Seeds of Civilization: Bronze Age Rural Economy and Ecology in the Southern Levant

Patricia L. Fall,* Lee Lines,** and Steven E. Falconer***

*Department of Geography, Arizona State University
**Department of Environmental Studies, Rollins College
***Department of Anthropology, Arizona State University

This paper considers the economic and environmental impacts of emerging regional commerce that accompanied the rise and collapse of early Near Eastern urbanism. We integrate regional data on settlement and vegetation with detailed evidence of rural agriculture from two Bronze Age villages in the Jordan Valley. This approach is explicitly rural, in light of the largely rural character of Levantine civilization, and in response to more orthodox analytical perspectives focused on the first cities. Long-standing interest in the advent of agriculture now reveals that intensive localized depletion of woodland resources followed the aggregation of sedentary agrarian communities in the eighth through sixth millennia B.C., while the development of specialized pastoralism established one potential source of more extensive, subsequent defoliation. We argue, however, that regional human impacts on Levantine vegetation were triggered only with the genesis of Bronze Age cities and urbanized economies in the third and second millennia B.C. Thereafter, these regional impacts molded an ever-shifting mosaic of anthropogenic and natural landscapes. Rank-size analysis illustrates the modestly integrated, largely rural nature of Bronze Age settlement in the southern Levant. In this context, Tell Abu en-Nfaj and Tell el-Hayyat provide appropriate examples of the resilient agrarian villages that persisted through the dramatic collapse and rebirth of early Levantine cities. Excavated plant remains and animal bones show that their inhabitants responded to the development of Bronze Age urbanism with a shift toward increased management of taxa with greater market potential, tempered by some retention of local economic autonomy. Shifts to greater sheep husbandry and, most significantly, cultivation of orchard crops like olives, figs, and grapes, signal a second wave of economic innovation that fundamentally altered the agricultural strategies of village farmers and their exploitation of the surrounding countryside. Thus the mixed cultural and natural landscapes that have supported long-term agriculture in the Levant reflect a legacy of discontinuous changes in rural economy and ecology in response to the waxing and waning of urbanized society and regional mercantile exchange.

Key Words: agricultural intensification, Bronze Age, environmental impacts, Near East, orchard cultivation, southern Levant, urbanism.

Southwestern Asia is particularly noteworthy as a heartland of early urbanized civilization. From the ancient Near East comes much of our understanding of the rise of the first cities and state-level governments, monumental architecture, formal religious institutions, writing, and mathematics. Despite the fact that the vast majority (80–90 percent) of preindustrialized populations, in the Near East and elsewhere, led agrarian lifestyles and lived in rural communities (Mann 1986), only minimal attention has been directed to detailed studies of rural communities within the fabric of urbanized societies (Eickelman 1989:55; Schwartz and Falconer 1994:1; Butzer 1996). The traditional analytical orientation toward early urbanism is “from the top down,” captured most bluntly by Oswald Spengler’s generalization that “world history is the history of city people” (1923:106). A common working assumption of this perspective holds that relatively homogeneous farming communities in the countryside compliantly supplied tax revenues, conscripted labor, and surplus foodstuffs for more dynamic and centrally important cities inhabited by merchants, craftsmen, bureaucrats, and urban elites (e.g., Redman 1978:215–16).
As a result of this urban bias, we are equipped currently with only a rudimentary comprehension of village economies and their fundamental roles in the coalescence or collapse of early civilizations (Schwartz and Falconer 1994). Many early civilizations, like those of the southern Levant (i.e., the region of modern Israel, Palestine, and Jordan), reveal greater long-term continuity in rural settlement and land use than in urban development (Falconer 1994). In such contexts marked by dramatically discontinuous urbanism, villages may provide our best evidence of long-term economic organization. In fact, geographical research has a strong tradition focused on rural agrarian systems within larger political economies (Bassett 1988; Zimmerer 1991, 1993). Agricultural systems incorporating both subsistence farming and surplus-oriented production have been documented in a number of comparable settings, most notably in the New World tropics (Whitmore and Turner 1992; Denevan 1996). Thus rural investigations of early civilization provide an avenue of inquiry that is both particularly appropriate for the ancient southern Levant and more widely applicable to a variety of geographic research settings in both the past and present.

Our research revolves around the question of how field studies of agrarian economy and ecology can illuminate the roles of rural communities in larger trajectories of urban growth and collapse. We ask more specifically how small farming villages in the southern Levant contributed and responded to the rise and fall of cities during the Bronze Age, this region’s first major period of urbanism. We argue that our perspective “from the bottom up” is especially well suited to the southern Levant amid its long legacy of sedentary agriculture, urban-rural dynamics, and their ecological consequences. The extent to which we offer new insights on rural economy and ecology may stem from this study’s Levantine focus. The larger value of such investigations, however, also lies in their potential applicability to other regions or time periods.

Our alternative approach to the development of early civilizations begins with an overview of early agriculture, human settlement, and their ecological impacts on the ancient Near Eastern landscape. Rank-size analyses then contrast the central importance of dramatically large Mesopotamian cities that were intimately linked to their surrounding hinterlands, with the less integrated, more commonly rural settlement of the southern Levant. Our rank-size depictions also highlight the persistent foundation of villages that underlay the waxing and waning of early Levantine urbanism. Most important, we offer a unique comparison of rural agrarian behavior during the pervasive abandonment and sudden rejuvenation of this region’s Bronze Age cities (ca. 2300–1500 B.C.).

Unlike prior studies of the ancient Near East, we draw from broad rank-size perspectives on early urbanism (Falconer and Savage 1995) to identify the hierarchical characteristics of Levantine settlement systems, thereby providing a regional backdrop for a case study of Tell Abu en-Ni’aj and Tell el-Hayyat, two Bronze Age villages in the Jordan Valley. Ni’aj, occupied during the abandonment of cities throughout the southern Levant in Early Bronze IV, and Hayyat, inhabited during the subsequent development of Middle Bronze Age cities and urbanized society, provide data that span the dramatic rebirth of Levantine cities and permit an assessment of rural responses to the highly variable fortunes and influences of early city life.

Our central hypothesis derives from the traditional expectation that cities dictated urban-rural relations in most, if not all, early urbanized civilizations. Accordingly, traditional approaches expect that rural economy and ecology will reflect the oscillating influences of urban communities through time. If these expectations hold for early civilization in the southern Levant, we should generate several interrelated results: (1) rank-size patterns of Bronze Age settlement should be comparable to those for the other best-known cases of initial urbanism in the Near East (e.g., Mesopotamia) from which most traditional interpretations of this region’s early urban societies have been drawn (e.g., Adams 1981); (2) evidence from Tell Abu en-Ni’aj, which was occupied during an interval of city abandonment, and Tell el-Hayyat, inhabited during the subsequent apex of early urbanism, should reveal fundamentally disjunct patterns of crop and herd management; (3) data from both villages spanning the collapse and redevelopment of Levantine urbanism should document increasing rural participation in regional economies and ecological impacts.

This exploration of Bronze Age rural life uses rank-size analysis to assess the first expectation of the null hypothesis presented above by describing the interregional settlement distinctions between the largely rural southern Levant and ancient Mesopotamia, a heartland of cities. Rank-size
analysis subsequently reflects structural changes in Levantine coastal settlement between the urban nadir of the Early Bronze IV Period (ca. 2300–2000 B.C.) and its later apex in the Middle Bronze Age (ca. 2000–1500 B.C.)

Our investigation then focuses on plant and animal management as they are reflected in evidence excavated from Tell Abu en-Ni'aj and Tell el-Hayyat. Although previous discussions of Tell el-Hayyat have considered evidence of ritual behavior (Magness-Gardiner and Falconer 1994) and selected aspects of household subsistence (Falconer 1995), this paper marks the first detailed synthesis of rural economy and ecology at both communities, which were inhabited during a remarkable process of regional reurbanization.

Our analyses of regional settlement and rural economy do not readily conform to the expectations of our central hypothesis. The results that depart from these expectations, especially the larger implications of crop production (especially orchard cultivation; see Lines 1995) and animal management, allow us to contribute a more sophisticated appreciation of how small agrarian communities responded to the rise and collapse of early urbanized civilization in the southern Levant and elsewhere.

Setting the Stage: Agrarian Settlement and Society in the Southern Levant

Near Eastern agrarian life developed on a landscape molded by a long legacy of human impact. Much of its environmental degradation has been ascribed to the gradually increasing aggregation of town and city populations, and their correspondingly enhanced reliance on agriculture and pastoralism (Miller 1991). Repeated cycles of stability and perturbation, however, have led to the coevolution of productive agricultural systems and sustainable anthropogenic environments that have supported rural and urban societies for thousands of years (Butzer 1996). Near Eastern urbanism, notable for its early genesis and grand scale, is equally notorious for its repeated episodes of dramatic rise and collapse. When dissected in greater detail, the course of human impact accordingly has been neither continuous nor directional. Lengthy spans of stability for the Mediterranean landscape were punctuated by shorter episodes of mismanagement, often followed by ecological recovery (Butzer 1996). The following chronological overview summarizes the long-term economic and political circumstances that fueled the advent, collapse, and rebirth of Bronze Age Levantine urbanism, which this study appraises from a rural vantage point.

Although the first cities in the Near East were not established until the late fourth and early third millennia B.C. (Postgate 1994:22–35), the first aggregated communities arose in the Pre-Pottery Neolithic period shortly before 7000 B.C. (Rollefson et al. 1992) (Table 1). These early communities laid the foundation for the rise of social, political, and economic centers in the region. Aggregated communities, such as ‘Ain Ghazal and Jericho (Figure 1), grew rapidly to large size with thousands of inhabitants, and then collapsed dramatically around 6000 B.C. (Rollefson et al. 1992).

<table>
<thead>
<tr>
<th>Cultural Period</th>
<th>Approx. Duration (yrs. B.C.)</th>
<th>Regional Settlement</th>
<th>Settlement at Ni'aj and Hayyat</th>
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<tbody>
<tr>
<td>Late Bronze</td>
<td>1500–1200</td>
<td>Urban recession</td>
<td>Hayyat Phase 2</td>
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<td>Middle Bronze II C</td>
<td>1650–1500</td>
<td>Height of urbanism</td>
<td>Hayyat Phase 3</td>
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<td>Middle Bronze II B</td>
<td>1800–1650</td>
<td>Height of urbanism</td>
<td>Hayyat Phase 4</td>
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<td>Middle Bronze II A</td>
<td>1900–1800</td>
<td>Cities redevelop</td>
<td>Hayyat Phase 5</td>
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<td>Middle Bronze II A</td>
<td>2000–1900</td>
<td>Cities reappear</td>
<td>Ni'aj Upper Phase</td>
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<td>Early Bronze IV</td>
<td>2300–2000</td>
<td>Urban collapse</td>
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<td>Early Bronze II–III</td>
<td>2900–2300</td>
<td>First cities</td>
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<td>Early Bronze I</td>
<td>3200–2900</td>
<td>Village-level farming</td>
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<td>Chalcolithic</td>
<td>4500–3200</td>
<td>Village-level farming</td>
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<td>Pottery Neolithic</td>
<td>6000–4500</td>
<td>Village-level farming</td>
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<td>Pre-Pottery Neolithic</td>
<td>8000–6000</td>
<td>First farming towns</td>
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The inhabitants of these Neolithic communities implemented new economic strategies, especially the cultivation of cereals and legumes (van Zeist 1988), and the domestication of goats and sheep (Helmer 1989; Rodrigue 1992). As the population of Neolithic towns expanded and their croplands grew, seasonal and permanent herding camps were established in their ever more distant pasturage, setting the stage for specialized mobile pastoralism (Köhler-Rollefson 1992). Localized resource depletion due to harvesting of fuelwood and construction timbers, as well as repeated house plastering, generated resource demands for these early towns that rapidly could have exceeded the productive capacity of their immediate environments (Köhler-Rollefson 1988; Köhler-Rollefson and Rollefson 1990; Rollefson et al. 1992). Archaeological data from 'Ain Ghazal suggest that this Neolithic town, and perhaps many of its contemporaries, eventually were abandoned in the wake of interrelated environmental impacts that began with intense localized deforestation (Köhler-Rollefson and Rollefson 1990), and subsequently became amplified by extensive herding (Köhler-Rollefson 1992). Strikingly, aggregated towns did not reappear on the Near Eastern landscape for almost three millennia.

Following the abandonment of Pre-Pottery Neolithic aggregated towns, more modest village-level settlements characterized the southern Levant through the Pottery Neolithic, Chalcolithic, and Early Bronze I periods (ca. 6000–2900 B.C.) (Joffe 1993; Levy 1995). The subsequent development of urbanized society during the Early and Middle Bronze ages marked the florescence of civilization, associated with the Canaanites of the Old Testament. The success of Canaanite urban-
isom oscillated dramatically, however, through the
third and second millennia B.C. (Table 1).

The initial urbanism of Early Bronze II–III (ca.
2900–2300 B.C.) paralleled the rise of the Egyptian state during Dynasties I–VI (Kantor 1992:17–21; Stager 1992:40–41). Shortly thereafter, Egypt entered the First Intermediate Period, during which centralized authority collapsed and regional economic ties were attenuated (Stager 1992:41). The southern Levant simultaneously experienced near-wholesale abandonment of towns and cities during Early Bronze IV (ca. 2300–2000 B.C.) (Dever 1995). In striking contrast to those in preceding and subsequent periods, Early Bronze IV settlements were small, often inhabited seasonally, and located at the arid margins of the southern Levant. The most influential explanatory model for Early Bronze IV society posits a largely pastoralized economy involving non-sedentary populations who moved seasonally between lowland winter camps around the desert fringes of the southern Levant and upland summer pasturage in the hills of Palestine and Transjordan (Dever 1995). But recent excavations of Early Bronze IV villages (e.g., Khirbet Iskander [Richard 1986] and Tell Umm Hammad [Helms 1986]) show that a significant sedentary rural population also persisted through the abandonment of Levantine towns and cities. Tell Abu en-Ni‘aj, which was first inhabited at the beginning of the Early Bronze IV Period and abandoned at its end, provides our most substantial body of evidence for a year-round farming community during this interval most commonly interpreted in terms of non-sedentary pastoralized society.

Canaanite cities were rapidly reestablished, and expanded in size and number during the subsequent Middle Bronze Age (Falconer 1994; Ilan 1995). The beginning of this urban heyday coincided with the reemergence of state-level authority and far-flung economic influence of Middle Kingdom Egypt. Middle Bronze IIA stands as a developmental prelude to the height of Canaanite urbanism in Middle Bronze II B and IIC. The Egyptian Execration Texts reflect the emergence of vaguely defined Levantine “city-states” with a modicum of political authority during these periods (Posener 1971:541, 555). The hamlet of Tell el-Hayyat was founded at the beginning of Middle Bronze IIA and occupied continuously for approximately five hundred years until the end of Middle Bronze IIC, when it was abandoned. Farming villages like Hayyat typically populated the hinterlands around the Levant’s towns and cities. Following political and military upheavals at the end of the Middle Bronze Age, Canaanite cities declined in number and size during the urban recession of the Late Bronze Age (Gonen 1984). Middle Bronze Age urbanism is particularly noteworthy because during Middle Bronze II B and C, the southern Levant’s cities and regional population grew to levels unsurpassed until the Roman and Byzantine periods more than a millennium later (i.e., first century B.C.–seventh century A.D.; Broshi 1979).

Despite the severity of local forest-resource exploitation by Neolithic villagers, the Levantine hill country probably still featured large tracts of oak/pistachio woodland at the advent of Bronze Age cities in the third millennium B.C. (Gophna et al. 1986; Liphschitz et al. 1989). Roughly five thousand years after the Neolithic domestication of cereals and legumes, a second wave of agricultural innovation, featuring intensive orchard cultivation, became pronounced during the third and second millennia B.C. (Miller 1991). As a consequence, lowlands and river valleys, like the lands around Tell Abu en-Ni‘aj and Tell el-Hayyat, became checkered with annual subsistence crops, while perennial fruit-bearing trees and vines encroached on the rockier slopes of neighboring uplands (Stager 1985). Despite the potential for localized Neolithic deforestation, palynological analysis of lake cores from the Sea of Galilee and the Dead Sea show that regional impacts on forests and woodlands emerged clearly only in the wake of Bronze Age urbanism (e.g., Baruch 1990). Thus the major impetus for the anthropogenic vegetation so characteristic of the Eastern Mediterranean stems from Bronze Age agricultural intensification—especially for the export of wine, olive oil, and dried fruit—to serve emerging urban markets, including Egypt and its trading partners (Stager 1985; Ben-Tor 1986).

Rank-Size Perspectives on Early Urbanism

The earliest Near Eastern cities depended, to varying extents, on agricultural surpluses provided by farmers and herders in the countryside. Agrarian populations, in turn, received the mixed blessings provided by ruling elites, religious institutions, professional bureaucrats, and mercantile specialists (Wirth 1938; Childe 1950; Redfield 1953; Weber 1958). Urban-rural relations tended to be hierarchical, such that more institutional
decisions and directives were issued from larger communities. Therefore, relative settlement sizes often reflect the nature of interactions between communities in ancient regional economic systems (e.g., Johnson 1977, 1980).

Rank-size analyses provide empirically-based descriptive portraits of settlement hierarchies that are most informative when settlement systems are compared between regions or over time within a single region. According to the “rank-size rule,” the size of any nth-ranked place in a settlement system may be predicted by dividing the size of the largest place by n, such that the rank and population of these cities describe a log-normal distribution when plotted logarithmically (Zipf 1949). Applying the “Principle of Least Effort,” Zipf attributed the rank-size rule to the interaction of the opposing economic forces of “diversification” and “unification” (1949:352). In this study, and in most other analyses of prehistoric data, these forces are undocumented and elude reliable quantification. In such circumstances, a special case of the rank-size equation commonly is applied, in which these forces are assumed to have been equal (see critical discussions in Moore 1959; Dziewonski 1972; Richardson 1973; Kowalewski 1982).

Log-normal distributions in accordance with the rank-size rule “appear to be typical of larger countries with a long tradition of urbanism, which are politically and economically complex” (Berry 1961:582). Since preindustrial settlement systems rarely follow the predictions of the rank-size rule, however, their economic interpretation commonly derives from the manner and degree to which rank-size distributions depart from lognormal (e.g., Johnson 1977, 1980; Adams 1981; Paynter 1983; Falconer and Savage 1995). These departures are molded by a variety of factors regarding community interactions within the system under analysis. These factors include the “closure” of the settlement system (i.e., the degree to which interactions are bounded within a system) and the “interdependence” or “integration” of communities (i.e., the relative frequency of interaction between communities in a system) (Vapnarsky 1968; Johnson 1980).

We apply rank-size analysis to assess the general structure of ancient settlement in lower Mesopotamia and the southern Levant, including the Jordan Valley, where Tell Abu en-Ni’aj and Tell el-Hayyat are located. We contrast these two regions because (1) they encompass the arenas of early Near Eastern urbanism that have been surveyed most comprehensively, and (2) reconstructions of early urbanism derived from the greater Near East (especially Mesopotamia) heavily influence many interpretations of Bronze Age society in the southern Levant. The Mesopotamian settlement data analyzed here are drawn from the Warka and Nippur-Adab surveys directed by Robert Adams, which covered approximately 6250 km² in southern Iraq (Adams and Nissen 1972; Adams 1981). We focus on the sizes reported for sites occupied during the Early Dynastic I Period (ca. 2900–2600 B.C.), the first peak of urban development in lower Mesopotamia.

Levantine settlement data are gleaned from a variety of surveys in Israel and western Jordan that encompass an aggregate area of 15,000 km² (see Ibrahim et al. 1976, 1988; Broshi and Gophna 1986; Gophna and Portugali 1988). Likewise, we feature site sizes for the southern Levant’s urban apex, Middle Bronze II B–C, as well as evidence from the urban collapse of Early Bronze IV. Site locations, sizes, and periods of occupation were determined using pedestrian and vehicular reconnaissance methods (see discussion in Falconer and Savage 1995). For both regions we consider the entire inventory of sites reported for the periods of interest.

During the late fourth and early third millennia B.C., the world’s first large fortified cities emerged on the plains of southern Mesopotamia as an apparent prototype for subsequent development of urbanism elsewhere in the Near East. Regional surveys directed by Adams (Figure 2) show that by the Early Dynastic I Period (ca. 2900–2600 B.C.), the city of ancient Uruk emerged as an anomalously large metropolis with a population of “no less than 40,000 to 50,000 inhabitants” (Adams 1981:85) that was almost an order of magnitude larger than the region’s second-ranked city (Figure 3).

Rank-size distributions featuring such a distinct “primate city” (following Jefferson 1939; Morse 1962; Mehta 1964; Linsky 1965), associated with smaller settlements that adhere roughly to the rank-size rule, may be attributed to conditions of low system closure and high interdependence between communities (Vapnarsky 1968). Indeed, Uruk stood at the center of a far-flung network of economic and political interaction with neighboring regions (Algaze 1989). Uruk’s primate size was achieved
through the rapid absorption of rural populations from its immediate hinterlands, reflecting the pronounced integration of Uruk with an array of supporting cities, towns, and villages in lower Mesopotamia (Adams 1981:60–94).

Interestingly, the Levant’s urban zenith stands in stark contrast to that of Mesopotamia. Canaanite cities, which very rarely exceeded a few thousand inhabitants (Falconer 1994), describe “convex” rank-size distributions in which large settlements are smaller, and small settlements are larger, than predicted by the rank-size rule (Johnson 1977:497). Such distributions, which are increasingly difficult to observe in the modern world, tend to characterize underdeveloped regions with high closure and low interdependence (Vapnarsky 1968; Johnson 1980). Ancient Levantine settlement patterns repeatedly produce convex rank-size distributions, even during the urban zenith of Middle Bronze II B–C, implying only modest regional interdependence through the Bronze Age (Falconer and Savage 1995) (Figure 3).

Some coastal settlement patterns provide more specific insights on the structure of Bronze Age urban and rural settlement. For example, the modest collection of small sedentary Early Bronze IV settlements along the Levantine coastal plain exhibits a vaguely convex rank-size distribution that implies a lack of interdependence among its local communities, which is not surprising for this period of urban collapse (Figure 4). Intriguingly, Middle Bronze Age data suggest the superimposition of a few cities and towns on a convex lower rank-size curve that closely resembles the distribution of Early Bronze IV villages. The similarities between these lower curves imply the persistence of rural settlement through the collapse and

**Figure 2.** Settlement survey regions. (a) The Warka and Nippur-Adab surveys in Lower Mesopotamia. (b) A variety of surveys in the southern Levant. See Adams (1981:figures 12, 13), Adams and Nissen (1972:maps 1A–4B), Ibrahim, et al. (1976, 1988); Broshi and Gophna (1986); Gophna and Portugali (1988); Falconer and Savage (1995).
rejuvenation of Levantine urbanism (Falconer and Savage 1995). The coastal cities atop the Middle Bronze II B–C curve apparently developed in response to the external stimulus of Mediterranean maritime commerce (e.g., between Egypt and the cities of coastal Syria), which had disappeared during Early Bronze IV but recovered during the Middle Bronze Age (Gerstenblith 1983; Falconer 1994; Falconer and Savage 1995).

These rank-size analyses do not adhere to the first expectation of our general working hypothesis. Instead, they effectively contrast the rapid growth of massive cities and primate settlement systems on the broad lower Mesopotamian Plain with the development of urbanism in the Southern Levant on a more tightly defined stage, a much smaller scale, and with less apparent integration between central and peripheral communities.

Field Investigations in the Jordan Valley

The rural basis for early civilization in the southern Levant is illustrated in a detailed case study of economy and ecology at the Bronze Age villages of Tell Abu en-Ni‘aj and Tell el-Hayyat, located in the Jordan Valley, Jordan. These sites were chosen for investigation for two reasons. First, they span a dramatic transition from pervasively nonurbanized society to the rapid rebirth and florescence of Canaanite urbanism. Tell Abu en-Ni‘aj was occupied ca. 2300–2000 B.C., during the pervasive abandonment of Levantine towns.
and cities in the Early Bronze IV period. Subsequently, Tell el-Hayyat was inhabited ca. 2000–1500 B.C. during the heyday of Middle Bronze Age urbanism. Despite the pronounced waxing and waning of Canaanite cities, village life persisted across this transition, as exemplified at Ni‘aj and Hayyat. Given their persistence in the face of urban collapse, villages like these provide the most appropriate venues for inferring the long-term economic and ecological foundations for the development of Levantine civilization. Second, Ni‘aj and Hayyat are located in prime agricultural land in which permanent agriculture and seasonal sheep and goat herding still flourish today. This criterion is crucial here since most Early Bronze IV settlements are located around today. This criterion is crucial here since most Early Bronze IV settlements are located around the arid fringes of the Levant where Middle Bronze II sites are virtually absent, and therefore unavailable for comparison.

Both archaeological sites are located about 240 m below sea level in the ghor, the broad agricultural terrace above the active stream channel of the Jordan River (Figure 1). Tell el-Hayyat, a low mound (ca. 4 m high), rises from the Holocene alluvium of the ghor, which provides the most fertile soil in the Levant (Zohary 1982) and has been intensively cultivated throughout the history of the region. Tell Abu en-Ni‘aj lies on Pleistocene lacustrine sediments at the terrace edge, overlooking the zor, the active floodplain of the Jordan River. The climate of the southern Levant is decidedly Mediterranean with mild, rainy winters and long, hot summers. Modern precipitation in the Jordan Valley averages 250 mm per year (Horowitz 1979: fig. 2.31), an amount sufficient for dry farming. A mean annual temperature greater than 20°C (Horowitz 1979:22) permits year-round horticulture.

Today, wheat fields generally are rain fed, while other fields and orchards in the vicinity of Hayyat and Ni‘aj are irrigated from the East Ghor Canal, which diverts water from the Yarmouk River, a tributary of the Jordan River (20–30 km north of these sites). Although there is no direct evidence for local Bronze Age canals, irrigation water could have been obtained from the Jordan River (1–2 km to the west) or from a permanent spring at the foot of the ancient town of Pella, 7 km to the northeast (see Figure 1).

Three seasons of excavation at Tell el-Hayyat in 1982, 1983, and 1985 exposed 400 m² of the tell’s surface (8 percent of the site’s area), while excavations in 1985 at Tell Abu en-Ni‘aj covered 200 m² (< 1 percent of the site’s area). The excavated portion of Hayyat is quite substantial by Near Eastern standards, whereas the exposure at Ni‘aj reflects a single season of fieldwork and will be expanded in the future. Archaeological deposits at both sites were excavated in 5 × 5 m squares to permit careful documentation and recovery of refuse discarded by villagers, and its spatial patterning in households, alleyways, and work areas. This fragmentary material includes broken ceramics, stone tools, and the most informative vestiges of village ecology: plant fragments and animal bones. These otherwise mundane remnants provide very eloquent, direct indications of the commodities and foodstuffs produced and consumed routinely by Bronze Age villagers.

All sediments excavated at Hayyat and Ni‘aj were sieved for animal bones and sampled for plant fragments. In open sites such as these, bone preservation is usually good, but floral remains are preserved very rarely unless they have been carbonized in antiquity. Thus sediment samples were collected nonrandomly from localities that clearly contained carbonized seeds and wood or showed evidence of burning (Fall 1983). Samples from Hayyat (n = 151) and Ni‘aj (n = 30), drawn from earthen floors, hearths, tabuns (cooking ovens), a kiln, storage pits, and trash deposits, were analyzed for plant remains.

Simple water flotation (Pearsall 1989) was used to extract more than 10,000 identifiable floral specimens, including seeds, fruits, and rachis segments, from 852 liters of sediment from Hayyat and 204 liters of sediment from Ni‘aj (mean sample volume for both sites is 5.9 liters). Because sample volumes differed (ranging between 1 and 20 liters each), density ratios (i.e., number of fragments/kiloliter of sediment) were computed to standardize the floral data (after Miller 1988; Pearsall 1989). These values do not necessarily reflect the relative importance of each crop at any given time, but they are extremely valuable for inferring differences in plant use through time or between the two villages (Pearsall 1989; Miller 1988).

All excavated sediments were screened through 0.5 cm mesh screen, permitting the recovery of more than 36,000 animal bone fragments from every excavated context at both sites (Metzger 1984, 1985). Our faunal data are presented as numbers of identified specimens (NISP), which reflect the frequency of bones for each of several, primarily domesticated, animal taxa. Variable bone frequencies reflect changing animal management through the Bronze Age at
Hayyat and Ni’aj. Because the volumes of some excavated sediments are not available, bone densities are not presented here.

Reconstructing Bronze Age Agriculture and Environment

Tell Abu en-Ni’aj embodies a village measuring 2.5 ha that revealed 2.5 m of cultural deposits with three major strata of mudbrick architecture, all dating to Early Bronze IV. Traditional Middle Eastern village population densities suggest that Ni’aj’s population measured between 500 and 600 (see Kramer 1982). Tell el-Hayyat contains the stratified remains of a Middle Bronze Age hamlet measuring 0.5 ha, which housed no more than 150 inhabitants. It produced 6 strata of village architecture to a total depth of 4.5 m at the center of the mound (Falconer and Magness-Gardiner 1989). Habitation at Hayyat began very late in Early Bronze IV and continued without interruption through the end of the Middle Bronze Age. Phases 5–2 provide robust data for village life through Middle Bronze II A, II B, and II C. At Ni’aj, the latest Early Bronze IV stratum contributes the most substantial data recovered thus far. In the following discussions, we combine excavated data from Tell Abu en-Ni’aj and Tell el-Hayyat that span five major strata and approximately five centuries through the Early Bronze IV–Middle Bronze II sequence (see Table 1).

Prevailing interpretations of Bronze Age society inspire fundamentally different expectations for the faunal and floral evidence from Tell Abu en-Ni’aj and Tell el-Hayyat. We anticipated faunal data from Ni’aj to be dominated by sheep and especially goat, the mainstays of Early Bronze IV mobile herding. Floral remains would feature abundant annual crops, especially cereal grains and legumes, suggesting the opportunistic seasonal agriculture that often accompanies pastoralism. On the other hand, we expected Tell el-Hayyat to reflect sedentary farming strategies incorporated within an increasingly urbanized regional economy (e.g., see Chernoff 1988). Among animal taxa, we expected increased deposition of sheep, important producers of marketable wool, and cattle, major sources of high-status meat, hides, and traction for pulling plows and carts. Floral evidence should document not only local food consumption, but a greater emphasis on cultivation of perennial orchard crops that could be rendered into transportable secondary products. In many significant respects, the agricultural data from both sites run contrary to our expectations and thereby open new insights on Bronze Age rural ecology.

Animal Husbandry and Consumption

When summarized, the faunal assemblages from Tell Abu en-Ni’aj and Tell el-Hayyat show many more similarities than differences (Table 2). As with most agrarian communities in the Near East, the majority of bones represent sheep (Ovis aries) and goat (Capra hircus), which provide very similar bone frequencies between these two villages. The relative abundance of cattle (Bos taurus) bones is identical at each village, while the frequency of pig (Sus scrofa) is slightly higher at the presumed “pastoral” settlement of Ni’aj. The pig bone frequencies at both sites are unexpectedly high and significantly greater than those for other Near Eastern Bronze Age communities, which commonly produce frequencies around 10 percent (e.g., Wapnish and Hesse 1988; Horwitz 1989). Low pig frequencies at other sites reflect their relatively high water needs and poor suitability for mobile pastoralism (Horwitz 1989). Low pig frequencies at other sites reflect their relatively high water needs and poor suitability for mobile pastoralism (Horwitz 1989). In addition to the general faunal similarities between Ni’aj and Hayyat, high pig-bone frequencies provide strong circumstantial evidence that both settlements were sedentary agrarian communities. The general agricultural orientation of both villages is underscored by the near absence of wild taxa, despite the availability of migratory birds along the Jordan Valley and fish in the nearby Jordan River.

Although the summary faunal evidence from these two villages is very similar, there are several significant trends through the Middle Bronze Age sequence at Tell el-Hayyat that document the

<table>
<thead>
<tr>
<th>Bone Frequencies as Percentage</th>
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<tr>
<td>Species</td>
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<tr>
<td>Sheep/goat</td>
</tr>
<tr>
<td>(Ovis aries/</td>
</tr>
<tr>
<td>Capra hircus)</td>
</tr>
<tr>
<td>Pig (Sus scrofa)</td>
</tr>
<tr>
<td>Cattle (Bos taurus)</td>
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<tr>
<td>Weed taxa</td>
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</table>
influences of developing urbanism. In most cases, sheep and goat bones cannot be distinguished, and must be analyzed collectively. However, for those cases in which sheep and goat can be segregated, the ratio of sheep to goat shows an increase through time (Table 3). Goat bones from Hayyat Phase 5 are slightly more numerous, but by Phase 3, sheep bones are almost three times more abundant (Falconer 1995). This trend implies increasingly market-oriented animal husbandry, since sheep carry more meat and produce more abundant secondary products (especially wool), which are suitable for transport and exchange (Sherratt 1981; Davis 1984), whereas harder goats are more indicative of mobile pastoralism.

In contrast, the other major animal taxa at Tell el-Hayyat reveal a diminishing potential for market-oriented husbandry, as the relative abundance of pig bones increases, while that of cattle decreases (Figure 5). Diminished use of cattle follows naturally from the shift toward sheep herding noted above. Although cattle may provide marketable goods and serve as important draft animals, they are grazers that compete more with sheep (which both graze and browse), than with goats (which prefer browsing) (Redding 1984).

Increased pig and diminished cattle husbandry reflect a growing emphasis on household-based subsistence at Hayyat (Falconer 1995). Pigs are poorly suited for regional exchange because they provide few secondary products and do not herd readily to distant pasturage or markets (Wapnish and Hesse 1988; Horwitz and Tchernov 1989). Instead, pig husbandry tended to flourish when institutional controls were relaxed (Zeder 1990) and is highly diagnostic of sedentary household husbandry, since swine can subsist as domestic scavengers and may be managed effectively by individual families (Grigson 1982).

Thus the bone assemblages from Tell Abu en-Ni‘aj and Tell el-Hayyat reflect mixed strategies of animal husbandry. High sheep and goat frequencies typify Bronze Age herd management, and escalating sheep:goat ratios suggest potentially increased regional exchange of animal goods by the inhabitants of Tell el-Hayyat, as might be anticipated to accompany Middle Bronze Age urbanization. These expected results are tempered, however, by pig-bone frequencies that are anomalously high at both sites and grow through time at Hayyat. These data suggest strongly that Tell Abu en-Ni‘aj was a sedentary agrarian village, and that market participation by Hayyat was tempered by accentuated household-level animal management and consumption despite the regional development of Middle Bronze Age towns and cities.

**Plant Cultivation and Exchange**

As with their faunal data, Ni‘aj and Hayyat are characterized by remarkably similar botanical assemblages (Table 4). Agricultural crops at both villages are grouped into four main categories: cultivated cereals, orchard crops, cultivated legumes, and wild species (Table 5). Annual and perennial crops often require very different cultivation strategies. Cereals and legumes require the planting of mature seeds but may not entail intensive maintenance before producing a harvest of new seeds within several months. Thus the

<table>
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<tr>
<th>Phase</th>
<th>Ratios</th>
<th>NISP</th>
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<tbody>
<tr>
<td>3</td>
<td>2.73:1</td>
<td>183</td>
</tr>
<tr>
<td>4</td>
<td>0.83:1</td>
<td>289</td>
</tr>
<tr>
<td>5</td>
<td>0.56:1</td>
<td>196</td>
</tr>
</tbody>
</table>

*Bone counts produce a chi-square statistic ($X^2 = 57.998$, df = 2, p < 0.001) that permits rejection of the null hypothesis that there is no difference between sheep and goat distribution at Hayyat by phase.*

**Table 3. Sheep:Goat Ratios at Tell el-Hayyat, Based on Number of Identifiable Specimens (NISP) Determined as Ovis or Capra**

**Figure 5. Relative frequencies of bone-element deposition from domestic animals at Tell el-Hayyat, phases 5–3. Data provided by M. Metzger. Chi-square statistic ($X^2 = 183.207$, df = 4, p < 0.001; NISP: Phase 5 = 2427, Phase 4 = 2802, Phase 3 = 1822), based on number of identified specimens (NISP), permits rejection of the null hypothesis that there is no difference in domestic animal-bone distribution by phase.**
cultivation of annual crops permits discontinuous seasonal cultivation by mobile populations (Zohary and Hopf 1988; LaBianca 1990). In contrast, the cultivation of fruit trees requires more continuous horticultural management and a shift from sexual (i.e., involving seeds) to vegetative reproduction (Liphschitz et al. 1991). Fruit trees represent a distinct long-term investment, since they do not bear fruit for three to eight years after planting and may not reach full productivity for ten to twenty years (Stager 1985; Hopkins 1983).

Cereal grains include einkorn (Triticum monococcum), emmer (T. dicoccum), bread wheat (T. aestivum/T. compactum), oat (Avena sativa), rye (Secale cereale), and barley in both hulled (Hordeum vulgare) and naked varieties (H. vulgare var. nudum) (Fall 1983; Lines 1995). All of these cultivated cereals would have thrived as winter-sown varieties in the Jordan Valley and could have been cultivated without irrigation. Hulled barley, the most common cultivated cereal at both villages, is four to seven times more abundant than the naked form. In traditional agricultural systems, hulled varieties of barley are preferred for animal fodder and brewing beer, while naked forms are favored as food (Zohary and Hopf 1988). The cultivated legumes found in these villages include lentil (Lens culinaris), pea (Pisum sativum), chickpea (Cicer arietinum), horsebean (Vicia faba), bitter vetch (Vicia ervilia), and grass pea (Lathyrus sativus) (Fall 1983; Lines 1995). Orchard crops feature olive (Olea europaea), grape (Vitis vinifera), and fig (Ficus carica), while the only common uncultivated fruit was Prosopis, a source of animal fodder (Helbaek 1966). All of the weeds, wild grasses, and wild legumes recovered from Ni’aj and Hayyat are prevalent in agricultural fields or disturbed areas. Weeds from a variety of genera include Malva, Plantago, Rumex/Polygonum, Galium, Amaranthus, and Chenopodium, among others.

Although the floral assemblages from Ni’aj and Hayyat are generally similar, there are several significant trends through time. Among cereal grains, density ratios show a predominance of barley cultivation at Ni’aj and during the early phases at Hayyat that gives way to similar wheat and barley densities during the latter half of the Middle Bronze Age (Figure 6). Both wheat and barley may be eaten as gruel or porridge or baked into bread. Barley flour traditionally has been viewed as an inferior source of bread for the poor (Zohary 1982), since wheat produces superior baking flour, particularly when grown in rich soil, with a climate affording low rainfall and a hot, dry, sunny ripening period (Renfrew 1973). The relative mercantile value of these crops is reflected in the biblical verse: “A quart of wheat for a denarius, and three quarts of barley for a denarius...” (Revelations 6:6). Although all varieties of wheat (einkorn, emmer, and bread wheat) are more common at Hayyat, the frequency of bread wheat in particular jumps to eight times its value at Ni’aj. The Jordan Valley provides precisely the agricultural characteristics favorable for wheat cultivation, making local bread wheat a potentially valuable commodity for local and, perhaps, regional trade.

The influence of regional exchange on rural agriculture is most apparent when considering evidence for fruit cultivation. Of the seven crop taxa—wheat, barley, grape, fig, pomegranate, olive, and date—with which the Old Testament says the Land of Israel was blessed, five are fruit trees (Deuteronomy 8:8; Zohary 1982). Rendered fruit products provide relatively low bulk, highly storable and transportable commodities that are much better suited for regional exchange than more perishable, higher bulk annual grains and legumes.

Olive, arguably the most important fruit tree of the eastern Mediterranean, was valued primarily as a producer of oil for eating and cooking, ointments, and fuel for lamps (Zohary 1982). Olive oil, because it could be stored for long periods, was a valued trade commodity and a symbol of wealth throughout the Mediterranean Basin beginning in the Early Bronze Age (Zohary and Hopf 1988; Neef 1990).

The grape vine, a similarly versatile orchard taxon, produced fruits that could be eaten fresh, dried to make raisins, or pressed to render juice and wine (Zohary 1982). Like olive oil, wine could be sealed in pottery jars, stored and transported, making it suitable for regional exchange (Stager 1985). Although wild grapes were utilized

<table>
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<th>Seed Frequencies as Percentage</th>
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<tr>
<td>Tell Abu en-Ni’aj (n = 2217)</td>
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<tr>
<td>Cultivated cereals</td>
</tr>
<tr>
<td>Orchard crops</td>
</tr>
<tr>
<td>Cultivated legumes</td>
</tr>
<tr>
<td>Weed taxa</td>
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</table>
earlier, the first evidence of cultivated grapes comes from excavations at Early Bronze Age Lachish (Helbaek 1958), Arad (Hopf 1978), Numereia (McCreery 1980), and Jericho (Hopf 1983).

Cultivated figs, which are particularly rich in sugar, could be dried, stored, and eaten year round. The earliest evidence for fig cultivation in the Levant dates to the Chalcolithic (Hopf 1983) and the Early Bronze Age (McCreery 1980). By the Early Bronze Age, olive, grape, and fig, which flourish collectively in Mediterranean environments, constituted the main horticultural products in areas throughout the Mediterranean basin that were dependent upon rain-fed agriculture (Zohary and Hopf 1988).

The densities of orchard crop remains at Tell Abu en-Ni’aj and Tell el-Hayyat show the same general pattern identified above for faunal and annual crop data: striking overall similarity, with some subtle but significant distinctions (Figure 7). Major fruit cultigens, all of which require long-term cultivation and maintenance, are well represented at both sites, reinforcing our interpretation of Ni’aj as a sedentary agrarian village, rather than a seasonal pastoral encampment.

Among the most informative floral distinctions, we note a shifting balance of grape and olive...
deposition, in which grape seeds are more common at Ni’aj, while olive becomes more abundant at Hayyat, particularly during phases 4 and 3 (Figure 8). Olive trees are perhaps the optimal cultigen for Mediterranean climates, since they thrive with warm, wet winters and hot, dry summers, particularly when planted on well-drained soils (Polunin and Huxley 1965; Renfrew 1973). Successful olive cultivation requires extensive landholdings since each tree has an extensive root system that requires a spacing of approximately 10 m between trees (Turrill 1952). The apparent shift to greater olive cultivation at Tell el-Hayyat represents a serious increase in local agricultural investment. This shift extended well after the end of Early Bronze IV into phases 5 and 4 at Hayyat, suggesting it was also inspired by the mercantile opportunities afforded by developing urbanism. Several clear trends of enhanced production of marketable commodities (especially olive oil, bread wheat, and sheep wool) suggest that the farmers of Tell el-Hayyat increasingly adapted their crop cultivation and animal management to meet the demands of emerging mercantile exchange and consumption in Middle Bronze Age towns and cities. An equally intriguing, and less expected, trend is marked by a parallel increase in more localized plant and animal management (e.g., especially of pigs and possibly grapes), possibly as a hedge by this hamlet against the potential inroads of urban economic and political authorities.

In a study of peasant agriculture under Inca rule, Zimmerer (1993) also emphasizes the importance of household subsistence cultivation. Surplus-oriented production under the Inca state featured only a few major crops such as maize, potatoes, and coca; localized subsistence farming, however, supported a wide variety of cultivars (Lathrap 1973; Plowman 1984; Knapp 1991; Zimmerer 1993). Household gardens undoubtedly also played a similar role in maintaining native crop diversity in pre-Columbian Mesoamerica (Whitmore and Turner 1992).

At Tell el-Hayyat, the most pronounced changes in both faunal and floral data occur between phases 4 and 3, and therefore suggest social and economic changes between the rebirth of town life in Middle Bronze II A and the culmination of urbanism in Middle Bronze II B and II C. In this manner, Tell Abu en-Ni’aj and Tell el-Hayyat illuminate the complex weave of village agriculture and intercommunity relations at the foundation of Bronze Age society in the southern Levant.

**Figure 8.** Density ratios of grape and olive seeds from Tell Abu en-Ni’aj and Tell el-Hayyat, phases 5–2. Seed counts for grape and olive produce a chi-square statistic ($X^2 = 63.8, df = 4, p < 0.01$) that permits rejection of the null hypothesis that there is no difference between grape and olive deposition through the sequence at Ni’aj and Hayyat.

Village Agriculture in Overview

This detailed profile of village agriculture in the Jordan Valley, as summarized in Table 6, provides several fundamental, and sometimes unexpected, insights on Bronze Age rural economy and ecology in the midst of urban collapse and florescence. Many of our inferences stem from several basic continuities between Tell Abu en-Ni’aj and Tell el-Hayyat. For example, the striking similarities in animal management and orchard cultivation at both villages reflect a persistent element of rural sedentarism that may link the seemingly distinct societies of the “pastoralized” Early Bronze IV period and the urban heyday of Middle Bronze II. Yet Ni’aj and Hayyat also provide their share of distinct contrasts that reflect rural responses to growing urbanism. Several floral data clearly reflect sedentary farming strategies at both Tell Abu en-Ni’aj and Tell el-Hayyat, with a growing emphasis on crops with greater market potential. The two major horticultural shifts, in which wheat became more dominant among cereals, and fruit cultivation shifted from grape to olive, are most accentuated within the Middle Bronze Age, rather than at the Early Bronze IV/Middle Bronze Age interface.
Conclusion

Any appreciation of the roots of civilization in the Near East must not only identify the origins of social revolutions such as agriculture and urbanism, but comprehend their concomitant effects on the natural environment and the economic behaviors of rural villagers who comprised the vast majority of ancient populations. The communities of Tell Abu en-Ni‘aj and Tell el-Hayyat provide a rare, intimate portrait of agrarian ecology on an increasingly anthropogenic landscape during the collapse and development of early towns and cities. Pre-Columbian state-level societies exerted comparably powerful influences on the rural environments of Mesoamerica (Denevan 1992; Whitmore and Turner 1992). Aztec and Maya demand for specialized orchard products such as cacao (*Theobroma cacao*) and avocado (*Persea americana*) created extensive agricultural landscapes throughout the region (Bergman 1969; Turner and Miksicek 1984; Whitmore and Turner 1992). Amid relatively long-term trajectories of agrarian and environmental change, rural communities often demonstrate remarkable resilience (e.g., Adams 1978), making them ideal vantage points for detailed reconstructions of the economy and ecology that lay at the root of early civilizations.

At Ni‘aj and Hayyat, striking overall similarities in crop cultivation and animal management reflect the persistence of sedentary agriculture, despite the varying fortunes of urban centers, that has escaped serious attention previously. Ni‘aj exemplifies the importance of sedentary communities and the persistence of orchard cultivation during the urban collapse and regional “pastoralization” of Early Bronze IV, while Hayyat demonstrates several striking trends that accompany the rejuvenation of Middle Bronze Age cities. The farmers of Hayyat increasingly exploited far-reaching mercantile opportunities afforded by urban markets, as signaled by clear shifts to greater sheep husbandry and, most significantly, accentuated cultivation of marketable orchard crops like olives, figs, and grapes. They clearly also accentuated some aspects of economic autonomy, notably pig husbandry, which may be interpreted as a strategy to avoid excessive mercantile dependence.

On the eve of Spanish contact in Mesoamerica, rural villages similarly integrated surplus-oriented tree cropping with diversified, household-level subsistence farming. Household orchard-gardens supported a wide variety of fruits, vegetables, condiments, fibers, and medicinal plants (Whitmore and Turner 1992). These diversified gardens provided a measure of household-level autonomy, facilitating the maintenance of traditional crop diversity. Nabhan (1987) suggests provocatively that the conservation of modern agricultural biodiversity may also depend on rural resistance to market forces and state-level political authority. Throughout the tropics, traditional diversified systems are being displaced by high-yield monocultures of cash crops such as coffee, bananas, and pineapple. The ability of rural peoples to resist this process in the face of emerging urban markets will have significant implications for the future of agrarian diversity.

While the assemblages of wild plant and animal taxa discussed above might suggest such extreme agricultural dedication that episodes of urban collapse would have a devastating impact on Bronze Age rural economy in the southern Levant, the evidence from Ni‘aj and Hayyat attests to the resilience of these early rural communities. This resilience is based on shifts in agricultural intensification that variably exploited growing market opportunities or reduced the potential for institutional control. Tell Abu en-Ni‘aj and Tell el-Hayyat exemplify the spec-

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### Table 6. Significant Results of Floral and Faunal Remains from Tell el-Hayyat and Tell Abu en-Ni‘aj

<table>
<thead>
<tr>
<th>Results</th>
<th>Significance</th>
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<tbody>
<tr>
<td>Substantial remains of cattle, pig, and perennial orchard crops at Tell Abu en-Ni‘aj</td>
<td>Persistence of sedentary farming in Early Bronze IV, despite the decline of urban centers</td>
</tr>
<tr>
<td>Increase in species that yield marketable commodities during the Middle Bronze II (e.g., olive, wheat, sheep)</td>
<td>Shift to market-oriented economy following the re-emergence of urban centers</td>
</tr>
<tr>
<td>Decrease in olive, increase in grape and pig during late Middle Bronze II</td>
<td>Enhanced economic autonomy; reduced potential for encroachment by political authorities</td>
</tr>
<tr>
<td>Relative absence of wild floral and faunal remains from both villages (except agricultural weeds)</td>
<td>Anthropogenic landscape</td>
</tr>
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trum of agrarian strategies that provided the basis for village economy and ecology in emerging urbanized societies such as those of the southern Levant.

Acknowledgments

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References


