Wood Economy in Early Roman Period Jerusalem

Helena Roth, Yuval Gadot, and Dafna Langgut

In this study we present the identification of several Early Roman (63 B.C.E.–70 C.E.) charred wood assemblages, collected from the “Lower City” of Jerusalem. The results outline elements in Jerusalem’s nearby woody vegetation, characterized by a mosaic of native Mediterranean maquis-forest species and olive orchards, and possibly pine and cypress stands. The arboreal surrounding of Jerusalem supplied the city with pruned olive branches and other types of agricultural refuse to serve as firewood. Local conifers (pines and cypress) as well as imported conifers (cedar of Lebanon), were used for construction purposes. The results further highlight important issues such as social status and importation of wood. The occurrence of prestigious imported tree species within the charcoal assemblage of the Lower City (e.g., cedar, boxwood) indicates the presence of wealthy residences, standing in contrast to prior assumptions that suggest a low social status for the inhabitants within this area.

Keywords: Dendroarchaeology; Early Roman period; Jerusalem; wooden artifacts; charcoal; Roman architecture; urban archaeology; garbage; firewood; horticulture
This study presents the results of dendroarchaeological investigations of assemblages collected from three excavation areas located in the Lower City of Jerusalem: Area S1 in The Stepped Street excavation; the Debris of a Wealthy House in Area M3 of the Givʿati Parking Lot; and The Western Wall Foundations excavations. The results are compared to other, contemporaneous assemblages from Jerusalem, such as The City’s Landfill (Roth 2017: 36–37, 97–103). The assemblages date to the first half of the 1st century C.E., namely, the later part of the Early Roman period. During this period, Jerusalem revolved economically, politically, and socially around the Temple. The city increased in its wealth, as the international pilgrimage, unique to the Temple in Jerusalem, flourished under the auspices of the Pax Romana, reaching its zenith during the 1st century C.E. (Goodman 1999). The city underwent an intensive demographic and territorial growth (e.g., Avigad 1983: 72–75; Shiloh 1984: 6, 29–30; Greenhut 2011). The colossal construction projects carried out by Herod the Great (73–4 B.C.E.) and his successors3 elevated the city’s holy status and incorporated its economy within the Mediterranean trade systems (Adams 2014: 174; Szanton et al. 2016). Word of its glory reached Rome itself; Jerusalem was even mentioned by Pliny the Elder, who described it as "by far the most famous city, not only of Judea but of the east" (Nat. 5.15.70). The Temple’s centrality in Jewish thought and practice during the Early Roman period brought ideas and people to Jerusalem from across the Roman Empire.

In the year 66 C.E., this period of Jerusalem’s history came to an end with the outbreak of the Great Revolt and the subsequent war that resulted in the violent destruction of the city. This unique situation has made the city central to archaeological and historical studies of the period and is reflected in the numerous excavations and research projects conducted in the city and its surroundings in the past 150 years (Reich 2011 and references therein).

Most of the archaeological excavations conducted in Jerusalem to date have focused on architectural finds or pottery, whereas other components of material culture have been comparatively overlooked. While the faunal remains dated to the Early Roman period were studied to a certain extent (Bar-Oz et al. 2007; Spiciarich, Gadot, and Sapir-Hen 2017), only a few analyses of charred wood remains have been conducted (e.g., Liphschitz 1989, 2010). However, no wide-scope comparative study of wood remains from Jerusalem has been carried out.

It should be further stressed that although wood is a natural material occurring throughout the landscape, when found in an archaeological excavation it should be considered an artifact, since it represents a series of conscious human actions rather than chance or passive processes. The aim of this study is to analyze archaeological wood remains as the result of human agency, in order to gain a holistic synthesis of the natural and man-made environs, wood use, and the cultural interactions and social status of the inhabitants of the Lower City of Jerusalem during the 1st century C.E.

Materials and Methods

The charred remains were collected from secure contexts within three contemporaneous (1st century C.E.) locations in the Lower City of Jerusalem (Fig. 1):

1. The Stepped Street excavation represents the destruction layer dated to the year 70 C.E. Samples were unearthed on top of the paving stones comprising the Stepped Street, which was one of the city’s main arteries (Area S1; Szanton and Uziel 2015; Szanton et al. 2016). In order to obtain a representative assemblage from this context, samples of various sizes from multiple loci were analyzed (Roth 2017: 24, 37–39).

2. The Debris of a Wealthy House located on the eastern slopes of the Tyropoeon Valley, unearthed in the Givʿati Parking Lot excavation (Area M3). The building was destroyed by fire in 70 C.E. and its debris was cleared into a nearby water cistern (Zilberstein 2015). In order to obtain a representative assemblage from this context, samples of various sizes from multiple baskets were analyzed (Roth 2017: 24, 39–41).4

3. The Western Wall Foundations excavation, representing a constructional fill lying beneath a street running close to the southwestern corner of the Temple Mount (Hagbi and Uziel 2015). All of the samples collected during the excavation underwent botanical identification (Roth and Langgut in press).

In all of the above described areas, the charred material was systematically collected in situ and through dry sifting using a 0.5 cm mesh. It was then transferred to the Laboratory of Archaeobotany and Ancient Environments at Tel Aviv University for taxonomic identification.

---

3 The most notable project is the Temple Mount itself. Josephus assigns the project to Herod (JW 1.21.401). Recent excavations reveal that the construction of the Mount continued into the time of the procurators (Szanton et al. 2016).

4 The debris was excavated under a single locus separated into baskets, reflecting the micro-stratigraphy of the fill.
to the most specific systematic level using microscopy. Taxonomic identification was accomplished by observing the anatomical structure of wood, which preserves well even after charring. When the state of preservation was satisfactory, the anatomical features were noted in the transverse, radial, and tangential sections of the sample.

Altogether, 734 charred wood samples larger than 0.5 cm$^3$ were analyzed, out of which 276 originated from The Stepped Street excavation, 168 from the Debris of a Wealthy House, and 115 from The Western Wall Foundation excavation. An additional 175 samples, previously published elsewhere (Roth 2017: 36–37), were included in the analysis.

The size of the individual assemblages is considered satisfactory (> 100). The total number of samples from a single stratigraphic layer exceeds the suggested minimum (400–500; Asouti and Austin 2005). The sample selection was performed as a “grab sample” of pieces representing a range of size, shape, and comparable loci (Smart and Hoffman 1988 and references therein).

---

5 These data refer to mainland Europe but may also be applied to the Mediterranean region in the southern Levant.
The samples were cut using razor blades and examined along the three observational plains under a Zeiss SteREO Discovery.V20 epi-illuminated microscope at magnifications of up to ×360 with a bright/dark field objective. A Scanning Electron Microscope (SEM: TM-3030plus) was used when higher magnifications were required. The wood’s anatomical structures (e.g., the presence or absence of annual growth rings or the abundance, arrangement, and size of the vessels, tracheids, rays, and fibers), along with a number of other diagnostic characteristics (such as the presence or absence of resin ducts), were noted and compared with the wood and charcoal reference collections of the Southern Levant, provided by the Steinhardt Museum of Natural History at Tel Aviv University. Specialized literature on plant anatomy was also used in order to make determinations (e.g., Fahn, Werker, and Baas 1986; Wheeler, Baas, and Gasson 1989; Schweingruber 1990; Richter et al. 2004; Akkemik and Yaman 2012; Crivellaro and Schweingruber 2013). In the case of charred remains of roots or tubers also discovered in the assemblages, an attempt to determine their species was conducted based on their anatomical structure (following Cutler et al. 1987). However, their poor state of preservation did not allow for an accurate botanical determination.

One hundred eighteen charred remains discovered in The Stepped Street in Area S1 and the Debris of a Wealthy House in Area M3 were identified as remains of various charred wooden artifacts. Prior to their cutting for taxonomic identification, the better-preserved samples were documented using 3D scanning at The National Laboratory for Digital Documentation and Research at the Israel Antiquity Authorities (IAA).

The identified wood taxa were then evaluated in relation to their natural distribution (Zohary 1962, 1973) and their occurrence in previous dendroarchaeological reports dealing with Judea and its surroundings from the Early Bronze Age to the Early Roman period (e.g., Lipschitz 2007: 34–46 and references therein). Investigations which present wood assemblages from other parts of the Roman Empire, as well as relevant textual evidence of classical authors were also studied, and include the writings of Theophrastus (early 4th century B.C.E.),6 Cato the Elder (late 3rd–2nd centuries B.C.E.), Varro (late 2nd–late 1st centuries B.C.E.), Vitruvius (1st century B.C.E.), Columella (1st century C.E.), Pliny the Elder (1st century C.E.), and Flavius Josephus (1st century C.E.).

### Results and Discussion

#### Wood Taxa Identification

The charred wood remains presented in this investigation belong to more than twenty woody taxa, both local and foreign to the city’s natural arboreal environment, including species growing outside the greater Judea region. The percentages of the different wood taxa varied within each assemblage. However, a clear pattern of taxa occurrence and abundance was observed between The Stepped Street ([Fig. 2a](#)), and the Debris of a Wealthy House ([Fig. 2b](#)) assemblages. At the same time, the Western Wall Foundations ([Fig. 2c](#)) shows great resemblance to a charred wood assemblage retrieved from The City’s Landfill, discovered in the Lower City ([Fig. 2d](#)), a contemporaneous assemblage published elsewhere (Roth 2017: 36–37). The three aforementioned assemblages will be compared to The City’s Landfill assemblage, and their similarities and differences will be discussed in the following paragraphs.

Based on the resemblance of these assemblages they were separated into two distinct groups (Groups A and B). A summary of the main differences between the two groups is given in [Table 1](#). Within this study only the main components of each group, comprising more than 2% of their assemblages, will be discussed (the complete information regarding all taxa, including those appearing in frequencies less than 2%, can be found in [Table 2](#)).

#### Group A

The assemblages of Group A are characterized by a relatively high species diversity, a high proportion of conifers, and a small proportion of fruit-tree wood, roots, and/or tubers. Most of these assemblages (about 75% of each) were identified as one of at least three coniferous species, in declining order ([Figs. 2a, 2b](#)): Aleppo pine (*Pinus halepensis*; [Fig. 3a](#)), Italian cypress (*Cupressus sempervirens*; [Fig. 3b](#)) and cedar of Lebanon (*Cedrus libani*; [Fig. 3c](#)). Local fruit-tree wood (e.g., olive [*Olea europaea*; [Fig. 3d](#)], common fig [*Ficus carica*; [Fig. 3e](#)]), represents at least 11% of The Stepped Street assemblage, and at least 2% of the Debris of a Wealthy House assemblage. Close to 5% of the Debris of a Wealthy House assemblage belonged to the date palm (*Phoenix dactylifera*; [Fig. 3f](#)). The date palm represents over 2% of The Stepped Street assemblage. The assemblages of Group A contained large amounts of samples that still retained some of their original artifact shapes, probably as a result of the assemblages’ good state of preservation.

---

6 Though Theophrastus predated the Early Roman period in Judea by approximately 300 years, the concepts described in his writings may have passed on through the ages.
samples were characterized by relatively low fragmentation. This good state of preservation was reflected also in the relatively high percentage of identifiable samples (94.9% for The Stepped Street assemblage and 94.0% for the Debris of a Wealthy House assemblage). Group A assemblages also included two imported species: *Buxus sempervirens* (boxwood) and cedar of Lebanon.

**Group B**

The assemblages of Group B are characterized by a high proportion of fruit-tree wood and a small proportion of conifers. The most dominant species in both assemblages belonging to Group B are the following, in declining order (*Figs. 2c, 2d*): olive, Aleppo pine, Italian

---

**Fig. 2.** Relative frequencies of identified wood taxa: (a) The Stepped Street excavation (n=276); (b) Debris of a Wealthy House (n=168); (c) The Western Wall Foundation excavation (n=115); (d) The City’s Landfill (n=175) (quoted from Roth 2017: fig. 4.1). Based on the similarity of these assemblages, they were separated into two distinct groups, Group A (The Stepped Street and Debris of a Wealthy House, representing domestic contexts) and Group B (The Western Wall Foundations and The City’s Landfill, representing urban garbage). (Compiled by H. Roth)
The Group B assemblages are also characterized by a high occurrence of roots and/or tubers as well as samples of wood that were unidentifiable due to a poor state of preservation. The charred samples were characterized by relatively high fragmentation. The poor state of preservation was reflected also in the relatively low percentage of identifiable samples, represented by 30.4% for The Western Wall Foundations excavation assemblage and 57.7% for The City’s Landfill assemblage (Roth 2017: 36–37).

Slight differences between the two assemblages should be acknowledged. The Western Wall Foundation assemblage is characterized by lower taxa diversity with only four identified species. On the other hand, the City’s Landfill assemblage is composed of ten different identified species (Roth 2017: 36–37). Furthermore, unlike the Western Wall Foundation, 6% of the City’s Landfill assemblage is made up of wild broad-leaved species, common to the natural environment of Jerusalem, such as the green olive tree (*Phillyrea latifolia*) and the Persian turpentine tree (*Pistacia atlantica*) (Roth 2017: 97, 100–1).

**Wood Utilization**

For the charred remains analyzed for this study we suggest the following uses of the wood: construction, wooden artifacts, and fuel (Table 2). This suggestion is based on the physical characteristics of the wood taxa identified (e.g., density), their archaeological contexts (e.g., on a floor or inside an oven), the present natural distribution of the identified species, the preserved shape of some wooden objects, and comparisons of these objects with wooden artifacts identified in other contemporaneous Judean sites as well as in textual sources and ethnographic studies.

**Construction.** This category consists primarily of two local (Aleppo pine and Italian cypress) and one foreign (cedar of Lebanon) coniferous species, and to a lesser extent, the date palm. These species are characterized by long trunks that could have been made into long beams. The three coniferous species were often used in monumental and luxurious construction, as the long and straight beams they produced were suitable for supporting and roofing large halls. The cedar wood was also characterized by straight grain and a pleasant smell, which contributed to its popularity. Imported cedar timber was considered the most prestigious of the three since as early as the Bronze Age (Lev-Yadun 1992; Lev-Yadun et al. 1996; Liphschitz 2007: 122). The use of these three coniferous species in monumental construction more than two millennia prior to Roman rule most probably represents local cultural choices and building traditions. Measuring a radius of at least 5 cm and bearing a rectangular sawn profile (Fig. 4), some of the coniferous samples retrieved from Group A clearly preserved the shape of large worked beams, a fact that supports their interpretation as remains of construction elements. The use of coniferous timber for construction purposes was also suggested in a previous Early Roman charcoal study from Jerusalem (Liphschitz 2010: 304).

---

**Table 1. Main Differences between Groups A and B**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group A: The Stepped Street Excavation and the Wealthy House Debris Assemblages</th>
<th>Group B: The Western Wall Foundations Excavation and the Landfill Assemblages</th>
</tr>
</thead>
<tbody>
<tr>
<td>State of preservation</td>
<td>Good</td>
<td>Poor</td>
</tr>
<tr>
<td>Taxa diversity</td>
<td>High</td>
<td>Low at the Western Wall Foundations excavation and relatively high at the Landfill</td>
</tr>
<tr>
<td>Frequencies of fruit trees</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>(olive, common fig, grape vine)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequencies of conifers</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>(Aleppo pine, Italian cypress, Cedar of Lebanon)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequencies of wild broad-leaved trees</td>
<td>Low</td>
<td>Low at the Landfill, or none at the Western Wall Foundations excavation</td>
</tr>
<tr>
<td>(Palestine oak, Tabor oak, Aleppo oak, turpentine tree, Persian turpentine tree, mastic tree, green olive tree, Syrian ash, Oriental plane and hawthorn)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequencies of roots and tubers</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Frequencies of imported wood</td>
<td>High</td>
<td>A single sample from the Landfill</td>
</tr>
<tr>
<td>(boxwood and cedar of Lebanon)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

cypress, and common fig. The Group B assemblages are also characterized by a high occurrence of roots and/or tubers as well as samples of wood that were unidentifiable due to a poor state of preservation. The charred samples were characterized by relatively high fragmentation. The poor state of preservation was reflected also in the relatively low percentage of identifiable samples, represented by 30.4% for The Western Wall Foundations excavation assemblage and 57.7% for The City’s Landfill assemblage (Roth 2017: 36–37).

Slight differences between the two assemblages should be acknowledged. The Western Wall Foundation assemblage is characterized by lower taxa diversity with only four identified species. On the other hand, the City’s Landfill assemblage is composed of ten different identified species (Roth 2017: 36–37). Furthermore, unlike the Western Wall Foundation, 6% of the City’s Landfill assemblage is made up of wild broad-leaved species, common to the natural environment of Jerusalem, such as the green olive tree (*Phillyrea latifolia*) and the Persian turpentine tree (*Pistacia atlantica*) (Roth 2017: 97, 100–1).

**Wood Utilization**

For the charred remains analyzed for this study we suggest the following uses of the wood: construction, wooden artifacts, and fuel (Table 2). This suggestion is based on the physical characteristics of the wood taxa identified (e.g., density), their archaeological contexts (e.g., on a floor or inside an oven), the present natural distribution of the identified species, the preserved shape of some wooden objects, and comparisons of these objects with wooden artifacts identified in other contemporaneous Judean sites as well as in textual sources and ethnographic studies.

**Construction.** This category consists primarily of two local (Aleppo pine and Italian cypress) and one foreign (cedar of Lebanon) coniferous species, and to a lesser extent, the date palm. These species are characterized by long trunks that could have been made into long beams. The three coniferous species were often used in monumental and luxurious construction, as the long and straight beams they produced were suitable for supporting and roofing large halls. The cedar wood was also characterized by straight grain and a pleasant smell, which contributed to its popularity. Imported cedar timber was considered the most prestigious of the three since as early as the Bronze Age (Lev-Yadun 1992; Lev-Yadun et al. 1996; Liphschitz 2007: 122). The use of these three coniferous species in monumental construction more than two millennia prior to Roman rule most probably represents local cultural choices and building traditions. Measuring a radius of at least 5 cm and bearing a rectangular sawn profile (Fig. 4), some of the coniferous samples retrieved from Group A clearly preserved the shape of large worked beams, a fact that supports their interpretation as remains of construction elements. The use of coniferous timber for construction purposes was also suggested in a previous Early Roman charcoal study from Jerusalem (Liphschitz 2010: 304).
### Table 2. Identified Taxa in Absolute Numbers and Percentages and Their Possible Use/s

<table>
<thead>
<tr>
<th>Taxa</th>
<th>The Stepped Street</th>
<th>The Wealthy House Debris</th>
<th>Western Wall Foundations</th>
<th>The Landfill</th>
<th>Fuel</th>
<th>Construction</th>
<th>Wooden Artifacts</th>
<th>Type of Artifacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Olea europaea (common olive)</td>
<td>23 (=8.3%)</td>
<td>4 (=2.3%)</td>
<td>18 (=15.6%)</td>
<td>69 (=39.4%)</td>
<td>**</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Ficus carica (common fig)</td>
<td>8 (=2.9%)</td>
<td>--</td>
<td>2 (=1.7%)</td>
<td>4 (=2.2%)</td>
<td>**</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Ficus sycomorus (sycamore fig)</td>
<td>4 (=1.4%)</td>
<td>1 (=0.6%)</td>
<td>--</td>
<td>1 (=0.5%)</td>
<td>**</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Phoenix dactylifera (date palm)</td>
<td>7 (=2.5%)</td>
<td>8 (=4.7%)</td>
<td>--</td>
<td>--</td>
<td>**</td>
<td>*</td>
<td>Peg, Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Vitis vinifera (grape vine)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>**</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Pinus halepensis (Aleppo pine)</td>
<td>112 (=40.5%)</td>
<td>58 (=34.5%)</td>
<td>9 (=7.8%)</td>
<td>10 (=5.7%)</td>
<td>**</td>
<td>*</td>
<td>Vessels, furniture, unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Cupressus sempervirens (Italian cypress)</td>
<td>67 (=24.2%)</td>
<td>37 (=22.0%)</td>
<td>5 (=4.3%)</td>
<td>3 (=1.7%)</td>
<td>**</td>
<td>*</td>
<td>Vessels, furniture, unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Cedrus libani (cedar of Lebanon)</td>
<td>26 (=9.4%)</td>
<td>25 (=14.8%)</td>
<td>--</td>
<td>1 (=0.5%)</td>
<td>**</td>
<td>*</td>
<td>Vessels, furniture, boxes, unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Buxus sempervirens (boxwood)</td>
<td>2 (=0.7%)</td>
<td>3 (=1.7%)</td>
<td>--</td>
<td>--</td>
<td>**</td>
<td>*</td>
<td>Kohl tube, box, spinning whorl</td>
<td></td>
</tr>
<tr>
<td>Crataegus spp. (hawthorn)</td>
<td>--</td>
<td>1 (=0.6%)</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Fraxinus syriaca (narrow-leafed ash)</td>
<td>--</td>
<td>7 (=4.1%)</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Phyllela latifolia (green olive tree)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>2 (=1.1%)</td>
<td>*</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Pistacia atlantica (Persian turpentine tree)</td>
<td>1 (=0.3%)</td>
<td>--</td>
<td>--</td>
<td>2 (=1.1%)</td>
<td>*</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Pistacia lentiscus (mastic tree)</td>
<td>--</td>
<td>1 (=0.6%)</td>
<td>--</td>
<td>1 (=0.5%)</td>
<td>**</td>
<td>*</td>
<td>Pin, dovetail joint, unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Pistacia palaestina (terebinth)</td>
<td>1 (=0.3%)</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Platania orientalis (Oriental plane)</td>
<td>--</td>
<td>6 (=3.5%)</td>
<td>--</td>
<td>--</td>
<td>**</td>
<td>*</td>
<td>Box, furniture, unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Quercus calliprinos (Kermes oak)</td>
<td>--</td>
<td>2 (=1.1%)</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Quercus ithaburensis (Tabor oak)</td>
<td>4 (=1.4%)</td>
<td>2 (=1.1%)</td>
<td>--</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Tamarix spp. (tamarisk)</td>
<td>2 (=0.7%)</td>
<td>--</td>
<td>1 (=0.5%)</td>
<td>--</td>
<td>*</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
<tr>
<td>Roots and tubers</td>
<td>12 (=4.3%)</td>
<td>8 (=4.7%)</td>
<td>59 (=51.3%)</td>
<td>45 (=25.7%)</td>
<td>**</td>
<td>*</td>
<td>Unidentified objects</td>
<td></td>
</tr>
</tbody>
</table>

Strength of evidence:
* = Indirect evidence (i.e., inconclusive evidence from texts and dendroarchaeological finds from other sites pointing to various possible uses)
** = direct evidence (i.e., preserved shape and/or conclusive textual and dendroarchaeological evidence of possible uses)
Fig. 3. Selected images of six taxa: (a) Aleppo pine, transverse section ×50 (note the presence of normal resin ducts); (b) Italian cypress, transverse section ×80 (note the absence of resin ducts); (c) cedar of Lebanon, transverse section ×80 (note the presence of traumatic resin ducts); (d) common olive, transverse ×100 (note the absence of annual rings); (e) common fig, transverse section ×80; (f) date palm, transverse section ×500 (note the scalariform perforation plates). (Photo by H. Roth)
Construction using the wood of coniferous species is also related in Greco-Roman textual sources, which reiterate their high value (e.g., Theophrastus, *Hist. plant.* 5.7.1, 5, 8; Vitruvius, *De arch.* 1.2.8, Pliny the Elder, *Nat.* 16.76.197–98). Although the integration of pine and cypress wood in monumental buildings in the area of Canaan was common from as early as the Early Bronze Age, an increase in their presence within local assemblages was documented from the Hellenistic to the Byzantine period (e.g., Liphschitz 2004, 2007: 34–46, 120–124 and references therein). Regarding the Early Roman period, these species were discovered in high frequencies in many Judean sites including the Upper City of Jerusalem (Liphschitz 1994, 2004, 2010). We suggest that Aleppo pine and Italian cypress were cultivated near Jerusalem for their wood. This stands in contrast to previous claims that pines and cypress species were imported to the region (e.g., Liphschitz and Biger 1989, 2001). Nevertheless, these claims are possibly correct regarding cedar, which was most likely imported from its natural distribution zone in the Northern Levant (e.g., Beals 1965). Still, there is sufficient evidence

Fig. 4. A fragment of an Aleppo pine wooden beam discovered on The Stepped Street. (a) transverse section; (b) radial and tangential sections; (c) transverse section (note the sawn, rectangular profile preserved in one corner, and minimum radius, larger than 5 cm). (Image by A. Karasik, The National Laboratory for Digital Documentation and Research at the Israel Antiquity Authority)
to suggest the local cultivation of both Aleppo pine and Italian cypress, both of which are natural arboreal components of the Mediterranean maquis-forest in the area of Judea and other parts of the Southern Levant (Zohary 1973: 341, 501; Lev-Yadun 1987; Lev-Yadun and Weinstein-Evron 1994; Weinstein-Evron and Lev-Yadun 2000; Langgut et al. 2011). Furthermore, the cultivation in nurseries of these or similar species for their timber in the Roman world was described by classical authors (e.g., Varro, Rust. 2.1.27; Cato, Agr. 28.1–2, 48.3; Pliny, Nat. 16.60.139–141). Thus, it may be reasonably assumed that these coniferous species were cultivated locally in the area of Judea—it being a part of the greater Roman world. We further suggest that pine and cypress were cultivated in the vicinity of Jerusalem and may have been used for the monumental construction projects common at that time. The extremely high percentage of Cupressaceae pollen (21%) as well as the high frequency of Pinus pollen (15%) extracted from the plaster of an Early Roman (Herodian) structure within the Giv’atim Parking Lot, corroborates this suggestion regarding local cultivation (Langgut 2017: table 2, sample no. 7). Additionally, Dafna Langgut, Kathryn Gleason, and Barbara Burrell (2015) suggest that during the Early Roman period, cypress was cultivated as an ornamental tree in royal gardens in the Southern Levant and beyond, indicating that the concept and techniques of coniferous tree cultivation was not foreign to Judea, and possibly also applied to other forms of arboreal farming.

Date palm was also employed as a construction material. This suggestion is supported by previous dendroarchaeological finds from various Judean sites. Date palm beams were discovered in ʿEn Boqeq (Liphschitz 2000), ʿEn Gedi (Hadas 2005), and the Upper City of Jerusalem (Liphschitz 2010), where it was presumably used for roofing. Although date palm wood remains were found in the Central Highlands, the major date palm crops were best known from the Jordan Valley, as is mentioned in textual sources that describe the area as world famous for the high quality of its fruit (Pliny, Nat. 13.9.44; Josephus, JW 2.1.18, 2.4.8; Theophrastus, Hist. plant. 5.6.2). This species requires hot, dry summers for pollination and fruit development (Chao and Krueger 2007). For that reason, this crop was cultivated mainly in oases within the desert regions of the Southern Levant. Its timber was used for construction in the area of the Judean Mountains starting from the Early Bronze Age (Liphschitz 2007: 44–45, 110–13 and references therein).

All in all, based on the Group A assemblages, it seems that the builders of the houses next to the Stepped Street incorporated supporting and roofing beams of not only local origin, but also of imported and expensive cedar wood, which is characterized by its great length. It is noteworthy that similar wooden building materials were detected within the luxurious urban villas of the Upper City (Liphschitz 2010), possibly built according to the Roman code of urban construction (e.g., Levine 2002: 328 and references therein).

**Wooden Artifacts.** To date, the study of Southern Levantine wooden artifacts has been limited due to the scarcity of the finds. Only a relatively small number of Early Roman wooden artifacts have been discovered in Judean sites and only within those located in arid environments (e.g., Liphschitz and Lev-Yadun 1989; Liphschitz 1994, 1998; Sitry 2006). A newly discovered method for identifying wooden artifacts through 3D scanning of fragmented charred remains (Roth 2017) enables us to enlarge this database with samples extracted from sites located in wetter regions, which are usually characterized by lower state of preservation.

The suggested wooden implements listed in this study are based on relatively small charred remains and include containers (mainly bowls), a spinning whorl, parts of boxes and furniture, pegs and joints, as well as other unidentified objects bearing preserved woodworking marks. In some cases, the preserved shape enabled reconstruction of the tradition and technological manufacture of lathe-turning in some of the containers, and sawing and polishing in other artifacts. The methodological aspects of these analyses will not be discussed within this paper; but, rather, the focus will be on the botanical determination of the samples identified as artifact remains (Table 2). Most of the artifacts were made of Italian cypress and Aleppo pine wood, and some were even made from luxurious imported boxwood. In antiquity, cypress and pine woods were used for a variety of purposes, including the manufacturing of boxes, coffins, furniture, and for carving images (e.g., Meiggs 1982). According to Pliny the Elder, these two coniferous species are resistant to rot and woodworms (Nat. 16.81.223). The qualities of Italian cypress timber in the context of woodworking were specifically addressed by authors of the classical periods. For example, Theophrastus described this tree as the only wood able to take a fine polish and that, for this reason, it was used for making valuable objects (Hist. plant. 5.4.2).

In antiquity, boxwood was considered to be of high quality, despite the species’ producing only short and narrow trunks. Consequently, it was mostly used for small and delicate objects that needed to be strong (Buxus sempervirens is characterized by a basic density of 0.82 g/cm³; Crivellaro and Schweingruber 2013: 189) or required fine craftsmanship. Nonetheless, boxwood was considered easily worked, making it excellent for carving and engraving, and was used to make parts of beds, couches,
chairs, combs, and small tables (Meiggs 1982: 280). Theophrastus lists Buxus among the woods suitable for carving images (Hist. plant. 5.3.7). Buxus was also considered by Virgil to be the best wood for turning (Georg. 2.449), while Pliny the Elder praised it for its hardness and resistance to decay (Nat. 16.28.70, 16.78.212) as well as its role in veneering luxury furniture (Nat. 16.84.230). The remains of items crafted from boxwood were only found in the assemblages of Group A (representing destroyed houses and their contents; Figs. 2a and 2b). They may therefore point to the presence of prestige domestic contexts and to a higher socio-economic status of the population living in the northern area of the Stepped Street and the adjacent Giv’ati Parking Lot area. Over 20% of both Group A assemblages were composed of wooden artifacts. This may also indicate a high occurrence of wooden object usage in Early Roman domestic contexts, in addition to their previously known wide usage in burial deposits during the Late Hellenistic period (e.g., Hadas 1994; Werker 1994; Liphschitz and Waisel 1999).8

Fuel. A common energy source of the ancient world was firewood, and its central role in everyday life cannot be overstated (Meiggs 1982: 203). The importance of firewood in the Greco-Roman world is evident from many ancient sources.9

The fuel remains category within the charred wood assemblages of the Lower City consists of the fruit trees, roots and/or tubers and, to some extent, certain wild broad-leaved trees. Two samples of wood, roots, and/or tubers of fruit trees probably originated from the orchards in the vicinity of Jerusalem and were likely refuse generated by agricultural and horticultural tending—namely the pruning of branches and plowing. The results of this study point to olive trees as the main source of firewood in Jerusalem during the Early Roman period. Overall, olive is the most dominant species within the Group B assemblages. Nevertheless, it is significant to note that wood specimens of common fig were also discovered within this group. It should be mentioned that charred fig wood remains were also discovered in The Stepped Street assemblage (Group A), inside a tannur (a clay oven). Within the tannur, some of the remains retained the shapes of young branches, a fact which suggests that they might have originated from pruning activities. The charred wood remains would then have been cleared to the garbage piles, to make way for fresh firewood. From the local garbage piles, the accumulated material was then transferred to be used as constructional fill in The Western Wall Foundations or to be disposed of at The City’s Landfill, where it was discarded from the top of the ridge and tumbled downslope. This movement of material caused further fragmentation of the charcoal.

The necessity for pruning the branches of olive and fig trees was known and practiced in antiquity, as is evident from Greco-Roman texts (for olive trees see: Theophrastus, Caus. plant. 3.7.11; Cato, Agr. 44.1; Pliny, Nat. 15.2.5; for common fig, see: Cato, Agr. 50.2 and Pliny, Nat. 17.43.254). Olive and common fig tree pruning is still a standard practice today because it allows for a sufficient amount of sunlight to reach all of the tree’s branches, keeps the trees at a desired size, and results in a significantly higher fruit yield (Zinger 1985; Flaishman, Rodov, and Stover 2008; Langgut, Lev-Yadun, and Finkelstein 2014; Langgut et al. 2019). After pruning, the branch trimmings are removed from the orchard in order to prevent the spreading of pests and fungi onto healthy trees. The pruned branch refuse would have served as an ideal (and readily available) fuel source, especially since olive wood possesses a rather high density (0.75–0.96 g/cm3; Engel and Frey 1996: 35; Crivellaro and Schweingruber 2013: 434), undoubtedly making it one of the higher quality fuel sources in the Levant.10 It is noteworthy that the use of agricultural refuse for fuel is commonplace today among many traditional societies, such as the Bedouin in Sinai and rural societies in central Africa (e.g., Hobbs 1989: 53; Picornell Gelabert, Asouti, and Martí 2011; Andersen et al. 2014: 41).

The Roman wood economy in urban centers did not rely on the mere collecting of scattered wood; rather, it recycled this agricultural refuse within its economic systems.11 Classical texts mention the collection of pruned branches to be used as firewood, as well as their trade in urban markets as a source of energy (e.g., Theophrastus, Hist. plant. 5.9.5–7; Cato, Agr. 7.1, 37.5, 50.2). The city of Jerusalem, following with the Roman trends of large-scale consumption and lavish lifestyles, was in great need of this provision on a daily basis. It may be suggested that fuel material originating from agricultural refuse was sold in the timber market mentioned by Josephus (JW 2.19.530).

---

8 In order to curate a broader examination of the material culture of wooden objects from this era, Late Hellenistic assemblages of the 1st century B.C.E. were also included in this synthesis, slightly transcending the modern-day scholarly definitions of the considered historic period.

9 This provision was essential for cooking, and therefore, for survival, and was the hardest to come by under siege (Vitruvius, De arch. 5.9).

10 For the complete description of the determined hardwood taxa density, see Roth 2017: table 3.2.

11 Another common fuel source documented in ethnographical research and applied to archaeological investigations is animal dung (e.g., Miller 1984). Although wood was discovered to be the main fuel source in several previous studies focused on 1st millennium B.C.E. sites from the region (e.g., Lev-Yadun, Lucas, and Weinstein-Evron 2010; Gur-Arie et al. 2014), the use of animal dung for fuel in Early Roman period Jerusalem cannot be overlooked.
The Urban Layout of Jerusalem

In this study, differences in woody taxa diversity and relative frequencies within the charcoal assemblages were helpful in clarifying the archaeological contexts from which the samples were retrieved. This, in turn, illuminates aspects, some still under scholarly debate, regarding the design and demographics of Jerusalem during the Early Roman period.

The high occurrences of fuel remains such as edible fruit-tree wood, roots, and/or tubers and wild broad-leaved trees (detailed below), as can be found in the assemblages of Group B (The Western Wall Foundations assemblage and The City’s Landfill assemblage; Figs. 2c and 2d, respectively), are explained in this study as concentrations of urban refuse. Their occurrence in The City’s Landfill reinforces the idea that this area served for garbage disposal during the 1st century C.E. (Reich and Shukron 2003; Bar-Oz et al. 2007; Gadot 2014, 2016; for a different view, see Shiloh 1984: 6–15, 30; de Groot 2012: 183–84; de Groot and Bernick-Greenberg 2012: 12–13, 68–69, 132–34). When comparing the botanical remains identified within The City’s Landfill assemblage (Fig. 2d; Roth 2017: 36–37) to those seen within either of the Group A assemblages, which represent domestic contexts, it is clear that the former corpus (Fig. 5) represents a completely different praxis. This comparison shows that contrary to the assumptions of Yigal Shiloh, Alon de Groot, and Hannah Bernick-Greenberg (see above), the accumulation along the eastern slope could not have originated from the destruction and erosion of the houses standing along the top of the ridge, otherwise the botanical assemblages would have been far more similar to Group A assemblages. The assemblage of the Western Wall Foundation, which is less varied, may represent the secondary usage of an urban refuse heap as constructional fill.

In contrast to this, prestige domestic contexts may be identified as such by the higher frequency of quality timber, such as those that characterize Group A (The Stepped Street and the Debris of a Wealthy House; Figs. 2a and 2b, respectively). This includes mostly coniferous species, or other trees that produce long and straight beams, such as date palm, as well as luxurious imported trees such as cedar and boxwood. This likely reflects the high socio-economic status of the population living in the northern area of the Stepped Street, from which the two assemblages originated. These results stand in contrast to previous assumptions regarding the low social status of the inhabitants of the Lower City and are supported by recent archaeological finds (e.g., Ben-Ami and Tchekhanovets 2011, and see already Szanton and Zilberstein 2016). Further supporting this claim, charcoal remains of the same coniferous tree species (Aleppo pine, ...
Italian cypress, and the imported cedar of Lebanon) were also documented in relatively high ratios in the Upper City of Jerusalem, in assemblages originating from luxurious buildings (Liphshitz 2010).

The Environs of Jerusalem During the Early Roman Period

The results of this study allow us to peer through a rarely-opened window into the natural and manufactured surroundings of Jerusalem during the 1st century C.E. However, it is important to bear in mind that the variety of wood taxa discovered within a site is not reflective of the entirety of the site’s surroundings, as the preferences for certain wood taxa for specific purposes was not always dependent only on the local supply, but also on cultural and economic choices based on an entangled relationship between beliefs, trends, and social agencies. Consequently, while some species of wood were intensively exploited, others were not disturbed, and thus failed to find their way into archaeological contexts (Lev-Yadun 2007). Along these lines, some species may be underrepresented in the charred wood assemblages due to the taxa’s natural characteristics, resulting in high fragmentation and poor preservation. Taking the above factors into account, the results suggest that olive trees were likely grown over large tracts of land in the environs of Jerusalem. The existence of wide-scale olive horticulture during the period in question is also evident from regional pollen diagrams; a sharp increase in the olive pollen ratios during the Late Hellenistic period and well into the Early Roman period is witnessed in several Dead Sea palynological records that mainly reflect the vegetation in the Judean Highlands (Neumann et al. 2010 and references therein; Litt et al. 2012; Langgut and Lipschits 2017).

Charcoal remains of two other fruit trees, the common fig and grape vine, likely indicate their nearby cultivation. The latter appears in extremely low frequencies, which is not surprising given that grape vine is often under-represented in charcoal assemblages of urban contexts.¹² Other botanical remains, as well as archaeological finds, corroborate the presence and cultivation of grape vines in the surroundings of Jerusalem. Eyal Baruch (1998) noted the relatively intense presence of vine presses dating to the period in question in the vicinity of the city. Large amounts of grape seeds were discovered in The City’s Landfill (Peters and Weiss 2018). The palynological evidence from the Giv’atim Parking Lot, though from a slightly earlier period (2nd century B.C.E.), points to the possibility of vineyards near the Seleucid Fortification System (Acra) on the other side of the Tyropoeon Valley (Langgut 2017).

Arboreal elements of the Mediterranean maquis-forest continued to grow on a limited scale around the city, despite the probable thinning of the forest in earlier times—a result of the expanding agriculture and other human activities. Aleppo pine and Italian cypress trees were also growing around Jerusalem during the 1st century C.E. and were possibly even cultivated for their wood—a common practice in other parts of the Roman world—in Judea itself or in its immediate proximity. This suggestion is corroborated by palynological finds from Jerusalem also dated to the Early Roman period (Langgut 2017).

The variety of taxa common to the Mediterranean maquis-forest noted in this study, alongside the apparent and considerable amount of olive cultivation (as well as the possible conifer plantations) taking place in the surroundings of the city, indicate the presence of a Mediterranean climate, one similar to—if not slightly wetter than—the present day. Indeed, relatively humid climate conditions for this period is evident within several proxies, including the high-resolution and well-dated Soreq Cave isotopic record (Orland et al. 2009), the reconstruction of Dead Sea lake levels (Bookman [Ken-Tor] et al. 2004), and Dead Sea palynological records (Neumann et al. 2010 and references therein; Litt et al. 2012).

Summary

This detailed investigation of the charred wood remains has revealed a great deal of previously unknown information regarding the Lower City of Jerusalem during the Early Roman period. This study demonstrated that just like pottery, wood remains can serve to elucidate information regarding trading patterns, social status, and cultural interactions.

Our findings show that the buildings in the northern area of the southeastern hill surrounding the Stepped Street were constructed with quality timber that—coupled with the evidence of the importation and use of wood from luxury trees (cedar and boxwood) in these areas—points to the presence of wealthy residences. This goes against previous assumptions regarding the low

¹² Unlike other fruit-tree wood, the charred remains of Vitis vinifera wood do not necessarily reflect the scale of viticulture in the city’s surroundings. Due to its low density (0.40 g/cm³; Crivellaro and Schweingruber 2013: 569) it makes for poor firewood, while its weak and thin branches and trunk make it unsuitable for construction, so this type of wood would rarely have been brought back from the vineyards into the city. Other uses of grape vine wood, such as animal fodder, are documented in textual sources (Columella, Rust. 2.219) and dendroarchaeological evidence (Jashemski, Meyer, and Ricciardi 2002: 272). This particular recycling of agricultural refuse would have lowered the chances of these wood remains from reaching urban centers and being preserved in an archaeological context.
social status of the inhabitants of the Lower City, while supporting more recent archaeological findings. Aleppo pine and Italian cypress trees were possibly cultivated in Judea itself for construction purposes and may have been traded on the local wood market. These two coniferous species were also utilized for woodworking, such as the manufacture of furniture and many other everyday objects. Some of the wooden items were made from wild broad-leaved trees, while in other cases they were crafted from wood imported from the Northern Levant (e.g., boxwood). On several occasions the shapes of the charcoal specimens hinted at the use of the original wooden objects. It is therefore suggested that, in future studies, charred remains be approached as relics of artifacts from objects. It is therefore suggested that, in future studies, charred remains be approached as relics of artifacts from the beginning, rather than simply a material unable to be tied to any specific activity, item, or function. The macro-morphology of the remains should be documented and their typology analyzed.

The excavations and processing of the finds are supported by the Israel Antiquity Authority. We are grateful to Doron Ben-Ami, Yana Tchekhanovets, Salome Cohen, Helen Machline, Josef Uziel, Moran Hagbi, Nahshon Sznant, Yuval Baruch, and Guy Steibel for the meticulous collection of material, the exchange of information and fruitful discussions, and to Simcha Lev-Yadun and Yigal Sitry for the exchange of thoughts and ideas. We wish to thank Mark Cavanagh for his professional assistance in the botanical identification and his help in preparing the figures. We wish to thank Mordechay Benzaken for his editing. Dafna Langgut acknowledges the support of the Israel Science Foundation and grant no. 2141/15. We would like to thank Rhenium Company for supplying the SEM TM3030plus, enabling the high accuracy of the study. We are grateful to the editors of this journal and the two anonymous reviewers of this article, for their insightful remarks and suggestions. Helena Roth wishes to thank the Skirball Department of Hebrew and Judaic Studies at NYU, and Professor Lawrence Schiffman, for their generous hosting.

Acknowledgments

References


2019  WOOD ECONOMY IN EARLY ROMAN PERIOD JERUSALEM  85

Crivellaro, A., and Schweingruber, F. H.

Cutler, D. E.; Rudall, P. J.; Gasson, P. E.; and Gale, R. M. O.

Deckers, K.

de Groot, A.

de Groot, A., and Bernick-Greenberg, H.

Engel, T., and Frey, W.

Fahn, A.; Werker, E.; and Baas, P.
1986  Wood Anatomy and Identification of Trees and Shrubs from Israel and Adjacent Regions. Leiden: Brill.

Flaishman, M. A.; Rodov, V.; and Stiever, E.

Gadot, Y.


Goodman, M.

Greenhut, Z.


Hadas, G.


Hagbi, M., and Uziel, J.

Hobbs, J. J.

Jashemski, W.; Meyer, F. G.; and Ricciardi, M.

Langgut, D.

Langgut, D.; Almogi-Labin, A.; Bar-Matthews, M.; and Weinstein-Evron, M.


Langgut, D.; Gleason, K.; and Burrell, B.


2007 Timber in Ancient Israel-Dendroarchaeology and Dendrochronology. Tel Aviv: Publications of the Institute of Archaeology.
Reich, R., and Shukron, E.  
Richter, H. G.; Grosser, D.; Heinz, I.; and Gasson, P. E.  
Roth, H.  
2017 *Wood Economy in Early Roman Period Jerusalem. M.A. thesis, Tel Aviv University. (Hebrew with an English Summary).*  
Roth, H., and Langgut, D.  
in press *Dendroarchaeological Analysis: The Western Wall Excavation (Area L), Jerusalem. ʿAtiqot.*  
Schweingruber, F. H.  
Shiloh, Y.  
Sitry, Y.  
2006 *Wooden Objects from Roman Sites in the Land of Israel, a Typological and Technological Study.* Ph.D. dissertation, Bar-Ilan University (Hebrew).  
Smart, T. L., and Hoffman, E. S.  
Spiciarich, A.; Gadot, Y.; and Sapir-Hen, L.  
Szanton, N.; Hajbi, M.; Heber, M.; Uziel, J.; and Ariel, D.  