Trees, Timber and Tree-rings in Historic Crete, Byzantine to Ottoman

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Introduction

Our project, *Trees, Timber and Tree-rings in Historic Crete, Byzantine to Ottoman*, arose out of a study of tree-rings from living Cretan trees, begun in 2008 by Professors Tomasz Ważny (Laboratory of Tree-Ring Research, University of Arizona; and Nicolaus Copernicus University in Torun, Institute for the Study, Conservation and Restoration of Cultural Heritage), †Oliver Rackham (Corpus Christi, Cambridge University), and Drs Jennifer Moody (Department of Classics, University of Texas) and Agnieszka Helman-Ważny (Laboratory of Tree-Ring Research, University of Arizona), members of the Cretan Dendrochronology Group (CDG).

That study focused on establishing reference tree-ring chronologies from Cretan trees (cypress, oak, pine) in order to date wooden objects and timbers; to identify years of favorable and unfavorable weather conditions (as well as years with other unusual natural phenomena); to obtain data on the history of climate change and major weather patterns (such as the Little Ice Age which affected Crete from the 14th to the 19th centuries AD); and to understand the demography and ecological history of trees on the island. Crete is particularly rich in ancient trees and it is also a region where trees have been increasing for about the last 150 years (Rackham & Moody 1996, 118-122). We were and continue to be interested in finding and cataloguing the historic (100–900 yrs) and ancient (1000+ yrs) trees of Crete, and in documenting and dating the spread of new trees over abandoned terraces and deserted settlements. Although dendrochronology – the scientific study of tree-rings – was introduced to the eastern Mediterranean in the 1980s (see e.g. Kuniholm & Striker 1987), no studies in Crete, prior to ours, have been successful.

Table 1 summarizes tree-types important to Crete, native and imported, and their relative frequency in Cretan constructions:

TREE-TYPE	COMMON NAME	Frequency in Cretan constructions *
Coniferous trees		
NATIVE TO CRETE		
Cupressus sempervirens	Mediterranean Cypress	+++ (local)
Pinus brutia	Turkish/ East Mediterranean Pine	+ (local)
Juniperus phoenicea	Land Juniper	+++ (local)
Juniperus macrocarpa	Sea Juniper	++ (local)
NEVER GROWN IN CRETE		
Abies cephallonica	Greek Fir	– (imported)
Abies alba	Silver Fir	+++ (imported)
Cedrus brevifolia/libani	Cyprus/Lebanon Cedar	+ (imported)
Pinus nigra/sylvestris	Black/Scots Pine	+ (imported)
Picea sp.	Spruce	(+) (imported)
Larix decidua	European Larch	(+) (imported)
Broad-leaved trees		
EVERGREEN OAKS		
Q. coccifera	Prickly Oak	++ (local)
Q. ilex	Holm Oak	? (local)
DECIDUOUS OAKS		
*Q. brachyphylla***	Deciduous Oak	++ (local and Imported)
Q. macrolepis	Valonia Oak	? (local)
OTHER TREES		
Castanea sativa	Sweet Chestnut	++ (local and imported?)
Ceratonia siliqua	Carob	+ (local)
Olea europea	Olive	(+) (local)
Phillyrea latifolia	Mock Privet	– (local)
Zelkova abelicea	Cretan Zelkova	– (local)

Table 1. Tree-types available and used in Cretan constructions. * Wood frequencies are based on our own observations, but also see Rackham & Moody 1996, 166-167. ** Now identified as *Quercus pubescens* subsp. *pubescens* in the *Catalogue of Life* (2019).

CDG has been especially focused on the wild Cretan cypress (**Fig. 1**), which is widespread in central and western Crete; is very long-lived; and has a wide altitudinal range. It is not an easy species to study because under some conditions cypress produces *false-rings* (intra-annual density fluctuations) that do not represent an entire year's growth and can be hard to distinguish from annual rings; under other conditions a cypress can have *missing rings* that represent years when it did not

grow at all. Nevertheless *CDG* has built-up a Cretan cypress chronology based on living trees that goes back nearly 900 years to the 12th century AD, the Late Byzantine period. *CDG* has also studied the annual rings of pine and deciduous oak.

Fig. 1 : Ancient cypress tree, Angathopi, Sphakia, Crete. Photo J. Moody, July 2012

Collaboration with the Ephorate of Antiquities of Rethymnon

The present collaborative project with the Ephorate of Antiquities of Rethymnon, *Trees, Timber and Tree-rings in Historic Crete, Byzantine to Ottoman*, builds on the work of the previous study and includes archaeological material. The archaeological material consists of timber components of historic buildings, shipwrecks, portable artifacts such as icons and furniture, and timber recovered in excavations in western Crete (Prefectures of Chania and Rethymnon).

So far, we have sampled wood from residential and public buildings related to craft production and industrial technology, water-mills, monastic complexes (Arkadi and Preveli), churches (Chapel of the Virgin Mary in Meronas, Amari), and sacred items and architectural elements (icons, chapel screens).

We prefer to collect samples in two ways: either by sawing a thin slice of a tree/timber/artifact or by drilling a small core. Cores are taken with a cylindrical borer attached to an electric drill. This type of sampling

leaves a small hole between 7 mm and 15 mm in diameter, depending on the type of corer used. The holes can be left open or can be filled with dowels if desired.

We avoid coring architectural features, furniture, doors, paintings, sculptures and other artifacts. Instead, we use a digital camera and/or magnifying glass and/or portable microscope to record tree-ring widths. This requires only a careful cleaning of the surface, which is non-destructive.

Below, we present details of two collaborative studies.

The Venetian Loggia in Rethymnon

The Loggia of Rethymnon is a typical example of Cretan Renaissance architecture. Three of its four sides are detached, each side formed by three semicircular arches. Stone staircases through each of the middle arches lead to the elevated floor of Loggia. The ceiling is supported by four polygonal stone pillars topped by wooden consoles carved with floral motifs (**Fig. 2**). These consoles are the only Venetian wooden archi-

Fig. 2 : The decorative consoles from the Venetian Loggia of Rethymnon. Photo J. Moody, July 2015

tectural elements known to survive in Rethymnon. The Loggia was used for administrative purposes, as a warehouse, and as a meeting and leisure center for citizens. The building, according to Kostas Lambrinos, was constructed after the earthquake of 1596 but before the end of the service of Giacomo Pasaro as Rector, in May of 1597 (Lambrinos 1998, 240-241).[1] In the Ottoman period, 1655–56, the Loggia was transformed

1 An earlier construction date of AD 1538–1541 was proposed by Iordanis Dimakopoulos following plans by the famous Venetian architect Michieli Sanmichieli

in a small mosque (mescit) by Cavi Ibrahim Aga, an officer of the Sultans court (Ψηφιακή Κρήτη, Στα χρόνια των Οθωμανών, Οικία Αρκαδίου 154-Ρέθυμνο).

The research focused on the consoles. Because the consoles are irreplaceable, we used digital macro-photography to record tree-ring widths, which is non-destructive (**Fig. 3**).

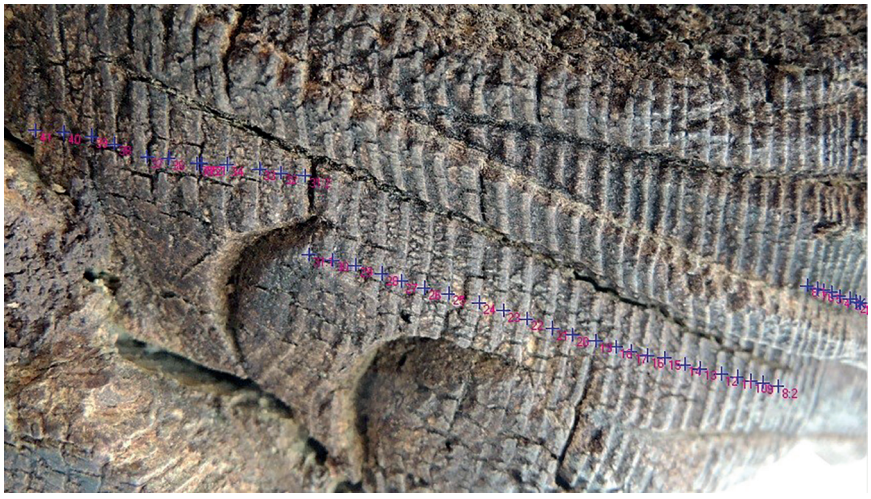

Fig. 3 : Detail of tree-rings in a section of the decorative consoles from the Venetian Loggia of Rethymnon. Photo J. Moody and T. Ważny, 2015

According to our analysis of the tree-rings, the consoles were carved after AD 1562 (**Fig. 4**). This date confirms the hypothesis made by Kostas

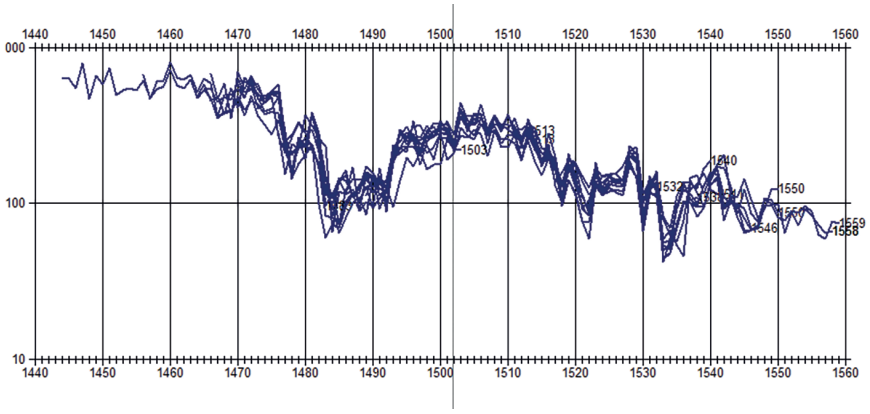

Fig. 4 : Tree-ring series representing all measurements of beam #2. Three outer rings were not measured. The number of missing outer rings is unknown, making our final date "after AD1562"

(b.1484–d.1559) (Δημακόπουλος 1971, 66, 77-81).

Lambrinos that the building was constructed after the earthquake of 1596 but before the end of the service of Pasaro as Rector, in May of 1597.

We securely identified the wood used for the consoles as European Larch (*Larix decidua*) – a tree that grows in Central Europe (**Fig. 5**). Cross-matching with Central European tree series shows that the timbers originated in the Alps, making it likely that the consoles were crafted in Venice before being transported to Rethymnon.

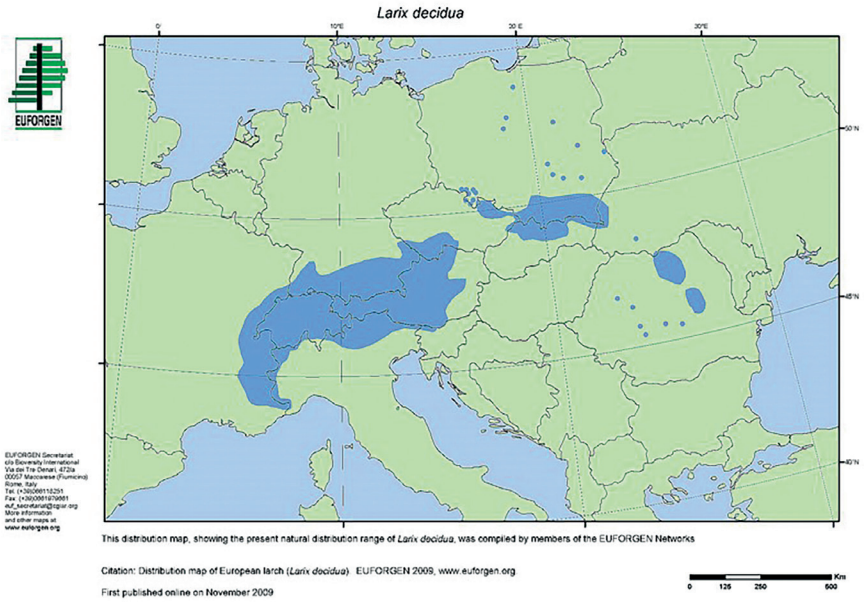

Fig. 5 : Distribution map of European Larch (*Larix decidua*). EUFORGEN 2009, www.euforgen.org

The Drandakis Mansion, Rethymnon

The Drandakis Mansion at 154 Arkadiou Street in Rethymnon is one of the most interesting buildings in the city. It is a three storey mansion with an inner court (**figs 6-7**). It is part of a greater complex, sections of which now belong to different owners. The west part of the inner court is a ground floor area with [? ... ? ... ?] at all pointed arch 'kamara', and at the northeast corner of the court there is a plain fountain. A stone staircase leads to the first floor and to an open wooden corridor. From there a wooden staircase leads to the second floor and the sheltered peripheral corridor which has the form of a kiosk. The initial construction of the house dates to the 16th – early 17th century, in the Venetian period. During the Ottoman period the building suffered many alterations which changed its form. The ashlar façade of the first and the second

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floors and the carved consoles which probably supported a balcony, all date to the Venetian period. The magnificent carved entry, inscribed

Fig. 6 : Drandakis mansion. The façade

Fig. 7 : Drandakis Mansion looking from the '*kamara*' storeroom into the atrium. Photo J. Moody, July 2015

in Greek and Turkish with the date 1844 (possibly a restoration date), as well as the inner wooden corridors and the wood carved ceilings in the rooms of the floors, were Ottoman period additions (Δημακόπουλος 1977, 93-95, 197).

We collected a total of 10 samples. They came from beams removed from the first floor during earlier restorations and kept in the 'kamara' storeroom; from the atrium's wooden pillars; from the galleries' planks and from the ceiling of the great hall on the first floor. According to our study, seven different tree species were used for construction purposes, suggesting a rather haphazard timber selection (**Table 2**). We were able to date two oak beams to the decade AD 1770–1780. A more precise dating was not possible because neither beam preserved sapwood. Their tree-ring sequences, however, correlated strongly with oak dendrochronological series from northern Greece and Turkey. Their stronger correlation with Turkey indicates that the timbers originated from there. No other wooden elements could be dated.

Future work

The continuing aim of our project is to strengthen and extend the tree-ring chronologies we have obtained from living trees and to use them to

SAMPLE NUMBER	CONTEXT	DATA LENGTH	SAP-WOOD	BARK	DATA BEGIN	DATA END	DATING RESULT	WOOD ID
CDRAN1	Ceiling of Room 1 on 2nd floor, splinter for wood ID						undated	*Pinus nigra/sylvestris*, fast grown
CDRAN2	Kiosk column 1						rotten	"chestnut?"
CDRAN3	Kiosk column 2	16		YES			undated	*Pinus brutia*, very fast grown, *c.*1 cm/yr
CDRAN4	Kamara storeroom ceiling Beam 9	66	12	YES			undated	Deciduous oak
CDRAN5	Kamara storeroom ceiling Beam 6	48?		YES			undated	Cypress, numerous false-rings, probably from a plantation
CDRAN6	Kamara storeroom ceiling Beam 4	44		YES			undated	young Cedar, only *c.*50 years old
CDRAN7	Kamara storeroom ceiling Beam 8	30		NO			undated	Spruce, imported
CDRAN8	Fountain ceiling Beam 9	26		NO			undated	Chestnut, local
CDRAN9	Kamara storeroom loose timber 1	108	0	NO	1649	1756	1770s-1780s	Deciduous oak, imported from Turkey
CDRAN10	Kamara storeroom loose timber 2	84	0	NO	1643	1726	1770s-1780s	Deciduous oak, imported from Turkey

Table 2 : Data from wood samples collected from the Drandakis mansion, Rethymnon

provide dates for buildings and wooden artifacts. Artifacts that can be independently dated – for example on the basis of artistic style – contribute significantly to the development of reference tree-ring chronologies.

Our activities, however, are not limited to the last millennium. We are also examining wood charcoal from well-dated archaeological contexts with the aim of developing tree-ring chronologies for prehistoric Crete, and to date them absolutely against Anatolian and Balkan tree-ring standards. Our study of Cretan trees and timbers may even help answer a question raised in 2015: 'Can dendrochronology solve the Thera-eruption question?'

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Δενδρα, ξυλεια και δενδροδακτυλιοι στην Κρητη των ιστορικων χρονων – απο τη βυζαντινη ως την οθωμανικη περιοδο

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Η παρούσα ανακοίνωση εξετάζει τα πρώτα αποτελέσματα του επιστημονικού προγράμματος «Δέντρα, Ξυλεία και Δεντροδακτύλιοι στην Κρήτη των Ιστορικών Χρόνων – από τη βυζαντινή ως την οθωμανική περίοδο», το οποίο πραγματοποιείται από την Εφορεία Αρχαιοτήτων Ρεθύμνου και το Cretan Dendro Group (Laboratory of Tree-Ring Research, University of Arizona – Nicolaus Copernicus University in Torum, Institute for the Study, Conservation and Restoration of Cultural Heritage – Department of Classics, University of Texas).

Στο πλαίσιο του προγράμματος ερευνήθηκαν δείγματα ξύλων που λήφθηκαν από ιστορικά κτήρια, δημόσια και ιδιωτικά, από αντικείμενα (έπιπλα, εικόνες, κ.λπ.), αλλά και από ευρήματα που προέρχονται από τις ανασκαφικές έρευνες στη Δυτική Κρήτη, με ιδιαίτερα ενδιαφέροντα αποτελέσματα.

Χαρακτηριστικά είναι τα συμπεράσματα από τη μελέτη των ξύλινων στοιχείων της ενετικής Λότζιας Ρεθύμνου. Για τους σκοπούς της έρευνας εφαρμόστηκε ψηφιακή μακροφωτογραφία στους ξύλινους με γλυπτό διάκοσμο κιλλίβαντες που βρίσκονται ανάμεσα στα δοκάρια του δώματος και τους πεσσούς που υποβαστάζουν το δώμα της Λότζιας. Η έρευνα κατέδειξε ότι προέρχονται από είδος κωνοφόρου, τη *Larixdeciduas*, η οποία φύεται στην Κεντρική Ευρώπη και χρονολογήθηκε μετά το 1562. Η χρονολόγηση κατασκευής της Λότζιας, κατά τη βιβλιογραφία, ανάγεται στην περίοδο 1596–1597.