably, such observations are ascent from the writings of the land surveyors, the *agrimensores* (Campbell, 2000). In the agricultural treatises, farmers and gardeners are taught what, when, and how to plant and husband animals based on celestial movements, the arrival of winds, and the physical changes in the soil wrought by seasonal changes. In a poem about agricultural matters written in 29 BCE the poet Virgil begins by describing springtime plowing but underscores the real foundation of agriculture practice: the importance of knowing a place,

“In the dawning spring, when icy waters tickle from snowy hills, and the crumbling soil loosens in a westerly breeze, then I'd first have my oxen groaning over the deep driven plough and the blade gleaming, polished by the furrow. Only the field that's twice felt sun, and twice felt frost, answers to the covetous farmer's prayer: from it boundless harvest burst the granaries. But before our iron ploughshare slices an unknown plain, let's first know the winds, and the varying mood of the sky, and note the nature of the ground, what each climate yields, the qualities of the place, and what it rejects.” (Virgil, 1999, *Georgics*, 1.43-70, trans., author)

Virgil's farmer is instructed first and foremost to listen and feel for all of the various place-specific qualities before undertaking cultivation (Doody, 2007; Spurr, 1986; Wilhelm, 1982). The act of listening to and learning about

a place means that non-human agents, such as soil, are treated as sentient beings that feel and record the number of frosts and periods of warm sun. There is also an implied cooperation or even reciprocity between nature and humans as Virgil warns the farmer to only cultivate those things which nature will herself support. Plants, insects, and animals also figure among the many non-human agents that communicated with humans and signaled the passage of time. Nature herself, according to Pliny the Elder, had created time-tellers for the farmers, noting that,

“It is not owing to me [nature] that you do not understand the heavens and know the things thereof. I will bestow a sign upon your ears also: only listen to the cooing of the ring-doves, and beware of thinking that midsummer is past until you have seen the dove sitting on her nest.” (Pliny the Elder, 1945, *Natural History*, 18.268, trans. H. Rackham)

Pliny then continues to list numerous other natural time-tellers, such as the annual arrival of fireflies that marked the appropriate time for sowing millet, and explains how glowworms, bees, heliotropes, and lupines have been created for the sole purpose of telling time,

“I have given you plants that mark the hours, and in order that you may not even have to avert your eyes from the earth to look at the sun, the heliotrope and the lupine revolve keeping time with him. Why then do you still look higher and scan the heavens themselves? Lo! you have Pleiads at your very feet.’ Glow-worms do not make their appearance on fixed days or last a definite period, but certain it is that they are the offspring of this particular constellation. Consequently anybody who does his summer sowing before they appear ‘will have himself to thank for labour wasted’. In this interval also the little bee comes forth and announces that the bean is flowering, and the bean begins to flower to tempt her out. We will also give another sign of cold weather being ended: when you see the mulberry budding, after that you need not fear damage from cold.” (Pliny the Elder, 1950, *Natural History*, 18.67., trans. Rackham)

Because mulberries bud after the last killing frost, they were a critical temporal marker for farmers. In fact, mulberry blossoms as a botanical calendrical signifier were perceived to be so useful that one even finds American Founding Fathers following Pliny's advice, as evidenced by the “Mulberry Row” at Jefferson's Monticello or the Mulberry tree outside the Plinian garden at the Madison plantation in Montpelier, Virginia, where the mulberry served as a natural call to work for enslaved gardeners in spring time (Brown, 2012; Kelso, 1986; Reinhold, 1984; Shumate, 1991).

Perhaps the most important markers of agricultural time were found by looking up at the heavens. As noted by the agronomist, Varro, writing in the first century BCE, the farmer's year was organized according to celestial movements and winds, so that:

“The first day of spring occurs [when the sun] is in Aquarius, that of summer when it is in Taurus, of autumn when it is in Leo, of winter when it is in Scorpio. As the twenty-third day of each one of these four signs is the first day of the four seasons, this makes spring contain 91 days, summer 94, autumn 91, winter 89, which numbers, reduced to the official calendar now in force, fix the beginning of spring on February 7, of summer on May 9, of autumn on August 11, of winter on November 10. But in the more exact divisions certain things are to be taken into account, which cause an eightfold division: the first from the rising of the west wind to the vernal equinox, 45 days, thence the rising of the Pleiades, 44 days, thence to the solstice, 48 days, thence to the rising of the Dog Star, 27 days, thence to the autumnal equinox, 67 days, from there to the setting of the Pleiades, 32 days, hence to the winter solstice, 57 days, and back to the rising of the west wind, 45 days.” (Cato & Varro, 1934, *On Agriculture*, I.28.1-2, trans. M. P. Hooper, W. D. Ash, & H. B. Adelman)

Written shortly after the adoption of the 12 month-365-day Julian Calendar in 46 BCE, it is significant to note that Varro moves effortlessly between the 12 month calendar and the ecological one founded on celestial movement and winds (Stern, 2012). His year is organized around four distinct locations of the sun and is then further subdivided into eight smaller increments. As the four major seasons are all roughly of equal duration, one might expect that Varro's eightfold subdivision feature a similarly neat division of days, suggestive of anthropogenic organization. Instead, the eightfold divisions are also governed by the skies and wind, and thus vary considerably in length, with the shortest lasting a mere 27 days and the longest 67 days. The precision of Varro's description of the exact length of days of each period and the exact location of the sun paints an image of a farmer who measures time by gazing up at skies. Once the celestial bodies align, Varro then continues by explaining what duties should be done in each of the eightfold periods. For example, in the first period, from the arrival of the west wind



to the vernal equinox, the farmer should plan out his nurseries, clear meadows, weed the grain fields, manure the meadows, prune the orchards, plow three times, as well as perform many other tasks (Cato & Varro, 1934, *On Agriculture*, I.29.1-3). While Varro explains how celestial movement is observed and used as a guide for completing agricultural tasks, we learn from Pliny the Elder in his *Natural History* that the movement of the stars and plants is also felt in bodies and the Earth,

“Moreover also the parts of some constellations have an influence of their own—for instance at the autumnal equinox and at midwinter, when we learn by the storms that the sun is completing its orbit; and not only by falls of rain and storms, but by many things that happen to our bodies and to the fields. Some men are paralyzed by a star, others suffer periodic disturbances of the stomach or sinews or mind. The olive and white poplar and willow turn round their leaves at the solstice. Fleabane hung up in the house to dry flowers exactly on midwinter day, and inflated skins burst.” (Pliny the Elder, 1855, *Natural History*, 2.41.1, trans. Riley and Bostock)

In this way the ecological calendar is not only seen, smelled, or observed but is also felt corporeally. In a lengthy section on the nature of the various winds in Italy and in Egypt, Pliny explains that these phenomena were also associated with animals,

“Certain persons give the name Chelidonias to the West wind on the 19th February, owing to the appearance of the swallow, but some call it Ornithias, from the arrival of the birds on the 71st day after the shortest day, when it blows for nine days.... But for six days before the shortest day and six days after it the sea calms down for the breeding of the halcyons from which these days derive their name.” (Pliny the Elder, 1855, *Natural History*, 2.47.1, trans. Riley and Bostock)

The naming of a wind after particular migratory species is suggestive of a stable ecological pattern from year to year. It also illustrates Roman sensitivity to the wild animals around them, their migratory movement, and their reproductive lifecycles.

Moreover, throughout the three books comprising *On Agriculture* and the agronomic texts of Cato and Columella, we find that ecological calendars were experienced according to place-specific conditions. While Varro opens with celestial movement, the remaining instructions he gives his farmer-reader follow Virgil's poetic advise: one must first know a place and the moods of the sky (above that land). In regard to the planting of seeds, Varro advises that “time is not the same for all locations and all species” but instead varies based on the place-specific conditions of the soil, whether it is clayey or thin, dry or humid (Cato & Varro, 1934, *On Agriculture*, I.40.3). In particular, Varro brings the reader's attention to the differences between lowlands, hillsides, and mountains,

“Undoubtedly a different system is applied to the lowlands than to the mountains, because the former are hotter than the latter; and the same is true of hillsides, because they are more temperate than either the plains of the mountains. These qualities are more apparent in broad stretches, when they are uniform; thus the heat is greater where there are broad plains, and hence in Apulia the climate is hotter and more humid, while in mountain regions, as on Vesuvius, the air is lighter and therefore more wholesome. Those who live in the lowlands suffer more in summer; those who live in the uplands suffer more in winter; the same crops are planted earlier in the spring in the lowlands than in the uplands, and are harvested earlier, while both sowing and reaping come later in the uplands.” (Cato & Varro, 1934, *On Agriculture*, I.6.2-3, trans. M. P. Hooper, W. D. Ash, & H. B. Adelman)

As Varro explains in the following passages, these place-specific conditions greatly impact cultivation and plant growth. For example, while pine and fir flourish in colder, mountainous, climates, willows and poplars grow more abundantly in warmer lowlands (Cato & Varro, 1934, *On Agriculture*, 6.3) The selection of passages presented here (comprising only a small fraction of those that exemplify these themes) articulate that the farmer's ecological calendar then was not only built upon celestial movement, on sensing the coming of a particular wind, on hearing the arrival of migratory birds, on noting the budding and growth stages of certain plant species, but also required the farmer to be familiar with the materiality of the soil, the physical qualities of the air (dry or humid), and the topography of his property.



**Figure 1.** The Mosaic of the Months, House of the Months, Thysdrus (modern El Djem), third century CE. (Source: © Ad Meskens/Wikimedia Commons).

#### 4. Wet Feet and Hotter Air

We find even more evocative evidence of human bodies measuring and feeling ecological and seasonal changes in representations of the calendar, an especially popular motif in Roman art in domestic, funerary, and public settings (Malek, 1999, 2017; Parrish, 1979; Rüpke, 2011). As the corpus of seasonal representations is much too large to fully examine here, I focus on two pairs of contemporaneous mosaics, two third-century CE mosaics from Africa Proconsularis (modern day Tunisia) and from Roman Gaul (modern day France), and two late fourth-century CE mosaics from Tunisia.

The Mosaic of the Months was discovered in the so-called House of the Months, a large and lavishly decorated complex on the outskirts of the ancient town of Thysdrus (modern El Djem) in Tunisia in 1961 (Eastman, 1996, 2001; Foucher, 1962; Porstner, 2020) (Figure 1). Although earlier partially preserved examples are attested around the Mediterranean, to date it is the oldest surviving complete calendar, featuring all 12 months and the four seasons (Porstner, 2020; Stillwell, 1961). Dated to the early third century CE, the mosaic measures roughly five by four m and features a white ground, a yellow palmette border framing a central section composed of 20 complete *emblemata* (more finely worked figural or decorative panels), four partially damaged ones, and yellow, red, and black, geometric and vegetal motifs in between the *emblemata* (Dunbabin, 1999). The panels are arranged orthogonally, akin to the placement of plantings in Roman vineyards or orchards. Mosaic calendars, such as this one, commonly portrayed the individual months by depicting significant events that annually occurred in them,

such as festivals or agricultural labors (Dunbabin, 1978). The depictions chosen for each month must have had such a strong connotation and connection with a particular period of time, that inscriptions naming the months are often absent; the image/action itself served to identify or even name a period of time. If we focus on just 1 month at Thysdrus, September (Figure 2), and a contemporary third century CE September example discovered in a rural villa in Saint-Romain-en-Gal (Figure 3), just south of Lyon in France, it becomes clear that September was understood as a time centered on viticulture, and more specifically on grape pressing. Despite the great distance between these two sites, roughly 1,500 km as the crow flies, the two mosaics bear many similarities. In both examples we find nearly nude male figures, two at Thysdrus and three at Saint-Romain-en-Gal, energetically jumping and pressing grapes into wine in large wooden basins. At Saint-Romain-en-Gal, one of the

figures plays a double-aulos, transforming a Dionysian instrument into a tool for keeping the rhythm of labor. The scene in both has been reduced to the bare (literal and figurative) essentials to increase legibility: we do not see the estate in the background or the local topography. At Thysdrus the figures and vat float on top of the white ground, completely without physical context. At Saint-Romain-en-Gal the mosaicist has placed the pressers in front of a colonnaded façade, creating a shallow pictorial space and blocking our view from the larger context. In both examples much greater effort has been made by the mosaicist to portray the action—the vigor and strength of the stomping legs and strong upper bodies—than in the facial features of the individuals. These are not meant to portray identifiable workers. Instead, the viewer sees generations of grape-pressers collapsed together into one body.



**Figure 2.** September grape-pressing, detail from the Mosaic of the Months, House of the Months, Thysdrus (modern El Djem), third century CE. (Source: © Ad Meskens/Wikimedia Commons).

Scholars have generally interpreted such depictions of labor as evidence of agricultural practice, as related to the social and political power of the homeowners, as symbols of desired fertility and productivity, and as tasks-capes (Dunbabin, 1978; Ingold, 1993; Mallon, 2021; White, 1967). Mosaic calendars such as these would primarily have been viewed by their elite free owners, their free family and friends, and their enslaved domestic workers. The enslaved or free laborers commonly depicted in the panels, like the grape





**Figure 3.** Grape-pressing scene, detail from the Rustic Calendar mosaic, Saint-Romain-en-Gal, third century CE. (Source: Carole Raddato/Wikimedia Commons, Creative Commons [Attribution-Share Alike 2.0 Generic](#)).

pressers, were unlikely to have spent anytime indoors within sight of these representations (Mallon, 2021). The implied bounty in the yield of the grapes and the strength and vigor of the laborers directly reflect on the power and estate management skills of the owner. In a world where enslaved individuals were legally categorized as “thinking-tools,” the stomping grape-pressers are a prosthetic limb of the estate owner (Giannella, 2014; Reay, 2005; Roth, 2007, 2010). But simultaneously, as Dunbabin has observed, seasonal representations of agricultural bounty and labor must also have been so largely popular because they were also future-looking and were perceived to bring blessings and prosperity to the estate (Dunbabin, 1978). Indeed, as Dundabin notes, “hardly any subject is commoner or more stereotyped on mosaics from the mid-second century onwards than the Season” (1978). It is significant to note that seasonal representations become ubiquitous coincidentally at the end of the Roman Climate Optimum, when, conceivably, cultivation became more challenging, and thus estate owners felt a greater need to express wishes for successful harvests. The intersection between naturally caused environmental changes and seasonal iconography is discussed later in this paper, but it is also possible that anthropogenic-caused environmental degradation played a role in the rise of seasonal depictions. The stable, warm, and moist conditions of the Roman Climate Optimum facilitated an agricultural boom, which in turn fueled imperial expansion. But this same phenomenon instigated a rapid consumption of raw materials, such as timber and

minerals for metal work (including coinage and weapons), resulting in increasing levels of pollution and environmental degradation. Ice cores from the Alps and Greenland have illustrated that increases in lead and antimony pollution levels directly correlate with Roman imperial expansion from the second century BCE to the Antonine Plague in 165 CE when the Roman army was decimated and pollution levels fell, and that spikes within that period coincide with political events and wars (McConnell et al., 2018; Preunkert et al., 2019). This same period is also marked by aggressive deforestation (clearing fields for agricultural endeavors and harvesting lumber for activities related to imperial expansion), which in turn led to erosion, runoff, flooding, and mosquito-borne illnesses (O’Sullivan et al., 2008). In other words, during a time when the natural world was especially fecund and facilitated the production of more goods, the Romans harvested and consumed raw materials and cultivated products at unprecedented rates, thus producing a level of pollution unparalleled until the Industrial Revolution (McConnell et al., 2018; Preunkert et al., 2019). This contradictory context suggests that perhaps representations of the bounty of the seasons could simultaneously be a result of the conspicuous consumption of the era, but that they might also reflect a growing concern with increasing challenges in cultivation caused by both natural and anthropogenic environmental changes.

Because multivalency was one of the main characteristics of Roman visual culture, allowing the same image to be read in differing ways, depending on audience and social context, I suggest that we might view September grape-pressing depictions, or any of the other monthly actions, such as plowing, olive picking, tree pruning, or manuring, through an additional and alternate lens (Hölscher, 2004; Zanker, 1990). To merely say that September was associated with grape-pressing collapses together a myriad of phenomenological experiences that deserve to be unpacked. If we reframe our perspective and consider what these panels tell us about how Romans perceived time vis-à-vis the human body, we find that wet feet, the aroma of ripe grape juice, skins and juice and pips squeezing up in between toes, and bodies splattered with wine mush (hence the nearly nude attire—this was messy work that covered and stained the body) were all sensations that marked the arrival and boundaries of September. Indeed, we might even question whether the images that lack textual labels naming the months invite us to do away with month names and instead to conceptualize that period as the grape-pressing-wet-feet time. Because of the characteristically Roman intersection of two concepts—the moral value of labor and the legal categorization of enslaved workers as possessions and extensions of their owners (Bradley, 1984, 1994; Giannella, 2014; Joshel & Petersen, 2014; Wallace-Hadrill, 1998), we must envision and feel not just the laborer’s literal wet feet, but the estate owner’s as well who by extension owned and metaphorically felt the slick skins of the grapes under their soles too. This type of reading extends beyond the framing of September and equally applies to the other months, where agricultural labor or scenes of festivals are depicted. Thus, in another panel from Saint-Romain-en-Gal (Figure 4), where we find two laborers dressed in short tunics, one leading





**Figure 4.** Scene of plowing and sowing of seeds, detail from the Rustic Calendar mosaic, Saint-Romain-en-Gal, third century CE. (Source: Crispins C. Crispian/Wikimedia Commons, public domain).

two plowing-oxen and another holding a basket and sowing seeds, we need to unfold the sensorial experience captured in the image (Hamilakis, 2014; Platts, 2020; Skeates & Day, 2019). In antiquity as today, turning the Earth is a powerfully aromatic undertaking. Running the plow through the ground forces dry, lighter particles of Earth to become airborne and creates rich, fragrant, earthy plumes that blow on the wind. The earthy smell would be released not just by one laborer, as depicted in the mosaic for greater visual clarity, but by many workers across neighboring farms over the course of a number of weeks, so that during plowing time, the entire community would be perfumed by the characteristic aroma of local soils. This smell would also indicate, as the *emblema* illustrates, that this was also a period for sowing seeds. Whether it is the heavy fragrance of roses during the *Rosalia* festival or the pungent smell of manure delivered by laborers, the common theme in all of these depictions of time via agricultural or festival scenes is the phenomenological experience of the human body with cultivated nature, with smell playing an especially prominent role.

Representations like those of grape-pressing illustrate a continuity in measuring, feeling, and smelling specific moments in time from year to year across the Roman world. But, if we examine the representations of the four seasons in the later Roman Empire, we also find evidence suggestive of altered sensations and climatic change. The seasons were such a ubiquitous motif in mosaic floors that Dunbabin, a leader in mosaic studies, speculated whether at times they were depicted merely out of habit (1978). For this reason, the mosaics of the four seasons have received limited scholarly attention, certainly less than depictions of seasons on carved sarcophagi or other media

considered to be finer and more elevated than floors (Dunbabin, 1978; Levi, 1941; Parrish, 1977, 1979). But I would like to suggest that in light of the major developments in ancient environmental studies, our growing understanding of the Roman Climatic Optimum (200 BCE–150 CE), and the blossoming of research that frames climate and environment not as a passive backdrop to anthropogenic activity but as an active agent in cultural history, it is time to re-examine representations of the seasons. I focus here on one visually minor but climatologically significant iconographic change in the representation of the personification of summer. As Dunbabin notes, the iconography of the seasons remained limited, depicting only a few different types, and was largely unchanged for nearly two centuries starting with the mid-second century CE (1978, 1999). Most commonly, personifications of the seasons, depicted either in bust or full figure form, were shown in conjunction with their bounty and the implements utilized to gather them. Thus, the portrayal of summer is characterized by wheat stalks and sometimes also features the scythe utilized in its harvest. The ubiquity of these compositional features, especially the wheat stalks, may be found across the empire. For example, we find busts of summer wearing a crown wheat in Cirencester in England (dated to the second century CE, at the Corinium Museum), at Saint-Romain-en-Gal (150–200 CE, at the Getty Museum), and at the House of Silenus at Thysdrus (late third century CE, in the El Djem Museum), to name but a few comparative cases. In more rare examples, summer is portrayed in full-figure, such as in the third century CE Thysdrus calendar mosaic discussed earlier (with the September grape-pressing scene) where summer is shown walking, carrying a large basket filled to the brim with wheat stalks in one hand and a scythe in the other. A similar full-figure composition was found at Haidra in Tunisia, dated to 238 CE (displayed in the United Nations Conference Building), where a full-figure winged summer putti stands holding a scythe and a basket of wheat stalks surrounded by a vine sprouting wheat heads. In rarer cases still, mosaicists made minor adaptations to these compositional features, so that, for example, a late third century CE mosaic found in a Roman house in Thessaloniki (in the Archeological Museum in Thessaloniki) depicts summer in bust form, but instead of wearing a crown of wheat, a handful of long wheat stalks are arranged, like a quiver, at an angle directly behind her, as if piercing her head and framing her hair. Interestingly, as the climate became less stable following 150 CE, summer's iconography remained relatively static. In example after example we find that wheat is her dominant attribute, with some depictions also featuring a scythe. It is only in the fourth century CE that we find a shift in the iconography from summer's wheat to the heat of summer. Of the four seasons, only winter has a long history of depicting an associated sensation, namely the cold, as its personifications were



**Figure 5.** The Dominus Julius Mosaic, Carthage, Tunisia, late fourth century CE. (Source: Boyd Dwyer/Wikipedia Commons, Creative Commons Attribution-Share Alike 2.0 Generic license).

commonly portrayed hooded and bundled in a long cloak, as we see for example, on one of the *emblemata* from Saint-Romain-en-Gal (Dunbabin, 1999; Steer, 2003).

Because the portrayal of the seasons was so heavily focused on the productive bounty and the associated labors of each period, the following discussion re-examines a few rare instances of deviation where summer was instead depicted as too hot. Two roughly contemporaneous mosaics dated to roughly the late fourth century CE from within 50 km of one another, from Carthage and from Djebel Oust in Tunisia, show summer as fanning herself with a *flabellum*, a plated and folded fan. The first example, from a wealthy house in ancient Carthage, features an unusual composition (Grabar, 1962; Nevett, 2010; Picard, 1951). The mosaic, divided into three registers, was discovered in an apsidal room and depicts a fortified villa at its center. Across the floor, we find repeated representations of the owners in the guise of seasonal personifications (Figure 5). The top third portrays winter activities (the olive harvest and duck hunting) in the upper left corner and summer ones in the right corner (shepherding and the wheat harvest). In between these two scenes the mistress of the estate reclines in what Parrish described as a “diaphanous” gown and fans herself, suggesting that she is part of the summer scene to her right (1979). The middle register depicts the arrival of the family and Dominus Julius hunting. The bottom register returns to seasonal motifs, with spring allusions in the bottom left where the mistress performs her toiletry surrounded by springtime blossoms while in the opposite right hand corner Dominus Julius, seated in an autumnal orchard with baskets of grapes, receives a scroll with his name.

The arrangement of the mistress fanning herself and reclining in the summer scene certainly connotes a number of social messages. Her leisurely, seated, and sedate posture contrasts with the energetic, diagonal, forward-tilt of the winter-time laborers, accentuating class, status, and gendered differences in rank within the estate (O’Sullivan, 2011). The mosaicist also captures differing and contradictory body temperatures. The laborers are depicted in movement and fully clothed, generating bodily heat by rushing to meet the demands of the estate owners but showing no indication of being too warm, in contrast to the mistress fanning herself, presumably made too hot by the tedious and onerous task of surveilling the estate tasks from her elevated position. The labor of the mind appears to be thus more strenuous than the physical labor of the workers (Harper, 2011; Reay, 2005; Wallace-Hadrill, 1998). Taken on its own, the summer fanning motif found on this mosaic might not make a convincing argument for climatic change in the area of Carthage or the wider Mediterranean, but its multi-layered





**Figure 6.** Season mosaic, Djebel Oust, Tunisia, late fourth century CE. (Source: Author).

sensorial associations take on a more environmental connotation when we compare it a contemporaneous mosaic from 50 km away from Djebel Oust.

In the second example, at Djebel Oust, personifications of spring, autumn, and winter are shown in three-quarter busts holding seasonal attributes: roses, grapes, and olives, respectively (Fendri, 1965; Parrish, 1979) (Figure 6). Of the four, only summer, in the bottom right corner, lacks a good produced during her reign. Her head lacks the wheat crown her countless counterparts don. Instead, wearing a sleeveless garment, she holds a fan in one hand, and is shown with a peacock feather behind her right shoulder and a scroll in the lower lefthand corner. Peacocks and their feathers possessed multivalent iconography in antiquity and were associated with luxury, fertility, immortality, and the goddess Juno, to name but a few associations—the birds were also considered a tasty treat (Apicius, 1980, VI.5; Dunbabin, 1978). But, the combination of fan and feather together may have had an entirely different reading here. An illustration of August from the *Chronograph of 354 CE*, an early Christian calendrical text, presents a peacock feather fan as a cure for the fevers that came during August's “dog days,” the hottest period of the year marked by the Sirius constellation (Figure 7) (Åkerström-Hougen, 1974; Fendri, 1965; Parrish, 1979; Salzman, 1990). The illustration, which portrays the personification of August as drinking from a glass vessel, is paired with a short metric commentary,

Look how, heated, he drinks fresh water plunging  
His lips into the shining glass cup, the month called  
By the eternal name of Augustus' reign; the month  
When it is said that Latona has given birth to Hecate. (Translated by  
Levi (1941))

Based on the calendrical illustration, Parrish (1979) and Åkerström-Hougen (1974) suggest that the personification of summer at Djebel Oust ought to be read as portraying hot weather and warding off August's bad air, but they do not further investigate the cause of the iconographic change. As already noted earlier, Dunbabin argues that the ubiquity of seasonal representations with displays of bountiful products stemmed from the fact that as “symbols of fertility and regeneration they were capable of bringing good fortune to the building in which they were represented, or to their observers.” (1978) This was an especially culturally significant function because Roman villa estates were primarily revenue generating enterprises, producing raw materials and goods which could be sold for profit (Marzano, 2007; Marzano & Métraux, 2018; Wallace-Hadrill, 1998) A personification of summer fanning herself and warding off bad airs brings a distinctly different wish into the house than one with bountiful wheat. One is a commentary on seasonal sensorial experience (are we meant to interpret summer as too hot or is the estate desirous of a return of warm summers?) and an apotropaic sign meant to ward off undesired fevers, while the other portrays desired agricultural fertility and, in turn, wealth. Although summer fanning herself was a rare motif, these were not the only two examples. To my knowledge, two other Late Antique examples of this composition have been found, a floor mosaic from the Villa d'Awza'i outside Beirut, in modern Lebanon, dated to 450–550 CE and the Month Mosaic from Beit She'an in modern Israel dated to the second half of the sixth century CE, followed by a number of later medieval illustrations (Åkerström-Hougen, 1974; Avi-Yonah, 1936; Chéhab, 1957).

Since Åkerström-Hougen and Parrish revived scholarly interest in the fan composition more than 40 years ago in the 1970s, great advances have been made in ancient environmental studies and especially in paleoclimate research, an area of study that has blossomed recently and has greatly expanded our understanding of the ancient world (Harper, 2017). Much of the research has focused on understanding the ancient ecology of the Mediterranean, ancient food production, famine, water systems, and forest management (Garnsey, 1988; Grove & Rackham, 2001; Harris, 2013; Horden & Purcell, 2000; McCormick, 2011). Building on this new discourse, I suggest that if we place this late fourth century iconographic innovation against the backdrop of our growing understanding of climatic history, it becomes even more clear that summer fanning herself cannot be read as merely an expression of leisure and status. As Harper and McCormick (2018) illustrate, proxy data from





**Figure 7.** An illustration of the personification of August from the Chronograph of 354 CE. (Source: Wikimedia Commons, public domain).

“tree rings, ice cores, speleothems (stalactites), lake varves (sedimentary layers) and other natural archives” all underscore the presence of the Roman Climate Optimum (an inconsistently defined era that roughly spanned from 200 BCE to 150 CE), a period of remarkably stable, warm, and moist conditions in the Mediterranean conducive to agricultural cultivation and innovation (Harper & McCormick, 2018). But these ideal conditions were followed by a period of irregularity. According to dendro-data, surface ocean temperatures, solar irradiance, and ice-core data, the early second century CE saw an initial phase of cooling, with more pronounced cooling in the middle of the third and fifth centuries CE, followed by even cooler temperatures in the sixth century (McCormick et al., 2012). But in between these cooler periods marked by more limited solar activity, the fourth century, when these mosaics were created, is characterized by a significant increase in solar irradiance (Harper & McCormick, 2018; Steinhilber et al., 2012; Vieira et al., 2011). To put it plainly: after significant cooling in the third century, the fourth century was unusually warm and summer, as indicated by her fan, was too hot. To unpack this further, the estate owners, like those in the Dominus Julius mosaic (or their mosaicist) must have noted the heat of the summer enough to warrant the change in summer's iconography. But even more importantly, the evidence suggests that we ought to imagine the portrayed villa laborers performing tasks across the estate in more challenging, summer-time conditions. The depicted and described thirst of August in the fourth-century CE calendrical text discussed earlier suggests the conditions must have been especially difficult for the lowest ranking estate laborers, who worked in sunbaked fields (Shaw, 2001). The presence of the peacock feather warding off fevers at Djebel Oust also aligns with our growing understanding of the impact irregular and unusual climatic

conditions played on rates of disease after 150 CE (McMichael et al., 2017). Harper and McCormick (2018) argue that “comparison of written and natural archives validates the idea that *both* preserve significant evidence about past climates,” but I suggest with these mosaics that we cannot limit the data set to just the two types of sources they identify, we need to re-investigate the visual material culture of the ancient world as well. This is especially critical because although paleoclimatology is a new and rapidly growing subfield in ancient studies, a quick scan of the publications of the last decade illustrates a recurring theme: of all of the many regions of the Roman world, the climate history of Roman North Africa (excluding Egypt, for which we have excellent flood records) is by far the least mentioned and investigated (Huebner, 2020; Manning et al., 2017; Murphey, 1951; Van Zeist et al., 2000). This is in part because our proxy data is unevenly distributed, providing the clearest information on the northwest provinces, modern Germany and France (Harper & McCormick, 2018; McCormick, 2011; McCormick et al., 2012). This challenge is further compounded by the fact that there is evidence of regional, divergent developments. For example, while parts of Turkey became wetter in the sixth century CE, Palestine during that same period became drier (Harper & McCormick, 2018). Thus, while we can place these mosaics within the larger pan-Mediterranean context of a warmer fourth century, we need to be mindful of the fact that they may also depict evidence of Carthage-centric environmental changes. In this way, visual representations may provide insight for a region that is less well documented in the proxy data.

## 5. Conclusions: Reading and Seeing Our Way to Feeling Time

We began by questioning whether the Romans were *indigeni*, sprung from the Earth, and by exploring how their chthonic origin may have shaped their sensitivity to feeling ecological time. The literary passages investigated here articulate a cooperative and even reciprocal relationship between human farmers, nature, and non-human agents. Rather than portraying cultivation as an aggressive act of conquest and domination, Roman farmers are depicted learning about and listening to the natural affordances of a place, gazing at the stars, and watching for fireflies, glowworms, and mulberry blossoms to signal various agricultural tasks. Despite the settler-colonialist roots of the Romans, at times one almost hears in the Latin an uncanny parallel to the writings of Robin Wall Kimmerer, citizen of the Potawatomi Nation, botanist, and poet (2013). Indeed, the resonances between Latin prose and Indigenous ecological knowledge serve as a call for further investigation.

Paleoclimatology in the Roman world is a budding field and the analysis conducted here provides merely a glimpse into the types of questions we are just beginning to ask of the new, growing body of evidence. At the heart of this discussion is the potential of weaving “the hard sciences,” that is, proxy data from the natural archives, with a humanistic approach that joins written primary sources and material culture. Thus, by applying ecological temporal labels, such as Roman Climate Optimum, to literary texts in place of more traditional ones (such as Late Republican, Early Imperial) it becomes possible to discern more clearly patterns of human-environment interactions. The exploration of agricultural and literary texts from this unusually warm, moist, and stable period illustrates an intimacy and sensitivity to annual ecological temporal markers, such as insects, animals, plants, winds, and celestial bodies. There is an implied expectation in the texts that the fireflies, mulberries, and westerly winds can be relied upon to arrive at preordained moments as a result of the climatological stability. Through the process of translation of media, from text to image, the mosaics offer a further, new perspective on Roman interactions with the natural world and the passage of time. In addition to the historically identified themes (expressions of social power, wishes of fecundity and wealth), the calendar mosaics illustrate an acuity to an eco-phenomenological perception of time. The year, according to the representations, was measured by wet feet at grape-pressing, the fragrance of roses during the *Rosalia* festival, the place-specific scent of freshly tilled soil while plowing and sowing, as well as many other festival or labor sensations (Graham, 2018). The mosaics from Carthage and Djebel Oust also underscore the utility of interdisciplinary work, as they potentially provide environmental data for a region that is not as well documented in the natural archive. They also draw attention to the rich ecological potential of late Roman and Antique material culture as an archive for a period of climatological instability. Taken together, the images and passages portray Roman farmers and gardeners attuned to the natural rhythms of the Mediterranean, feeling and watching for, and listening to non-human agents as signifiers of ecological time.

## Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

## Data Availability Statement

Data were not used, nor created for this research.

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## References

- Åkerström-Hougen, G. (1974). *The calendar and hunting mosaics of the Villa of the Falconer in Argos: A study in early Byzantine iconography*. Svenska Institutet i Athen.
- Apicius. (1980). *Apicius* (F. Serra, trans.). Giardini.
- Apuleius. (1996). *Metamorphoses (The Golden Ass), volume I: Books 1–6* (J. A. Hanson, trans.). Harvard University Press.
- Avi-Yonah, M. (1936). Mosaic pavements at El Hammām, Beisan. *Quarterly of the Department of Antiquities in Palestine*, *V*, 11–30.
- Beach, T., Luzzadder-Beach, S., Cook, D., Dunning, N., Kennett, D. J., Krause, S., et al. (2015). Ancient Maya impacts on the Earth's surface: An Early Anthropocene analog? *Quaternary Science Reviews*, *124*, 1–30. <https://doi.org/10.1016/j.quascirev.2015.05.028>
- Bradley, K. R. (1984). *Slaves and masters in the Roman Empire: A study in social control*. Latomus.
- Bradley, K. R. (1994). *Slavery and society at Rome*. Cambridge University Press.
- Brown, C. A. (2012). *Montpelier landscape cultural study: Visualizing the plantation of James and Dolley Madison*. The Montpelier Foundation.
- Campbell, J. B. (2000). *The writings of the Roman land surveyors: Introduction, text, translation and commentary*. Society for the Promotion of Roman Studies.
- Cascio, E. L., & Tacoma, L. E. (Eds.). (2016). *The impact of mobility and migration in the Roman Empire*. Brill. <https://doi.org/10.1163/9789004334809>
- Cato & Varro. (1934). *On agriculture* (M. P., Hooper & W. D., Ash, & H. B., Adelman, trans.). Harvard University Press.
- Chéhab, M. (1957). Mosaïques du Liban. *Bulletin du Musée de Beyrouth*, *XIV*, 123–139.
- Chen, S., Su, Y., Fang, X., & He, J. (2020). Climate records in ancient Chinese diaries and their application in historical climate reconstruction – A case study of Yunshan Diary. *Climate of the Past*, *16*(5), 1873–1887. <https://doi.org/10.5194/cp-16-1873-2020>
- Cicero. (1914). *De finibus bonorum et malorum* (H. Rackham, trans.). W. Heinemann.
- Columella. (1941). *De arboribus* (H. B. Ash, trans.). Harvard University Press.
- Dench, E. (2005). *Romulus' asylum: Roman identities from the age of Alexander to the age of Hadrian*. Oxford University Press.
- Dommelen, P. A. R. van, & Knapp, A. B. (Eds.). (2010). *Material connections in the ancient Mediterranean: Mobility, materiality, and Mediterranean identities*. Routledge.
- Doody, A. (2007). Virgil the Farmer? Critiques of the *Georgics* in Columella and Pliny. *Classical Philology*, *102*(2), 180–197. <https://doi.org/10.1086/523737>
- Dunbabin, K. M. D. (1978). *The mosaics of Roman North Africa: Studies in iconography and patronage*. Clarendon Press.
- Dunbabin, K. M. D. (1999). *Mosaics of the Greek and Roman world*. Cambridge University Press.
- Eastman, E. M. (1996). *Roman Thysdrus and the Mosaic of Months* (Ph.D.). University of Melbourne.
- Eastman, E. M. (2001). The Mosaic of Months from Thusdrus: Origin and influences. In *La mosaïque gréco-romaine VIII: Actes du VIIIème Colloque international pour l'étude de la mosaïque antique et médiévale: Lausanne (Suisse): 6–11 octobre 1997* (pp. 183–200). Cahiers d'archéologie romande.
- Fendri, M. (1965). Évolution chronologique et stylistique d'un ensemble de mosaïques dans une station thermale du Djebel Oust. *La mosaïque gréco-romaine*, *I*, 157–171.
- Feresin, F. (2021). Cosa mangiavano i nostri antenati 2000 anni fa? Uomini e donne si nutrivano in modo diverso: Ecco chi consumava più pesce. Reporter Gourmet. Retrieved from <https://reportergourmet.com/221506/cosa-mangiavano-i-nostri-antenati-2000-anni-fa-uomini-e-donne-si-nutrivano-in-modo-diverso-ecco-chi-consumava-piu-pesce.html>
- Forster, E. S. (1936). Trees and plants in Homer. *Classical Review*, *50*(3), 97–104. <https://doi.org/10.1017/s0009840x00076563>
- Foucher, L. (1962). *Decouvertes archeologiques a thysdrus en 1961* (Ser. Notes et documents. n.s. / institut d'archéologie, tunis, 5). Imp. du Secretariat d'Etat aux affaires culturelles et à l'information.
- Franchetti, G. (2017). *A tavola con gli antichi romani. Storia, aneddoti e tante ricette per scoprire come mangiavano i nostri antenati culturali*. Edizioni Efesto.
- Garnsey, P. (1988). *Famine and food supply in the Graeco-Roman world: Responses to risk and crisis*. Cambridge University Press.
- Giannella, N. J. (2014). *The mind of the slave: The limits of knowledge and power in Roman law and society* (Order No. 11016047) [Doctoral dissertation, University of Southern California]. ProQuest Dissertations Publishing.
- Gower, E. (2011). Trees and family trees in the *Aeneid*. *Classical Antiquity*, *30*(1), 87–118. <https://doi.org/10.1525/ca.2011.30.1.87>
- Grabar, A. (1962). Recherches sur les sources juives de l'art paléochrétien. *Cahiers Archeologiques: Fin De L'antiquité Et Moyen Âge*, No. (12), 115–152.
- Graham, E. J. (2018). 'There Buds the Laurel': Nature, temporality, and the making of place in the Cemeteries of Roman Italy. *Theoretical Roman Archaeology Journal*, *1*(1), 1–16. <https://doi.org/10.16995/traj.147>
- Grove, A. T., & Rackham, O. (2001). *The nature of Mediterranean Europe: An ecological history*. Yale University Press.
- Hamilakis, Y. (2014). *Archaeology and the senses: Human experience, memory, and affect*. Cambridge University Press.
- Harper, K. (2011). *Slavery in the late Roman world, AD 275–425*. Cambridge University Press.
- Harper, K. (2017). *The fate of Rome: Climate, disease, and the end of an empire*. Princeton University Press.
- Harper, K., & McCormick, M. (2018). Reconstructing the Roman Climate. In W. Scheidel (Ed.), *The science of Roman history: Biology, climate, and the future of the past* (pp. 11–52). Princeton University Press.
- Harris, W. V. (Ed.). (2013). *The ancient Mediterranean environment between science and history*. Brill.
- Hingley, R. (2000). *Roman officers and English gentlemen: The imperial origins of Roman archaeology*. Routledge.
- Hingley, R., Bonacchi, C., & Sharpe, K. (2018). 'Are You Local?' Indigenous Iron Age and mobile Roman and post-Roman populations: Then, now and in-between. *Britannia*, *49*, 283–302. <https://doi.org/10.1017/s0068113x18000016>
- Hölscher, T. (2004). *The language of images in Roman art*. Cambridge University Press.



- Homer. (1919). *Odyssey volume II* (G. E. Dimock, trans.). Harvard University Press.
- Homer. (1925). *Iliad volume II*, (A. T. Murray, trans.). Cambridge University Press.
- Horden, P., & Purcell, N. (2000). *The corrupting sea: A study of Mediterranean history*. Blackwell.
- Huebner, S. (2020). Climate change in the breadbasket of the Roman Empire—Explaining the decline of the Fayum Villages in the third century CE. *Studies in Late Antiquity*, 4(4), 486–518. <https://doi.org/10.1525/sla.2020.4.4.486>
- Hughes, J. D. (2014). *Environmental problems of the Greeks and Romans: Ecology in the ancient Mediterranean* (2nd ed.). Johns Hopkins University Press.
- Hylan, S. (2020). Public and private space and action in the Early Roman period. *New Testament Studies*, 66(4), 534–553. <https://doi.org/10.1017/S0028688520000120>
- Ingold, T. (1993). The temporality of the landscape. *World Archaeology*, 25(2), 152–174. <https://doi.org/10.1080/00438243.1993.9980235>
- Joshel, S. R., & Petersen, L. H. (2014). *The material life of Roman slaves*. Cambridge University Press.
- Juvenal and Persius. (2004). *Juvenal and Persius* (S. M. Braund, trans.). Harvard University Press.
- Kelso, W. M. (1986). Mulberry row: Slave life at Thomas Jefferson's Monticello. *Archaeology*, 39(5), 28–35. Retrieved from <http://www.jstor.org/stable/41731802>
- Kimmerer, R. W. (2013). *Braiding sweetgrass*. Milkweed Editions.
- Koortbojian, M. (2020). *Crossing the Pomerium: The boundaries of political, religious, and Military Institutions from Caesar to Constantine*. Princeton University Press. <https://doi.org/10.2307/j.ctvr69521>
- Levi, D. (1941). The allegories of the months in classical art. *Art Bulletin*, 23(4), 251–291. <https://doi.org/10.2307/3046786>
- Livy. (2019). *History of Rome, volume V* (J. C. Yardley, trans.). Harvard University Press.
- Livy. (2020). *History of Rome, volume VI* (J. C. Yardley, trans.). Harvard University Press.
- Longo, V. (2017). *Alla tavola della longevità*. Vallardi A.
- Macaulay-Lewis, E. (2008). The fruits of victory: Generals, plants and power in the Roman world. In E. Bragg, L. I. Hau, & E. Macaulay-Lewis (Eds.), *Beyond the battlefields: New perspectives on warfare and society in the Graeco-Roman world* (pp. 205–224). Cambridge Scholars.
- Malek, A. (1999). *Le sentiment de la nature dans les domus de l'Afrique romaine ième-vème siècles* (Ph.D.). École des hautes études en sciences sociales.
- Malek, A. (2017). Mosaics and nature in the Roman domus. In W. F. Jashemski (Ed.), *Gardens of the Roman empire* (pp. 317–340). Cambridge University Press.
- Mallon, K. (2021). Taskscapes, landscapes, and the politics of agricultural production in Roman Mosaics. *Theoretical Roman Archaeology Journal*, 4(1), 1–26. <https://doi.org/10.16995/traj.4340>
- Manning, J. G., Ludlow, F., Stine, A. R., Boos, W., Sigl, M., & Marlon, J. R. (2017). Volcanic suppression of Nile summer flooding triggers revolt and constrains interstate conflict in ancient Egypt. *Nature Communications*, 8(1), 900. <https://doi.org/10.1038/s41467-017-00957-y>
- Maresca, A. (2022). Lettere da Paino di Sorrento- Condannati...a farsi votare! Positano News. Retrieved from <https://www.positanonews.it/2022/08/lettere-da-piano-di-sorrento-condannati-a-farsi-votare/3581437/>
- Marzano, A. (2007). *Roman villas in central Italy: A social and economic history*. Brill.
- Marzano, A. (2014). Roman gardens, military conquests, and elite self-representation. In K. Coleman, & P. Derron (Eds.), *Le jardin dans l'antiquité: Introduction et huit exposés suivis de discussions* (pp. 195–244). Fondation Hardt.
- Marzano, A., & Métraux, G. P. R. (Eds.). (2018). *The Roman villa in the Mediterranean basin: Late republic to late antiquity*. Cambridge University Press. <https://doi.org/10.1017/9781316687147>
- Mattingly, D. J. (2006). *An imperial possession: Britain in the Roman Empire, 54 BC–AD 409*. Allen Lane.
- McConnell, J. R., Wilson, A. I., Stohl, A., Steffensen, J. P., Chellman, N. J., Eckhardt, S., et al. (2018). Lead pollution recorded in Greenland ice indicates European emissions tracked plagues, wars, and imperial expansion during antiquity. *Proceedings of the National Academy of Sciences*, 115(22), 5726–5731. <https://doi.org/10.1073/pnas.1721818115>
- McCormick, M. (2011). History's changing climate: Climate science, genomics, and the emerging consilient approach to interdisciplinary history. *The Journal of Interdisciplinary History*, 42(2), 251–273. Retrieved from [https://doi-org.proxy.library.cornell.edu/10.1162/JINH\\_a\\_00214](https://doi-org.proxy.library.cornell.edu/10.1162/JINH_a_00214)
- McCormick, M., Büntgen, U., Cane, M. A., Cook, E. R., Harper, K., Huybers, P., et al. (2012). Climate change during and after the Roman Empire: Reconstructing the past from scientific and historical evidence. *The Journal of Interdisciplinary History*, 43(2), 169–220. [https://doi.org/10.1162/jinh\\_a\\_00379](https://doi.org/10.1162/jinh_a_00379)
- McMichael, A. J., Woodward, A., & Muir, C. (2017). *Climate change and the health of nations: Famines, fevers, and the fate of populations*. Oxford University Press.
- Monroe, J. C., & Ogundiran, A. (Eds.). (2012). *Power and landscape in Atlantic West Africa: Archaeological perspectives*. Cambridge University Press.
- Murphey, R. (1951). The decline of North Africa since the Roman occupation: Climatic or human? *Annals of the Association of American Geographers*, 41(2), 116–132. <https://doi.org/10.2307/2560906>
- Myers, K. S. (2005). "DOCTA OTIA": Garden ownership and configurations of leisure in Statius and Pliny The Younger. *Arethusa*, 38(1), 103–129. <https://doi.org/10.1353/are.2005.0005>
- Nevett, L. C. (2010). *Domestic space in classical antiquity*. Cambridge University Press.
- Newlands, C. (2004). Statius and Ovid: Transforming the landscape. *Transactions of the American Philological Association*, 134(1), 133–155. <https://doi.org/10.1353/apa.2004.0007>
- Östenberg, I. (2009). *Staging the world: Spoils, captives, and representation in the Roman triumphal procession*. Oxford University Press.
- O'Sullivan, L., Jardine, A., Cook, A., & Weinstein, P. (2008). Deforestation, mosquitoes, and ancient Rome: Lessons for today. *BioScience*, 58(8), 756–760. <https://doi.org/10.1641/B580812>
- O'Sullivan, T. M. (2011). *Walking in Roman culture*. Cambridge University Press.
- Ovid. (1916). *Metamorphoses* (F. J. Miller, trans.). Harvard University Press.
- Parrish, D. (1977). *Season mosaics of Roman North Africa* (Ph.D.). Columbia University.
- Parrish, D. (1979). Two mosaics from Roman Tunisia: An African variation of the season theme. *American Journal of Archaeology*, 83(3), 279–285. <https://doi.org/10.2307/505058>
- Picard, C. (1951). *Carthage*. Société d'Édition 'Les Belles Lettres.
- Platts, H. (2020). *Multisensory living in ancient Rome: Power and space in Roman houses*. Bloomsbury Publishing Plc.
- Pliny the Elder. (1855). *Natural history* (H. T. Riley & J. Bostock, trans.). Taylor and Francis.
- Pliny the Elder. (1945). *Natural history volume IV* (H. Rackham, trans.). Harvard University Press.
- Pliny the Elder. (1950). *Natural history, volume V: Books 17–19* (H. Rackham, trans.). Harvard University Press.
- Porstner, L. (2020). Boundaries, magic, and popular religion in two mosaics from ancient Thysdrus (El Jem in Tunisia). *New Classic*, 2, 1–69.

- Preunkert, S., McConnell, J. R., Hoffmann, H., Legrand, M., Wilson, A. I., Eckhardt, S., et al. (2019). Lead and antimony in basal ice from Col du Dome (French Alps) dated with radiocarbon: A record of pollution during antiquity. *Geophysical Research Letters*, *46*(9), 4953–4961. <https://doi.org/10.1029/2019GL082641>
- Reay, B. (2005). Agriculture, writing, and Cato's Aristocratic self-fashioning. *Classical Antiquity*, *24*(2), 331–361. <https://doi.org/10.1525/ca.2005.24.2.331>
- Reinhold, M. (1984). *Classica Americana: The Greek and Roman heritage in the United States*. Wayne State University Press.
- Roth, U. (2007). *Thinking tools: Agricultural slavery between evidence and models*. Institute of Classical Studies, School of Advanced Study, University of London.
- Roth, U. (Ed.) (2010). *By the sweat of your brow: Roman slavery in its socio-economic setting*. Institute of Classical Studies, School of Advanced Study, University of London.
- Roymans, N., & Fernández-Götz, M. (2015). Caesar in Gaul. New perspectives on the archaeology of mass violence. In T. Brindle, M. Allen, E. Durham, & A. Smith (Eds.), *TRAC 2014: Proceedings of the Twenty-Fourth Annual Theoretical Roman Archaeology Conference, Which Took Place at the University of Reading, 27–30 March 2014* (pp. 70–79). Oxbow Books.
- Rüpke, J. (2011). *The Roman calendar from Numa to Constantine time, history, and the fasti* (D.M.B. Richardson, trans.). Wiley-Blackwell.
- Salzman, M. R. (1990). *On Roman time: The codex-calendar of 354 and the rhythms of urban life in late antiquity*. University of California Press.
- Schildgen, B. D. (2013). Reception, elegy, and eco-awareness: Trees in Statius, Boccaccio, and Chaucer. *Comparative Literature*, *65*(1), 85–100. <https://doi.org/10.1215/00104124-2019302>. <http://www.jstor.org/stable/41819576>
- Shaw, B. D. (Ed.) (2001). *Spartacus and the slave wars: A brief history with documents*. Palgrave Macmillan. Retrieved from [https://doi-org-proxy.library.cornell.edu/10.1007/978-1-137-12161-5\\_](https://doi-org-proxy.library.cornell.edu/10.1007/978-1-137-12161-5_)
- Shumate, M. S. (1991). The architecture of Jefferson's Mulberry Row: Changes in form, 1770–1826. *Quarterly Bulletin of the Archaeological Society of Virginia*, *46*, 31–41.
- Skeates, R., & Day, J. (2019). *The Routledge handbook of sensory archaeology*. Routledge.
- Spurr, M. S. (1986). Agriculture and the "Georgics". *Greece and Rome*, *33*(2), 164–187. <https://doi.org/10.1017/s0017383500030321>
- Stark, R. J., Emery, M. V., Schwarcz, H., Sperduti, A., Bondioli, L., Craig, O. E., & Prowse, T. (2020). Imperial Roman mobility and migration at Velia (1st to 2nd c. CE) in southern Italy. *Journal of Archaeological Science*, *30*, 102217.
- Statius. (1928). *Statius* (J. H. Mozley, trans.). Harvard University Press.
- Steer, C. (2003). Interpreting winter in the mosaic of Neptune and the seasons: Another look. *Mouseion Series*, *III*(3), 363–376.
- Steinhilber, F., Abreu, J. A., Beer, J., Brunner, I., Christl, M., Fischer, H., et al. (2012). 9,400 years of cosmic radiation and solar activity from ice cores and tree rings. *Proceedings of the National Academy of Sciences of the United States of America*, *109*(16), 5967–5971. <https://doi.org/10.1073/pnas.1118965109>
- Stern, S. (2012). *Calendars in antiquity: Empires, states, and societies*. Oxford University Press.
- Stillwell, R. (1961). Houses of Antioch. *Dumbarton Oaks Papers*, *15*, 45–57. <https://doi.org/10.2307/1291175>
- Stoddart, S. (1999). Redirected light on the indigenous Mediterranean. *Antiquity*, *73*(281), 703–705. <https://doi.org/10.1017/S0003598X00065315>
- Suetonius. (1914). *Suetonius* (J. C. Rolfe, trans.). W. Heinemann.
- Totelin, L. (2012). Botanizing rulers and their herbal subjects: Plants and political power in Greek and Roman literature. *Phoenix*, *66*(1/2), 122–144. <https://doi.org/10.7834/phoenix.66.1-2.0122>
- Turner, B. L., II, & Sabloff, J. A. (2012). Classical period collapse of the Central Maya Lowlands: Insight about human-environment relationships for sustainability. *Proceedings of the National Academy of Sciences*, *109*(35), 13908–13914. <https://doi.org/10.1073/pnas.1210106109>
- Van Zeist, W., Bottema, S., & Van der Veen, M. (2000). *Diet and vegetation at ancient Carthage: The archaeobotanical evidence*. Groningen Institute of Archaeology.
- Vieira, L. E. A., Solanki, S. K., Krivova, N. A., & Usoskin, I. (2011). Evolution of the solar irradiance during the Holocene. *Astronomy & Astrophysics*, *531*, A6. <https://doi.org/10.1051/0004-6361/201015843>
- Virgil. (1999). *Eclogues, Georgics, Aeneid* (H. R. Fairclough, trans.). Harvard University Press.
- Virgil. (2001). *Aeneid books 7–12* (H. R. Fairclough, trans.). Harvard University Press.
- Wallace-Hadrill, A. (1998). The Roman Villa as cultural symbol. In A. Frazer (Ed.), *The Roman Villa Villa Urbana* (pp. 43–54). Science Press.
- Wallace-Hadrill, A. (2008). *Rome's cultural revolution*. Cambridge University Press.
- Webster, J. (2001). Creolizing the Roman provinces. *American Journal of Archaeology*, *105*(2), 209–225. <https://doi.org/10.2307/507271>
- White, K. D. (1967). *Agricultural implements of the Roman world*. Cambridge University Press.
- Wilhelm, R. M. (1982). The Plough. Chariot: Symbol of Order in the "Georgics". *Classical Journal*, *77*(3), 213–230. Retrieved from <http://www.jstor.org/stable/3296972>
- Williams, C. A. (2022). The Latin language and native survivance in North America. *American Journal of Philology*, *143*(2), 219–246. <https://doi.org/10.1353/ajp.2022.0014>
- Zanker, P. (1990). *The power of images in the age of Augustus*. University of Michigan Press.