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ORIGINAL ARTICLE

Chapter 9. Feral fields of Northern Dalmatia (Croatia)

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Abstract

How do we identify ancient fields and farming systems in areas where the same spaces of cultivation have been used repeatedly over thousands of years? In the limestone karst landscapes of northern Dalmatia, on the Adriatic coast of Croatia, drystone field walls, terraces, and cairns are common features that attest to generations of working the land for agriculture. While confounding archaeological objects due to complex histories of reuse, drystone terraced field systems throughout the Mediterranean are believed to have roots in ancient and prehistoric land use. Against this backdrop, this paper works to better understand the dynamic patterns and outcomes of field "recycling" through multiple lines of evidence for long-term changes in cropping patterns and agroecology in multi-millennial agricultural landscapes of northern Dalmatia. We compare archaeobotanical data from the Ravni Kotari plain to documents of preindustrial land use from the 1826 Franciscan cadastre. We also draw upon contemporary observations of traditionally managed, semi-wild olive groves on the nearby Adriatic island of Ugljan to better understand the land-use legacies inherent in the landscapes of northern Dalmatia today. These data show that, despite a relatively static agricultural built environment of field walls and terraces, Dalmatian communities held historically dynamic relationships with domesticated and wild plant ecologies. Prehistoric integration of cereal agriculture with wild forest resources appears to have shifted to commercial-scale domesticated arboriculture in the Classical period, leaving a multifaceted legacy of commercial agriculture, traditional farming, and rewilding among the contemporary cultural landscapes of Dalmatia.

KEYWORDS

central Mediterranean, historical ecology, Iron Age, paleoethnobotany, Roman Empire

INTRODUCTION

Mediterranean Europe presents both advantages and distinctive challenges for interpreting ancient agricultural systems. Many important aspects of agricultural knowledge, practice, and scale of production may be gleaned from Greek and Latin agronomic texts, taxation records, and the abundant material records of ancient Mediterranean trade in agricultural commodities (Bevan, 2014; Butzer, 2005; Glicksman, 2005; Kessler & Temin, 2007; Scheidel, 2012). However, identifying the actual spaces of agricultural production—the farms and fields where crops were grown—as well as discerning the impact of ancient agricultural activities on the environment, is complicated by the fact that very often the same spaces have been cultivated continuously or intermittently into the present, obscuring dynamic and complicated histories of land use through time.

As is often the case, Mediterranean rural landscapes reflect a palimpsest of ancient, medieval, and modern field systems. Perhaps the most obvious and tangible markers of these are the extensive networks of drystone walls, terraces, and clearance cairns that are common throughout many areas of southern Europe.

These structures have often caught the attention of landscape archaeologists, many of whom have worked to elucidate chronologies and life histories of field architecture (Barbarić, 2011; Chapman et al., 1996). Such features may be constructed systematically or accumulate incrementally, yet they may also be devalued, abandoned, or repurposed in an equally complicated fashion (Zaro, 2014). These structures attest to generations of working and modifying the land for purposes of improving plant cultivation, retaining soil and moisture on steeper slopes, corralling animals, and marking property boundaries. The ubiquity of relict field architecture across Mediterranean countrysides can contribute to a (false) impression of timeless, unchanging agrarian landscapes.

Although field architecture may perdure for centuries, agrarian landscapes are anything but static. The ways that field spaces are used and valued changes historically, leading to complicated land-use legacies that are manifested in species composition and biodiversity in the present. This paper works to better understand processes and outcomes of field "recycling" through multiple lines of evidence for long-term changes in cropping patterns and agroecology in the multi-millennial agricultural landscapes of northern Dalmatia (Croatia). Rather than analyzing physical spaces of fields per se (walls, soils, etc.), we focus here on evidence of crops and vegetation to consider how the composition and value of field spaces changes through time. As an example of dynamic agricultural practices in the distant past, we first present preliminary results of ongoing paleoethnobotanical research at Nadin-Gradina, the site of an Iron Age-to-Roman period town that was a focus of settlement and land use in northern Dalmatia for about 1500 years before falling into an apparent centuries-long period of abandonment. To help contextualize the archaeobotanical finds within the broader landscape of Nadin and its environs, we examine the modern distribution of fields, orchards, and pasturelands around the site using the 1826 Franciscan cadastre survey of the Nadin municipality as a primary source. Rather than providing a direct analog for the distribution of ancient fields, this analysis highlights important contrasts between the cultivated landscapes of the Iron Age and Roman periods, and those of modern times. To expand the spatial scope of our analysis and better articulate the historical and archaeological data with the contemporary landscapes of the broader region, we incorporate in situ observations of traditionally managed and semi-wild olive groves on the Adriatic island of Ugljan, located across the narrow marine channel from the Croatian city of Zadar. This area illustrates the effects of field abandonment, or deintensification of cultivation, that allows new plant communities to develop which are the combined result of past generations' investments in the land as well as spontaneous, unintended growth. We use the term "feral" to describe the blurred boundaries between domesticated and wild that is evident in these spaces. Feral designates land or organisms that were at one time intentionally managed or domesticated but are subsequently left to themselves (Struthers Montford & Taylor, 2016). The example of Ugljan suggests ways in which comparable processes of "feralization" may have occurred in the past, in ways that are not directly visible from the archaeological or historical records alone.

The interpretations drawn from these disparate forms of evidence are necessarily tentative, as each of these datasets provides different kinds of information about agrarian landscapes that are not directly commensurable. We posit, however, that understanding landscape changes at millennial scales requires creatively integrating dissimilar data as available from different time periods. Archaeobotanical datasets, historical cartography, and observations of a related living landscape can be mutually informative for understanding complex historical ecologies of agrarian spaces. These settings transform considerably through time and may be conceptualized along a continuum from intensively managed, domesticated landscapes to unkept "feral" spaces and back again. This combined approach illustrates the temporally dynamic nature of such anthropogenic environments in contrast to the relatively fixed configuration of immobile field walls, terraces, and stone cairns.

ANCIENT FIELD SYSTEMS IN MEDITERRANEAN EUROPE

Durable, centuries-old field networks, defined by formally and informally constructed drystone walls, cairns, and terraces, are widespread throughout the Mediterranean region and have become increasingly well-documented in recent decades, particularly in Greece, Italy, and Spain (Bevan & Conolly, 2002; Bevan et al., 2003; Bull et al., 2001; Forbes, 2007; Frederick & Krahtopoulou, 2000; French & Whitelaw, 1999; Krahtopoulou & Frederick, 2008; Price & Nixon, 2005). Terrace walls create cultivable land on steep slopes by preventing soil erosion, improving soil depth and root penetration for crops, collecting runoff from rainwater, and making use of field stones that would otherwise interfere with cultivation (Borejsza et al., 2021; Denevan, 2001; Dunning & Beach, 1994; Grove & Rackham, 2001; Inbar & Llerena, 2000; Sandor et al., 1990; Treacy & Denevan, 1994). There is clear evidence that upland areas in the Mediterranean were heavily cultivated from at least the 17th to early 20th centuries (Bevan et al., 2003; Forbes, 2007; McNeill, 1992). Similarly, agricultural decline and abandonment of rural lands during the 20th century is well-documented in the region (Douglas et al., 1996; Grove & Rackham, 2001, 91–92, 107; Rackham & Moody, 1996, 126).

The deeper histories of Mediterranean field systems have proven challenging to ascertain. Some ancient textual evidence indicates the importance of wall construction for maintaining fields (Price & Nixon, 2005,

2–5) but it is debatable whether the same practices (e.g., terracing) that created extensive field networks in the early modern period were also utilized in antiquity (Foxhall, 1996, 44–67; Grove & Rackham, 2001, 112–13, 117). Straightforward and unambiguous archaeological examples of ancient fields depend on special circumstances of preservation (Bull et al., 2001; French & Whitelaw, 1999; Krahtopoulou & Frederick, 2008; Rackham & Moody, 1996, 128). In many cases, the proposed ancient chronology of walls and terraces is based on associated materials within the fill, associated settlement features, construction techniques, or even tree rings from ancient olive trees growing on their surfaces (Bevan, 2002; Bull et al., 2001; Grove & Rackham, 2001; Price & Nixon, 2005; Rackham & Moody, 1996).

In our study region, eastern Adriatic coastal and island landscapes are also characterized by centuries-old field systems of drystone walls and terraces. Many of these systems are quite extensive, sometimes covering entire islands and hillsides, and they display a great diversity of construction, form, and function (Andlar et al., 2017, 2018; Kale, 2010). The cultural knowledge associated with these and other similar constructions around the Adriatic were recognized in 2018 when the "Art of Drystone Walling, Knowledge and Techniques" was inscribed into UNESCO's List of Intangible Cultural Heritage.

It is plausible that many Adriatic field systems have ancient roots. As durable forms of landesque capital (Brookfield, 2001; Håkansson & Widgren, 2014), drystone walls and terraces improve the conditions for plant cultivation and can benefit future generations well beyond their initial construction. The most well-documented case in the eastern Adriatic may be the Stari Grad plain on the island of Hvar, where rectilinear fields (*chora*) laid out by Greek colonists of Pharos in the 4th century BCE remain intact and are still under cultivation today (Andlar et al., 2017; Kirigin, 2004; Kirigin & Slapšak, 2010). In the Zadar region, where our project is situated, archaeological survey in the 1980s documented stone clearance cairns and enclosures associated with Bronze and Iron Age artifact scatters throughout the Ravni Kotari plain (Chapman et al., 1996).

STUDY AREA

Dalmatia (*Dalmacija*), a vernacular region in the Republic of Croatia, has been home to agricultural communities for the past 8000 years. Numerous islands and natural harbors along the eastern Adriatic coast facilitated maritime navigation from the early Holocene, making this one of the early routes for the spread of domesticated plants and animals from the Near East and eastern Mediterranean into Europe (Bass, 2008; Borojević et al., 2008; Forenbaher & Miracle, 2005; Reed, 2015). The physiognomic region of Ravni Kotari in northern Dalmatia is a low-elevation coastal plain, characterized by gently sloping limestone ridges and bands of flysch and alluvial soil that became a locus of early farming communities. Neolithic settlements appear in alluvial lowland areas from about 6500 to 6000 BCE (Horvat, 2017; Marijanović, 2009). Development of "hillfort" (*Gradina*) sites on ridges and uplands began at least as early as the Bronze Age. By the Iron Age, a network of relatively large hillfort settlements characterized the region, many of which persisted as major settlements into the Roman period (Čelhar, 2014; Suić, 2003).

Nadin-Gradina (Roman *Nedinum*) is one such example of a large Iron Age settlement with strong continuity into the Roman imperial period. Nedinum is documented in ancient textual records as a Liburnian settlement and later designated as a *municipium* when Roman administration of the region became formalized in the late 1st century BCE (Wilkes, 1969). The site of the ancient town has been investigated archaeologically since the 1980s (Batović & Chapman, 1987a, 1987b; Chapman et al., 1996), and most recently since 2015 through a collaboration between the University of Zadar and the University of Maine. The material evidence from Nadin-Gradina attests to a period of sustained growth and urbanization from the end of the Late Bronze Age (ca. 10th century BCE), until the 6th century CE when the fortified hilltop settlement appears to have been largely abandoned. The site was reoccupied in the Late Medieval–Early Modern era as a Venetian and subsequently Ottoman fortress and adjacent settlement before its ultimate abandonment, likely in the late 17th century (Zaro et al., 2020). Nadin today is a small village community mostly engaged in agriculture. Houses and fields belonging to the community are dispersed across the lower slopes of the Nadin ridge, mostly within 1 to 2 km to the west, northwest, and southwest of the ancient site. Vines and olives are nowadays the major cash crops and a prominent component of the agricultural landscape in this area. The area of the archaeological site is no longer inhabited and, prior to recent decades, had been mostly used for pasturing sheep and goats. The size of herds in the area has declined sharply in the last decade as the community has invested more in commercial vineyards, wineries, olives, and agrotourism. As a result, woody vegetation has grown up rapidly around the Nadin-Gradina site, creating a much more forested landscape than existed even 10 to 20 years previously.

THE ANCIENT LANDSCAPE—NADIN-GRADINA PALEOETHNOBOTANY

Macro-fossils of carbonized seeds, fruits, and wood recovered in recent excavations of settlement deposits at Nadin-Gradina provide a window on shifting agricultural landscapes in northern Dalmatia from the early 1st

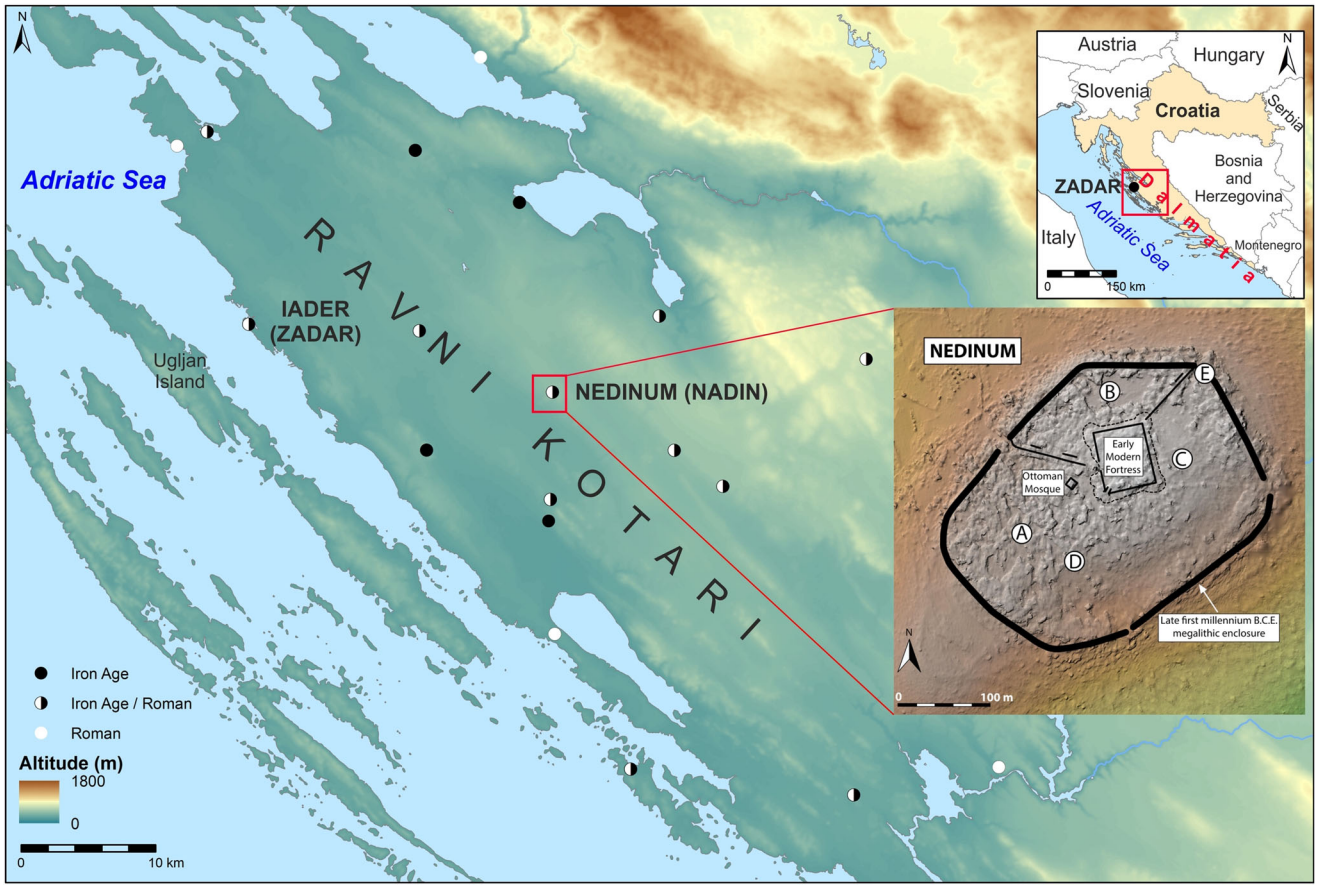


FIGURE 1 Geographical context of the study area showing the locations of Iader (Zadar), Nedinum (Nadin), Ugljan Island, and other major Iron Age and Roman settlements in the region. A base map of Nedinum with locations of our initial 2015 units (A–E) is also included. Maps were produced in QGIS3 using STRM data made available by NASA's Jet Propulsion Laboratory (https://www2.jpl.nasa.gov/srtm/) and ArcMap 10.1 using data from the Croatian Geodetic Administration (2016) and European Environment Agency (2016, 2018). STRM, Shuttle Radar Topography Mission.

millennium BCE through the middle 1st millennium CE. As the residues of routine burning practices (Fuller et al., 2014; van der Veen, 2007), macrobotanical remains reflect plant resources commonly present, chosen, and utilized in the environment of the site. Besides plant material collected specifically for use as fuel (e.g., wood), some of the most commonly burned plantstuffs are waste products from crop processing or early stages of food preparation: inedible pits, husks, stems, unwanted seeds (e.g., ruderal weeds) discarded during sieving or cleaning of grain crops (Capparelli et al., 2011; Dennell, 1974; Minnis, 1981). In agricultural settings, macrobotanical remains are thus a useful indicator of what crop types are most widely cultivated in the catchment area of a site.

The Nadin-Gradina Archaeological Project (NGAP) began investigating urbanization and landscape change in 2015 with the excavation of five test units (A–E in Figure 1), each measuring approximately 25 m^2, scattered around the summit area of the hillfort (Čelhar & Zaro, 2016, 2023; Zaro & Čelhar, 2018). Based on the depth and integrity of the archaeological record in Unit B, which evinced Late Iron Age Liburnian, Early Roman, and Late Roman architecture along with a scatter of artifacts dating to the Late Middle Ages and Early Modern Era in upper deposits, this unit was progressively expanded over four subsequent field seasons to an area of approximately 350 m^2. This expanded Unit B consisted of fourteen 5 × 5 m quadrants, forming a long trench extending from the edge of the Iron Age megalithic fortification walls into the intramural part of the settlement. The stratigraphy within Nadin-Gradina Unit B is a complex array of clay deposits, pockets of collapse debris, paved surfaces, stone alignments, formally constructed walls, pits, burned patches, and other activity areas—many of which are superimposed over or cut into earlier structures and features. Ceramic finds and a series of more than 30 calibrated radiocarbon age ranges indicate continuous occupation of the settlement from approximately the 10th century BCE until about the 6th century CE. During excavation from 2016 to 2019, sediment samples for flotation were

collected from approximately 200 different stratigraphic contexts, focusing especially on floor surfaces and subsurfaces, burn features, pit fills, and midden deposits. Sediment samples were processed at the University of Zadar using a simple manual flotation system (Pearsall, 2015, 53): 1.5 mm screen was used to collect heavy fraction and a 0.1 mm cloth sieve was used to collect light fraction. Carbonized plant material from heavy and light fractions was examined with a stereo microscope at 10× to 20× magnification and identified to botanical family, tribe or subtribe, genus, and species when possible.

To date, archaeobotanical material has been analyzed from 52 stratigraphic contexts (489.4 L) spanning approximately 600 BCE–300 CE, corresponding to the latter part of the Early Iron Age (Liburnian culture) through the Roman imperial period. This dating is based on preliminary analysis of ceramic finds and architectural features. Due to the complex nature of urban stratigraphy, not all contexts can be dated precisely. This group of samples falls into a few approximate, broad chronological clusters: (1) 6th to 2nd century BCE, encompassing the latter part of the Early and most of the Late Iron Age, primarily from compacted and burned clay surfaces underlying later architectural features; (2) 2nd century BCE to the mid-1st century CE, a phase spanning the latter part of the Late Iron Age and the transition to and beginning of the Roman period; this period is marked by structures built of large, unmortared limestone blocks; and (3) the imperial Roman period from the mid-1st century CE through the 3rd century, characterized by new construction using mortared stone walls, re-surfacing of interior floors, and construction of an east–west stone cobbled street.

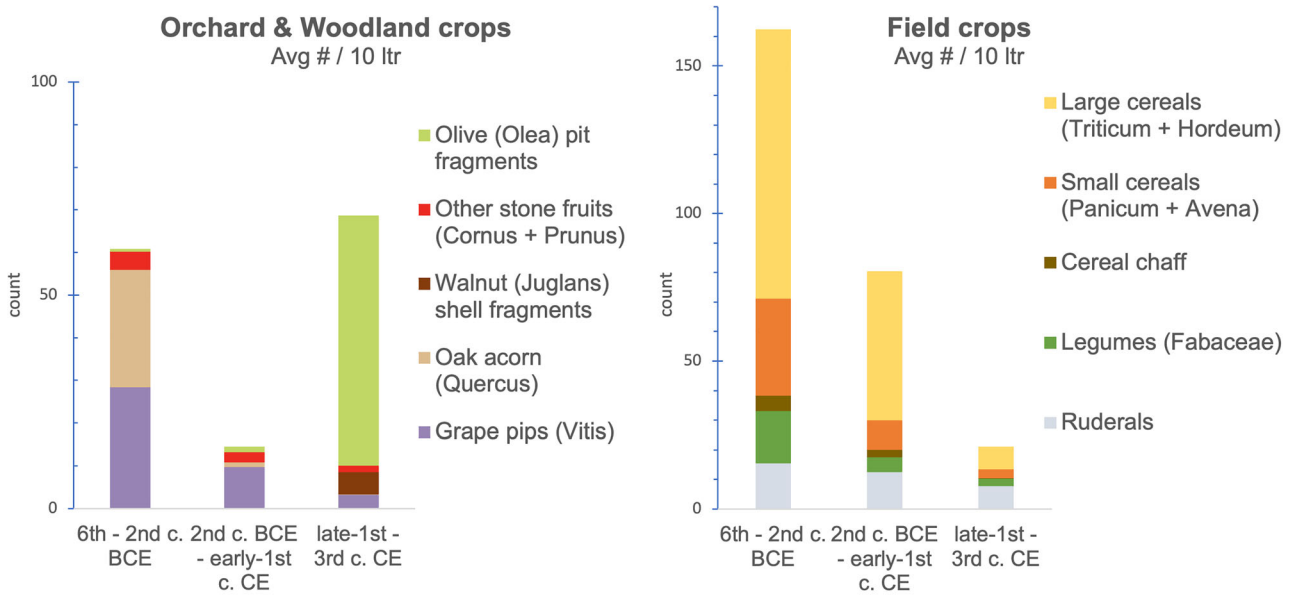
The macrobotanical remains from Nadin-Gradina Unit B consist of fruit and nut elements from trees and woody perennials along with seeds and seed fragments of cereal and legume crops and field weeds. Arboreal taxa include *Quercus* cf. *ilex* (holm oak) acorn, *Vitis vinifera* (grape) pips and stem fragments, intact pits and pit fragments of *Cornus mas* (cornelian cherry), *Olea europaea* (olive), *Prunus* cf. *avium* and cf. *cerasifera* (cherry, plum), as well as nutshell fragments of *Juglans cf. regia* (walnut) and *Corylus* cf. *avellana* (hazelnut), and small seeds of *Sambucus* (elderberry), *Juniperus* (juniper), and *Rubus* (raspberry/blackberry). Field crop remains include *Triticum* (wheat), *Hordeum* (barley), *Panicum* (millet), *Avena* (oat), *Secale* (rye), *Vicia faba* (broad bean), *Pisum sativum* (pea), and *Lens* cf. *culinaris* (lentil), as well as small numbers of various wild or ruderal plant types, including *Galium*, Amaranthaceae, Asteraceae, Polygonaceae, and Caryophyllaceae.

Figure 2 summarizes changes in the abundance of major botanical taxa between the three time periods. Each period is represented by average counts per 10 L of sediment of the major botanical taxa, aggregated from all samples within that temporal bracket. To highlight general trends, some taxonomic categories are combined into larger groupings. Only the top five most frequently occurring arboreal fruit and nut taxa are shown here.

A few general trends are evident in the archaeobotanical remains from Nadin-Gradina Unit B. Deposition of wood charcoal increases from average rates of 3.7 g/10 L in the Iron Age (6th to 2nd century BCE) to 18.1 g/10 L after the mid-1st century CE (imperial Roman period). This corresponds with a decrease over time in the abundance of cereals and other field crops: field crop remains comprise over 70% of all identified items from Iron Age (6th to 2nd century BCE) deposits but only 21% of identified items in imperial Roman (1st to 3rd century CE) contexts. A rise in wood fuel consumption during the early 1st millennium CE could be related to the growing population at the site. It could also reflect growth in materials manufacturing, such as pottery production, metalworking, glass production, and lime production for plaster, all of which require high heat and large amounts of fuel. Although we do not have direct evidence of manufacturing within Unit B itself, it is notable that plastering and mortaring of stone walls appears to be characteristic of Roman-period building construction at the site.

High proportions of cereal and legume crop remains in Iron Age (6th to 2nd century BCE) contexts may reflect some amount of animal foddering and burning animal dung for fuel (Miller & Smart, 1984; Spengler, 2019; Valamoti & Charles, 2005) but given the higher proportion of cleaned grain to chaff and weed seeds, we suggest that a significant part of the crop remains probably derives from late-stage processing (e.g., cleaning and sieving grain) and food preparation at the household level. The abundance of these field crops in prehistoric contexts suggests cereal agriculture was a major component of Nadin's economy in the Iron Age and that cereal cultivation probably took place within the local region. Analysis by Knežić (2022, 113–14, tab. 4) has determined that during the Iron Age, plant materials including cereal chaff were used as part of wall building material (wattle-and-daub) and added to clay in the case of some bigger storage vessels. Through analysis of impressions and carbonized and mineralized remains embedded in the clay of the analyzed ceramic sherds, individual parts of wheat plants were recognized, including unhusked grains and various parts of chaff that provide information on multiple stages of grain threshing at the site (Knežić, 2022, 214–15, fig. 164). These data show that cereals were cultivated for utilitarian purposes as well as foodstuffs.

The reduction in cereals and legumes in samples from the 1st to 3rd centuries CE suggests less cereal processing activities taking place within the settlement. This hints at broader changes in the spatial organization of labor related to food production: grain farming could have been taking place at further distances away from



Period	No. layers sampled	Liters floated	Avg. sample size (l) per layer	Total wood char (g)	Fruit + Nut: No. identified items	Field crops + ruderals: No. identified items	Avg. No. Identified items per 10 l
6th - 2nd c. BCE (Iron Age)	14	119.8	8.6	44.5	737	1930	222.6
2nd c. BCE - early-1st c. CE	14	108.4	7.7	66.3	159	836	91.8
late-1st - 3rd c. CE (Roman)	24	261.2	10.9	473.6	1829	500	89.2
Total	52	489.4	9.4	584.4	2725	3266	122.4

FIGURE 2 Summary data of macrobotanical remains analyzed to date from 2016 to 2019 excavations of Nadin-Gradina Unit B.

the settlement; cereals might be processed through more centralized and/or commercialized milling operations outside the household. Some amount of grain may have been imported during the Roman period. Changing architectural styles—for example, use of ceramic roof tiles, mortared and plastered stone walls—may further account for the weaker representation of local grain production in the archaeological context.

The second obvious trend in the Nadin macrobotanical assemblage is a shift over time in abundance and species representation of tree fruits and nuts. *Vitis* remains are present throughout the entire stratigraphic sequence but are most common (and best preserved) in prehistoric contexts. In Iron Age contexts, *Vitis* frequently co-occurs with *Cornus mas*; grape pips are presumably residues of wine-making and it is possible *Cornus* was also used for making alcohol (Renfrew, 1973, 143). Oak (*Quercus* cf. *ilex*) acorns—mostly fragments of shelled kernels—are found in notable quantities in several Iron Age contexts, comprising 12% of all identified remains from this period and the second most abundant arboreal taxa after *Vitis*. Acorns are infrequent in Early Iron Age contexts (Knežić, 2022) but seem to become more common among deposits associated with 6th through 2nd centuries BCE. While not often considered as a staple food, *Quercus* acorns are frequently found in prehistoric contexts across Europe and the Near East, from the Mesolithic through the Bronze Age. In Dalmatia, they have been recorded at Grapčeva Cave on the island of Hvar in multiple stratified deposits spanning the Neolithic to the Late Bronze Age (Borojević et al., 2008). Use of acorns as food in the ancient Mediterranean world is attested cursorily by some ancient writers; historically, acorns have been known as animal feed and eaten in some traditional contexts among European rural populations (Ayerdi et al., 2016; Renfrew, 1973). High in tannins, acorns typically require processing to be made palatable; this can be done through leaching, boiling, or roasting. Roasting the nuts to improve flavor may be a likely pathway to carbonization. While we cannot be certain how commonly these may have been harvested or consumed, the occurrence of acorns in some Iron Age contexts at Nadin attests to knowledge and engagement with wild resources of Mediterranean woodland landscapes.

Imperial Roman (1st to 3rd centuries CE) deposits at Nadin are distinguished by large quantities of pit fragments of *Olea europaea* (olive). Olea fragments are found in only small quantities prior to the 1st century CE, averaging 0 to 2 fragments per 10 L sample. Frequency of Olea increases markedly in imperial Roman layers, to an average of 59 fragments per 10 L sample, comprising nearly 66% of all identified items from this period. We believe the abundance of olive pits probably reflects

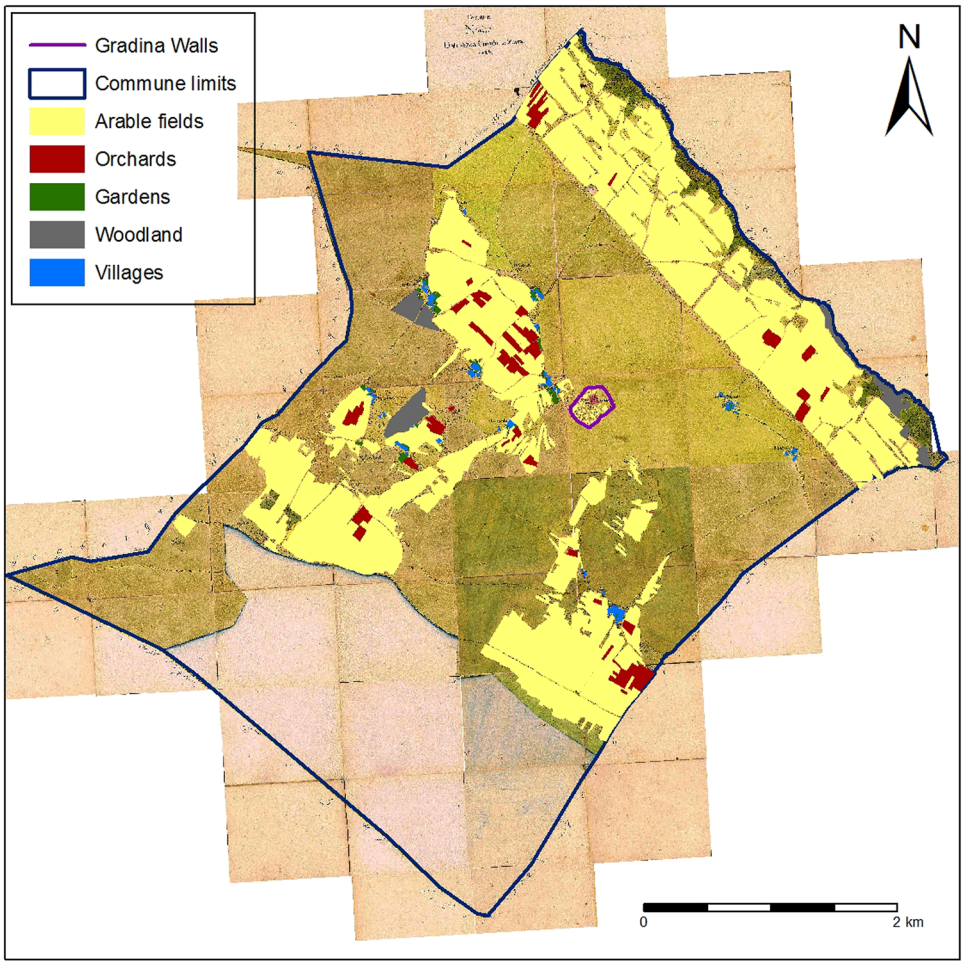


FIGURE 3 Georeferenced sheets of the 1826 Franciscan Cadastre, Nadin cadastral municipality, overlain with polygons representing cultivated fields.
Source: Nadin Cadastral Municipality 1826, Elenco delle Mappe catastali esistenti nell'Archivio Reale di Stato compilate nell'anno 1830, Comune di Nadin, State Archives in Zadar, Cadastral Survey Administration, HR-DAZD-382, number 592.

of the use of olive oil pressing waste, a pulpy residue called pomace, as a secondary source of fuel. Pomace burns longer and with less smoke than wood, and in many parts of the Roman world it was also cheaper and more readily available than wood fuel (Margaritis & Jones, 2008a, 2008b; Rowan, 2015). Shell fragments of *Juglans regia* (walnut) are also a common component of the Roman samples. We have identified multiple varieties of *Prunus* (cherry, plum) from these contexts, as well as at least one specimen of *Phoenix dactylifera* (date) which was almost certainly an exotic import. Collectively, this evidence suggests changing patterns of tree cultivation during this period.

These findings align well with a range of other material evidence from Roman Dalmatia that shows olives, grapes, and other tree crops such as walnut, hazel, and cherry, to have been a significant portion of the regional commercial economy. Extant Roman-era villa sites and farm buildings are documented throughout the region, typically with storage cellars, amphorae, mills, and presses for processing olives and grapes for oil and wine (Škegro, 2006, 156–59). Adriatic shipwrecks containing cargos of amphorae transporting wine and oil are found and excavated regularly by Croatian marine archaeologists (Jurišić, 2006). Waterlogged botanical material from Roman urban and villa contexts in the northeastern Adriatic region of Istria also gives a picture of a fruit-heavy cultivated landscape (Essert et al., 2018; Šoštarić & Kunster, 2001).

Taken collectively, the botanical data from Nadin-Gradina tentatively show a broad shift in patterns of fuel use, crop processing, and waste disposal at Nadin between the Late Iron Age and the later Roman imperial period. These findings suggest changes in agricultural practices, in the organization of labor and land-holdings, and potentially food preferences under an imperial Roman political economy. This was a period of population growth, intensifying maritime connectivity, exchange, and imperial expansion and subsequent decline. The botanical data attest especially to the regional

FIGURE 4 Feral olive field on Ugljan island, Croatia. Two large *Olea europaea* can be seen growing amidst *Quercus ilex, Phillyrea latifolia*, *Clematis flammula, Euphorbia* sp., and others. Remnants of drystone field walls visible in foreground and right frame. Photo by J. Countryman.

intensification of olive-focused arboriculture in the early 1st millennium CE. Does this correspond to changes in the structure and organization of the agricultural landscape? Is the legacy of Roman farming detectable in the contemporary landscape of northern Dalmatia?

EARLY MODERN LANDSCAPE—THE 1826 FRANCISCAN CADASTRE

Historical cartography offers a window on the spatial organization of agriculture, which we cannot discern directly from archaeobotanical remains. In Dalmatia, the recording of rural settlements, population, and land use began in the early 18th century when the Republic of Venice established a new inland border against the Ottoman Empire following a series of wars in the 16th and 17th centuries. Venice organized new settlement of farming communities on lands that had been sparsely populated during the war period. Part of this resettlement process involved a series of land surveys, the Venetian Cadastre, that produced census records of village populations and livestock as well as generalized small-scaled maps of land use (Blaće, 2015). A systematic survey of Dalmatia was performed in the period 1823–1838 by the Austrian (Habsburg) Empire that took control of the territory following the dissolution of the Venetian Republic in 1797 and the defeat of Napoleon in 1813. A detailed land-use map of the Nadin cadastral municipality from the 1826 Franciscan Cadastre survey (named after Francis I, emperor of Austria) depicts different land-use categories including ploughlands, vineyards, gardens, meadows, pasture, forests, and uncultivated or unusable land. The Nadin cadastral municipality encompasses a network of villages and associated fields, including both Nadin and Zagrad which remain the primary villages in the vicinity today. The hillfort site is located in the center of the municipality boundaries.

The 1826 Cadastre provides a base for calculating historical land cover and land use in the vicinity of Nadin-Gradina. In a previous study (Blaće, 2015), sheets of the Nadin cadastral municipality housed in the State Archives in Zadar were scanned and georeferenced in ArcMap 10.1. Land use plots referring to arable land were manually vectorized in order to create polygons and calculate area of land under various types of cultivation. The resultant map captures a snapshot of preindustrial land use, at a time when the rural population was relatively high (around 350) and oriented completely towards household subsistence and local markets (Blaće, 2015).

The 1826 cadastre shows that the present-day distribution of cultivated fields around Nadin-Gradina has existed in close to its current form for at least the past 2 centuries. In 1826, just over 50% of land within the commune boundaries was designated as pasture (*pascolo*). Cultivated land comprised about 25% of the municipality, with fields on flysch deposits on lower slopes in the central part of the village, along a seasonal

river stream on the northeast side of the Nadin ridge, and along the edge of the seasonal marsh known as Nadinsko Blato, located to the south and southwest. Small field plots are also marked within the walls of the Gradina amidst the ruins of the Ottoman-era fortress. Of the cultivated land within the municipality, a few dozen fields were designated as vineyard or orchard, amounting to about thirty hectares. These were dispersed among arable fields, though a somewhat larger cluster of orchard/vineyard land was located to the west of the hillfort in the vicinity of an inhabited area marked "*Staro Sello*," or "Old Village." Although circumstantial, the presence of an inhabited area may hint at orchards associated with some of the older occupations of the Nadin area. Polyculture is indicated for approximately one third of the vineyards (combination of vines and olive trees) and for almost every orchard and garden plot (different vegetables and fruit trees).

Although some individual property boundaries have shifted over time, the overall layout of fields around Nadin today partially corresponds to that of the Austrian period, with some of the same lands still under cultivation. The higher ground on the ridge is mostly open grassland and scrub woodland (maquis). One significant change has been the draining of the seasonal wetland, Nadinsko Blato, which has enabled new fields, particularly vineyards, to be established in the basin to the south of the hill. Otherwise, the most significant changes have been in the content of the fields: vineyards and olive orchards are more numerous now than they were in the early 19th century. In many cases these are planted on previous ploughlands because grain (wheat, corn, rye, barley) is no longer being grown.

Reading the 1826 Franciscan Cadastre in light of the paleoethnobotanical data from Nadin-Gradina highlights some of the differences and discontinuities between the farming landscape of early modern Nadin and the landscape around Nedinum in antiquity. For example, unlike the situation suggested by botanical and other archaeological evidence for the Roman period, olive cultivation at the beginning of the 19th century does not appear at an industrial scale. In some respects, the early modern landscape of Nadin may more closely resemble the Iron Age with focus on localized cereal production. Demographic changes and shifting imperial borders of the Middle Ages disrupted the settlement continuity of this area between Late Antiquity and the Venetian reclamation of inland Dalmatia. Farmers of the early modern era would have inherited an ancient farming landscape that had, to some extent, gone feral in the intervening centuries. If the Roman period transformed much of the landscape into orchards of economically valuable trees, such as olives, it is not clear how much of this arboricultural landscape persisted into the early modern period. Some tracts of once-cultivated land may have developed into scrub and woodland that then came to be used as common pastureland. The legacy of Roman-era fruit cultivation is nevertheless reflected in mixed orchards as well as the commercial scale olive and vine cultivation seen today.

FERAL OLIVE GROVES OF UGLJAN

The island of Ugljan, located in the Adriatic Sea about 40 km southwest from Nadin, offers a comparative example of another agricultural landscape also strongly shaped by Roman period land use, but with a distinct trajectory of development in recent times. Ugljan showcases the diversity of micro-ecologies that can develop in response to varying labor investments and cultivation activities across field systems, as well as the rapid vegetation changes that can occur following socioeconomic changes in human communities. Much of the island is covered in a network of stone walls and terraces that contain olive trees. Most of the extant field boundaries are considered to date to the 18th and especially 19th centuries, and many of the olive trees are at least as old (Faričić, 2012). Some elements of this olive field system may be older: a 2nd century Roman olive mill, part of a villa complex, was discovered on the north end of Ugljan (Ilakovac, 1997). The site indicates olive oil processing on a commercial scale. Namely, that part of Ugljan island was the territory of the centuriated ager of the Roman Zadar (Iader), whose traces can still be seen as dry stone walls in the landscape today (Kadi, 2016; Suić, 1955). The Middle Ages were marked by self-sufficient agriculture with combined olive growing, grain growing, and sheep breeding. With the Ottoman conquests of Ravni Kotari in the 16th century, the island was occasionally inhabited by the population seeking shelter, so due to the need for a larger amount of food, land cultivation was more intensive (Faričić, 2012). During the 19th century, due to the stabilization of political and economic conditions and the increase of the population, more intensive cultivation occurred. The lucrative wine trade prompted extensive vine planting in the 1890s. However, at the turn of the 20th century, the phylloxera epidemic devastated the island's vineyards. Most have since been abandoned or partially replanted by olives and other fruit trees (Defilippis, 1997) (Figure 3).

Olive groves in Ugljan show extremely varied states of maintenance and cultivation. Some fields have clearly been recently planted or replanted; some trees are actively pruned and maintained; many other fields are not evidently maintained or worked, and possibly have not been for some time. Growth of weeds and woody shrubs has rendered many abandoned fields virtually indistinguishable from a typical Mediterranean scrub forest (maquis), save for the large drystone walls that indicate prior cultivation (Figure 4).

This low-intensity cultivation, as well as the niches created by walls and terraces, facilitates biodiversity.

Grasses and forbs can grow freely in the spaces between trees. Many of these plants are traditional medicines that are collected and sold in local farmers markets, like *Hypericum perforatum* (St. John's wort/gospina trava). Other economically useful woody plants—such as fig, juniper, and arbutus—are allowed to grow along the edges and interstices between fields, becoming part of the boundary along with the stone wall. Woodland species like *Quercus ilex* become more frequent along upland rocky ridges. Field walls do not extend to the steepest areas but wild-growing olives can be found on rocky outcrops. The feral nature of these Ugljan field systems contrasts sharply with their condition just 50 years ago. Aerial photographs from 1968 (Croatian Geodetic Administration, 2023) depict an open and intensively managed orchard landscape, where large tracts of individual trees are clearly evident without much interspersed shrubby growth.

CONCLUSIONS

Bringing together these distinctive data sets and observations illustrates the historical dynamism of agricultural landscapes in northern Dalmatia. This dynamism is sometimes obscured by the seemingly static physical structure created by durable field boundaries and terracing. We suggest that attention to plants and vegetation is as important for understanding the historical ecologies of agricultural fields as mapping the field systems themselves. Paleoethnobotanical data from Nadin-Gradina show variation through time in the kinds of agricultural production dominant in the local landscape. These data hint at potentially significant change, from an open landscape of diversified cereal agriculture in prehistory to large-scale and intensive production of olive and other domesticated fruits. Changing representation of orchard and woodland species raises questions about shifting engagements with wild plant resources at different periods in the life history of ancient Nedinum. The 1826 Franciscan Cadastre illustrates how the lands around Nadin were utilized to support a small rural population at one point in time. The picture of widely dispersed ploughlands and extensive grazing areas, supplemented by small vineyards and orchard plots, impressionistically corresponds to the diversified subsistence base indicated by the prehistoric botanical material. But this map also highlights the reshaping of the land through time—the gradual abandonment of the Gradina, and the changing focus of cultivation from local subsistence to specialized production over the last 200 years.

The "re-wilding" seen among the olive fields of Ugljan island highlights the historically specific trajectories of individual fields. Ugljan was shaped by some of the same processes in the 1st millennium CE that affected Nedinum and its hinterland: expanded markets for olive oil, larger elite landholdings and commercial production, and more land devoted to orchard crops. As such, Ugljan provides another possible analog for ancient land use, in this case corresponding more to the archaeobotanical evidence from the Roman period of the mid-1st through 3rd centuries CE.

These contemporary farming landscapes do not represent an unbroken tradition of cultivation from antiquity—rather, these have been reinvested and reinscribed in specific, and different, ways. The island and the mainland have different histories of ownership and investment that have resulted in distinct configurations of the cultivated landscape. Importantly, the picture from Ugljan challenges the idea that olive arboriculture necessarily equates with monoculture or a loss of landscape biodiversity. These fields are complex living spaces that combine elements of cultivated, domesticated plant life with wild and weedy growth, and much of this unintentional vegetation may in fact be useful or valued. The ways the land and its components are valued by people changes historically, sometimes in short periods of time. These changes matter for the constitution of the living landscape, as shifting degrees and kinds of human investment result in fields that periodically transform from intensively managed, cultivated spaces, to feral spaces, and back again.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

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