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Aegean Dendrochronology Project: December 2010 Progress Report

Your Gifts!

We greatly appreciate the support you have all given, often for many years, to the Aegean Dendrochronology Project. It is a critical part of keeping the Project and Lab operation at Cornell going. Sometimes you may have wondered: what exactly happens to this money I send each year? Does it just go into the general support of the Lab, fieldwork and student workers, and so on? This year we can give you a very specific answer. A couple of the microscopes in the Lab are older than the Lab – we have been sent tree-ring samples with fewer ring/years than these instruments have been in service. They have become hard on the eyes of their users. We have also been unable to take a proper microscope photograph of any wood sample for a couple of years after the previous camera failed. Thus this year we have used some of your wonderful gifts to purchase a new microscope and camera system! Thank you! We can see again. The photograph below (Figure 1) shows Ariel Aicher, taking the Dendro course Fall 2010, using the new system.



Figure 1. Ariel Aicher photographing a 6th century oak sample from Yenikapı, Istanbul, using the new camera and microscope system provided by your donations – you can see the digital image on the computer screen to the right.

For an update on the progress of our work at Yenikapı, see further below.

Working on Old Wood from the Orašje region of North Bosnia

Last year we reported on the collection of samples of oaks dredged from rivers in the Orašje region of North Bosnia, thanks to the ADP's long-time friend and collaborator

Aleksandar Durman and colleagues. These ancient oaks were dredged by a company (ABONOS) to make furniture. Based on a radiocarbon date on one sample they certify the wood (or at least some of it) as nearly 8000 years old! Lab Manager Charlotte Pearson and this year's students and old-timers have had a busy 12 months working on a range of these wet oak samples. Working with Cornell graduate student Xan Stepp, in particular, Charlotte has put together three new chronologies (of 320, 239 and 198 years each). At least one dates around c. 5800BC based on a single radiocarbon date. These samples therefore have the potential to form one of the older floating tree-ring chronologies in Europe. The only snag is that we get more samples only if people keep buying 8000 year old coffee tables. So, if you are looking for a unique Christmas gift, let us know!

Bulgaria to Turkey

A National Geographic grant to Tomasz Wazny gave us the opportunity to extend our network of oak chronologies north of the Cornell Lab's traditional hunting area: Bulgaria. The main aim of this new project is to

build a set of chronologies along a north-south transect from Turkey through the Balkans and eastern Europe, in order to connect the two sets of regional chronologies: central Europe (Poland, Germany) and the Aegean. This will create a major new European dataset for absolute dating and paleoclimatic reconstruction. As part of this project, we therefore selected forest stands located in Bulgaria’s protected national parks and conducted an intensive sampling campaign. Members of the “Bulgarian team” were Tomasz and grad student Brita Lorentzen (Cornell University), supported by Jeni Kamenova Vasileva and Krassimir Leshtakov (Sofia University). The Bulgarian forest was strongly affected by extensive timber exploitation during the Communist Era, so it was difficult to find trees older than 100 years. However, we finally enjoyed untouched oaks in the idyllic environment of the Strandja Mountains in southeastern Bulgaria: Figure 3. Sampling in the forest yielded cores from 112 trees.

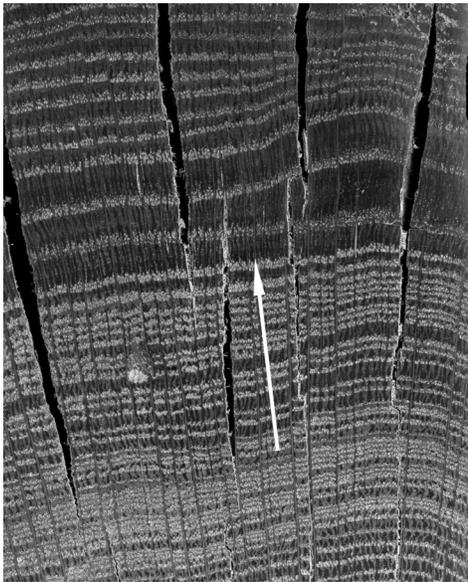


Figure 2. A growth release in one of the oak samples from the Bosna, Krapina and Lukavica rivers in the Orašje region of North Bosnia (this one is from the Bosna River). We hypothesize that several flood events resulted in the transportation and burial of the samples we are working with – hopefully many times over a long period if we are lucky. As new areas of trees were undercut, those not washed away were newly exposed to light and more water, explaining the sort of dramatic growth acceleration indicated with the arrow.

Figure 3. Oaks and friends; in addition to nice oak trees, the trek through the Strandja forests brought the team face to face with a friendly herd of water buffalo.



Less successful was our initial survey of historic buildings, which are a rapidly disappearing resource for dendrochronology and dendroclimatology in the Balkans. As an example: Tombul Mosque (the Sherif Halil Pasha Mosque), built between 1740 and 1744, is the largest mosque in Bulgaria and one of the largest in the Balkans. However, we were able to find only three of its historic timbers (which probably originated from cupola construction) buried below a pile of leaden waste in the courtyard outside. We were told that the original wooden construction was replaced during restoration in 2010 and removed in a garbage container. It is therefore clear that we need to act quickly before other similar resources are lost forever.

The southern end of the North-East oak transect is located in Turkey. The “Turkish team” of the National Geographic project—Tomasz Wazny, along with collaborators Ünal Akkemik and Nesibe Köse from Istanbul University—worked on both sides of Bosphorus this last summer. Tomasz is keen to compare the tree-ring records from the managed forest in the Demirköy district (southern slopes of the Strandja Mountains) with the natural forest on Bulgarian side. These fascinating mountains descend down to the Black Sea where there are numerous submerged settlements.

Southern Levant Dendrochronology Project (SLDP)

Brita Lorentzen, grad, continued to work hard on the Southern Levant Dendrochronology Project (SLDP). During the past two field seasons she has been sampling native and planted *Pinus halepensis* along rough north-

south and east-west transects in Israel in order to investigate their response to climate and examine the variability in the tree-ring record. When we compare correlations among the three resulting chronologies from native *Pinus halepensis* sites in Israel—Masreq, Mt. Carmel, and Rosh HaNiqra—with other *Pinus halepensis* and *Pinus brutia* chronologies that we and other researchers have created in Jordan, Syria, Cyprus, and Turkey, it is clear that the northeastern (Turkey, Cyprus, Syria) and southeastern (Israel, Jordan) Mediterranean sites produce two distinct tree-ring signals which have low to occasionally negative correlation with one another: Figure 4. (The notable exception to this trend is our *Pinus brutia* chronology from Mitsero Hills, Cyprus, which has a moderate correlation with the Mt. Carmel chronology.) Interestingly, select Israeli/Jordanian pine chronologies also have moderate to high correlations with juniper (*Juniperus phoenicea*) and oak (*Quercus aegilops*) chronologies in Jordan. This indicates a strong, climate-driven, common tree-ring signal in the southern Levant. It is our hypothesis that the transition between these two tree-ring signals lies in Lebanon. A new group of *Pinus brutia* samples from Lebanon, courtesy of Sara Rich (Katholieke Universiteit Leuven), will help us investigate this important transition zone.

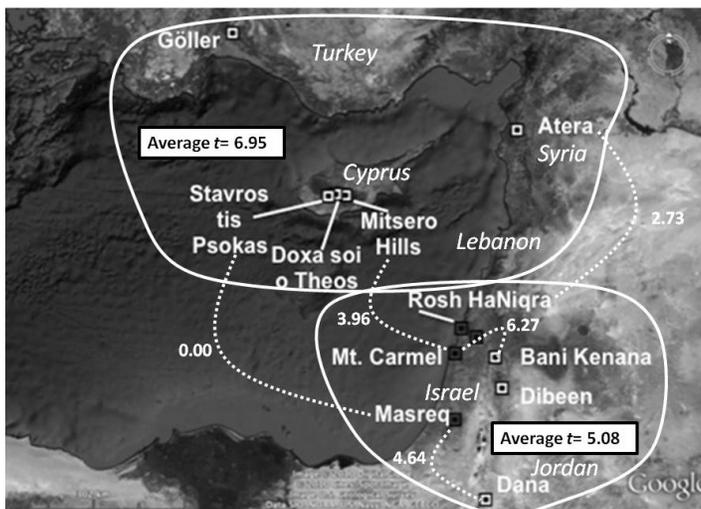


Figure 4. Correlations (*t* scores), among tree-ring chronologies in the eastern Mediterranean. One group, which all correlate significantly, lies in the SE Mediterranean. Another group, which all correlate significantly, lies in the NE Mediterranean. Except for occasional teleconnections (i.e. Mitsero Hills, Cyprus with Mt. Carmel, Israel), the two zones are almost entirely distinct. It is our hypothesis that the division lies about halfway up/down the Levant in Lebanon.

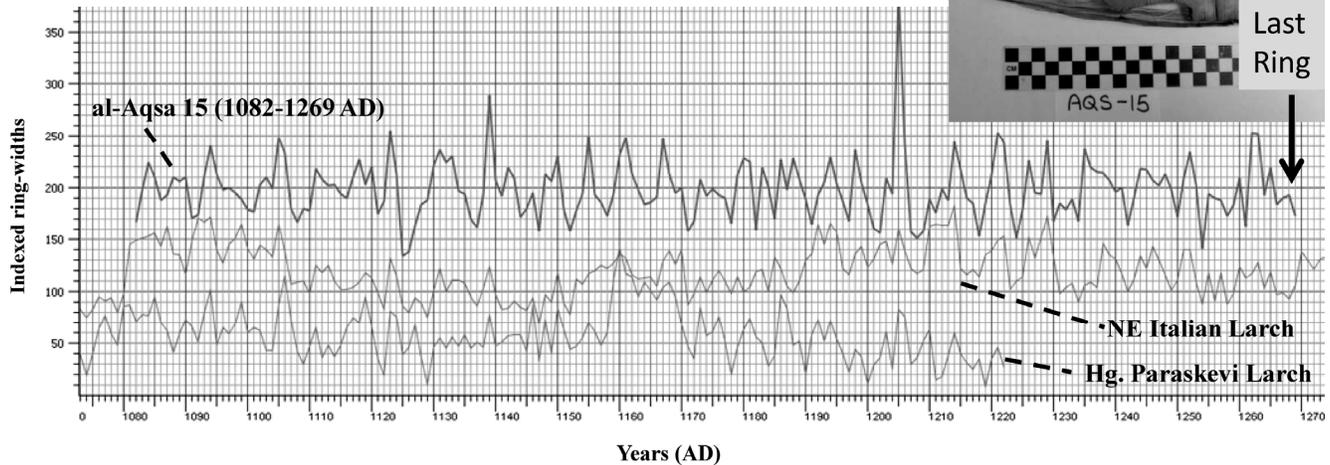
What this means for archaeologists working in the southern Levant is that we will have to implement a dual strategy for dating timbers from the region.

Specifically, we will be able to date timbers imported from the northeastern Mediterranean, Europe, and (more recently) even the U.S. against our pre-existing chronological networks, while we will need to continue building separate chronologies for species growing in the southern Levant to date timbers procured from this region.

We have already had success utilizing this approach. With the assistance of Elisabetta Boaretto (Weizmann Institute of Science), we were able to obtain timbers removed during renovations from the southeastern area of al-Aqsa mosque in Jerusalem. The final ring of one particularly interesting sample, a European larch (*Larix decidua*) beam, dates to 1270 AD, during the Mamluk reign in Jerusalem. Bark is not present on this sample, so the date provides a *terminus post quem*. From the historical record, we know that Mamluk Sultan al-Nasir Muhammad conducted a series of renovations to al-Aqsa (AD 1293-94, 1298-1308, and 1309-1340), so we think that this timber is from one of these projects. The al-Aqsa larch sample most strongly correlates with A.E. Bebbler’s larch chronology from the northeast Italian Alps and the Cornell lab’s larch chronology from Hg. Paraskevi, which longtime readers may remember is a mid-13th century AD Frankish church in Chalkis that we dated back in 2004. Historical records attest to intense trade between the Venetian Republic and the Mamluk sultans in items including timber, so it is likely that the Venetians were supplying al-Nasir Muhammad with larch timbers from their Alpine backyard when the sultan wanted to renovate his mosque. A group of oak timbers from al-Aqsa dating to an earlier period also show correlation with oaks at Yenikapı and the church at Sveti Donat in Croatia; we will continue to analyze this material and keep you posted on our results.

Our analysis and collection of historic and archaeological samples from the southern Levant will continue during the coming year, so as always, if you or your colleagues have material that may be useful, please let us know!

Figure 5. Top: a sample (AQS-15) of European larch (*Larix decidua*) from the southeastern area of al-Aqsa mosque in Jerusalem. Bottom: the final extant tree ring (the ring after the final measured one) of this sample dates to AD 1270, shown here with two especially significant cross-matches against dated European larch chronologies. Bark is not present on this sample, so the date of AD1270 is a terminus post quem.



Cyprus

Sturt investigated the potential for a major dendrochronological dating project on historical buildings in Cyprus with collaborator Nikos Bakirtzis (Cyprus Institute) – visits were made to numerous religious (especially) and some secular monuments to record wood potential. A small additional amount of sampling on *Pinus brutia* was undertaken in the Mitsero Hills area. This is because of ongoing work on regional climate reconstructions based especially on (i) a set of *Pinus brutia* chronologies from Cyprus and (ii) a long *Pinus nigra* chronology from the Troodos area of Cyprus. Sampling 2004-2010 has allowed us to build up well-replicated tree-ring chronologies in each case. These chronologies record annual precipitation, and are an excellent source for understanding the history of drought across the species' range. The best record we have for Cyprus comes from trees from the lower elevation areas on the northeast foothills of the Troodos (e.g. the hills near the village of Mitsero), a rain-shadow region, which receives much less precipitation than the higher areas and along the mountain ridges. Carol Griggs is currently reconstructing annual precipitation for that area, and for the mountain region of western Cyprus, covering the last 180 years. This allows an assessment of the drought record for the island across a much longer span of time than is possible from the available meteorological data. Tentative results indicate that the frequency of droughts may occur in a cyclical pattern, perhaps corresponding to changes in the North Atlantic Oscillation and the Atlantic Multidecadal Oscillation. Drought is not unusual for the island; similar periods occurred in most all the 180 years of the reconstruction. A paper on this will be submitted very soon for publication. We hope to finish work on the multi-century *Pinus nigra* record early in 2011.

Crete

In further intensive work following our previous trial seasons on Crete in 2007 and 2008, Tomasz Wazny with continuing collaborators Jennifer Moody and Oliver Rackham continued investigations on Crete thanks to an INSTAP grant this past summer. A longer report will appear next year. Most notable was the discovery of a new very high elevation group of Cypress (*Cupressus sempervirens*) trees above the Dounávi Pass, with at least one individual of over 900 years (some other such very elderly specimens were previously sampled a little lower at the Angathopí site in 2007 and 2008). Predictions that these trees may well be some of the very oldest in Europe may prove correct!

Yenikapı, Istanbul

Work on some 1794 samples from the Byzantine docks and other structures at Yenikapı continues under Charlotte Pearson's supervision. With the help of LeAnn Canady, Kayla Altland and this fall's dendro class, work this year

takes the number measured to 910! That is 210,868 rings measured in all or 223.9m of wood in a straight line. It seems possible that the timbers used as pilings in Istanbul were imported from as far west as the North Adriatic, and as far east as the Black Sea, and perhaps even a significant distance up the Danube River. Two timbers might even have come from Hungary. The tree-ring chronologies do not yet have absolute dates, but historic context and some radiocarbon dates give us likely approximate dates (as used below) at this preliminary stage.

As the Lab's first millennium (AD) oak chronology comes together, docks which appear to have been sheared by a purported tsunami in the mid 6th century are providing dates of around AD 550 and 556. These docks are directly overlain by a chaotic layer of sediment which must have been laid down sometime after October 556. The year 557 is known to have had a number of earthquakes, culminating in two major tremors in December 557. One well-known result recorded in the chronicles was the collapse of the dome of Hg. Sophia in 558. The chronicles are silent about what happened in the harbor, but one interpretation of the debris at Yenikapı (Figure 6) suggests that either the big earthquake itself, or a subsequent underwater landslide into the 1500 meter deep trench off the Gulf of İzmit, caused a fast-moving tsunami, possibly 4-6 meters high, to obliterate the Yenikapı harbor. The tsunami hypothesis is not agreed upon by all, and our dendro dating will play a key role in helping to establish what really happened and when.

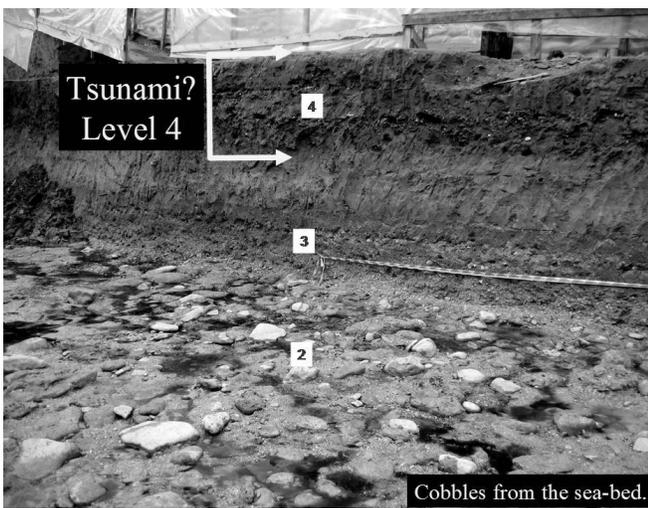


Figure 6. A section at the Yenikapı excavations where the thick layer marked as “4” is thought to be the remains of a devastating tsunami. Photo by Doğan Perinçek.

The second major chronology dates to the 7-9th centuries AD, and includes 56 timbers from three major docks and two minor constructions. The timbers came from two sources, even within one dock, with two building phases. One source was shared with the timbers used in the early St. Eirene (Istanbul) construction. This chronology's dates are extrapolated from the radiocarbon dates of several St. Eirene samples. Part of the work to date is summarized in Figure 7, put together by Carol Griggs. Much more work on oaks from SE Europe and Yenikapı will now continue over

the next four years thanks to a new NSF grant led by Peter Kuniholm and Tomasz Wazny.

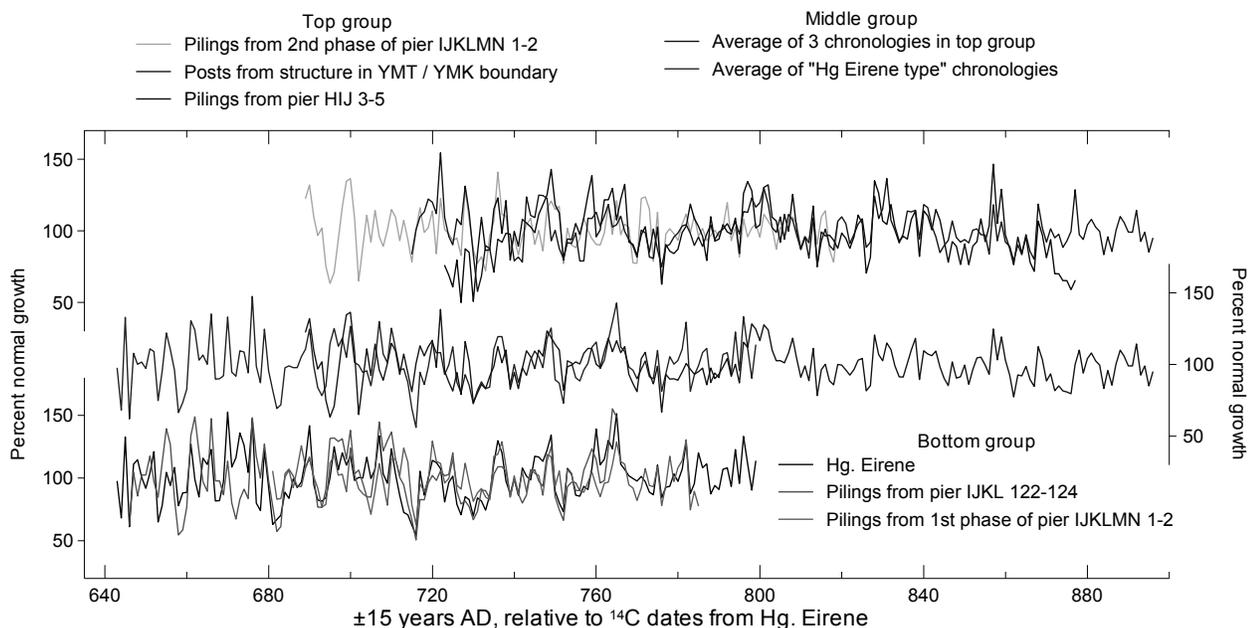


Figure 7. A summary of the 7-9th century AD Yenikapı dendrochronologies assembled at present.

TRiDaS, TRiCYCLE and beyond

This year has seen a number of exciting informatics developments in the lab. Following two years of development, the Tree Ring Data Standard (TRiDaS) was finally published in March this year. This was an international collaboration led by Peter Brewer (Cornell) and Esther Jansma (Utrecht) with contributions from over 80 dendrochronologists and computer scientists from 13 different countries.

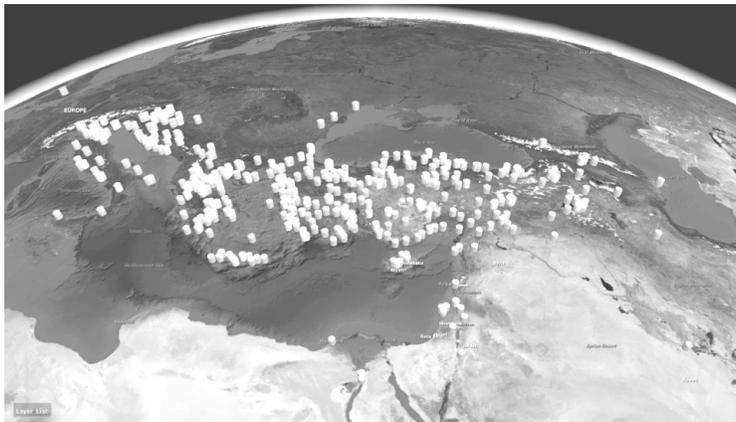


Figure 8. Sites in the Mediterranean region and southern Europe from where the ADP have studied samples.

TRiDaS provides a mechanism whereby dendrochronologists from all over the world working in many subdisciplines can effectively share dendro data and the associated information about samples. The reaction to TRiDaS has already been very positive with many laboratories both within the US and overseas making plans to use TRiDaS to organize their collections and data holdings. As more laboratories commit to the new standard, collaboration between labs around the world will become much easier, enabling more efficient use of resources and opening up exciting new research opportunities.

TRiDaS has also been central in the development of our in-house open-source dendrochronology software – Corina. Peter Brewer, assisted by Cornell student Daniel Murphy, have made great progress in developing Corina into a cutting edge data collection and management tool. The new features developed this year have greatly reduced the time required to administer the lab’s growing collections, freeing up more time for lab members to get on with dendro research. The newly developed Corina is also proving very attractive to researchers from other laboratories. Early in the new year we plan to test Corina in the dendro labs at both the Lamont-Doherty Earth Observatory at Columbia University and Auckland University in New Zealand.

Peter and Daniel have also built upon the success of TRiDaS to develop the first universal dendro-data translation tool: TRiCYCLE. TRiCYCLE allows dendrochronologists to convert seamlessly back and forth between any one of 17 different dendro-data formats. This will not only facilitate further collaboration between labs, but will also ensure continued access to dendro-data archived in a number of obsolete formats in laboratories around the world.

Peter has been continuing to foster links in both the US and Europe. He recently visited with the director of the Paleoclimate division of the National Oceanic and Atmospheric Administration (NOAA) in Boulder, CO, to discuss plans to upgrade the existing International Tree-Ring Databank to support the newly developed data standard. He has also just returned from a very successful trip to the Netherlands where he was introducing TRiDaS and TRiCYCLE to dendrochronologists from the UK, Holland, Belgium, France, Germany, Latvia, Lithuania and Spain.



Other things? Lots. One example: old timer Kate Seuffer preparing tree-ring samples from a Late Bronze Age site in Armenia excavated by the ArAGATS Project based at the University of Chicago (Adam Smith and Lori Khatchadourian). These are for a collaborative dendro-radiocarbon wiggle-matching project aiming to try to begin to create a higher-resolution chronology for this important region in the prehistoric period.



And finally: at right, a tree with real attitude when cored in the Strandja Mountains.

Sturt W. Manning, Cornell University