DENDROCHRONOLOGY OF SUBMERGED BULGARIAN SITES

Peter Ian Kuniholm, Maryanne W. Newton, and Bernd Kromer

1Malcolm and Carolyn Wiener Laboratory for Aegean and Near Eastern Dendrochronology, Cornell University, Ithaca, NY 14853 U.S.A.
2Heidelberger Akademie der Wissenschaften, Institut für Umweltphysik der Universität Heidelberg, D-69120 Heidelberg, Germany

Abstract: During the late 1980s, 83 timber pilings off the Black Sea coast of Bulgaria at Kiten were sampled for dendrochronological research. According to the excavators, the pieces derived from house foundations associated with a now submerged Early Bronze Age habitation site. The wood, mostly oak, formed a 285-year tree-ring sequence, currently the longest Early Bronze Age oak chronology from the Balkans, with at least four, possibly five, building phases identified. The four major phases are represented by at least 10 specimens each, and all construction episodes span a 64-year period. A limited number of specimens exhibited dates falling between these phases, suggesting that maintenance activities involving wood replacement were ongoing between phases. Nine 15-year-long ring sequences were wiggle-matched to the decadal radiocarbon calibration curve of Stuiver and Becker. With an error of ±10 years, the resulting dates place the cutting of the trees for phase 1 at ca. 2778 BC and for the possible phase 5 at ca. 2715 BC. Kiten is only one of several submerged sites discovered by Bulgarian underwater archaeologists. In a discussion of flooding in the Black Sea basin, the submergence of a site occupied during the early 3rd millennium BC requires some explanation, considering that the date proposed by Ryan and Pitman for their inundation lies in the 6th millennium. An even earlier set of submerged timbers from Eneolithic Sozopol has now been dated and is here reported.

Keywords: dendrochronology, sea-level change, Black Sea, Bulgaria, tree-ring dating

1. INTRODUCTION

Tree-ring dating is deceptively simple. Some species of trees add annual growth increments in recognizable sequences. When trees in a specific
climatic region such as the Black Sea basin are similarly affected by yearly changes in the climate, their rings can be matched or 'crossdated' with one another so that a given ring can be assigned to a specific calendar year (see Kuniholm and Striker 1987; Kuniholm 1996a). Sometimes a felling time within a year can be identified (Kuniholm 2001). Dendrochronology is the only archaeometric dating technique that furnishes this kind of annual or sub-annual resolution. The method works only with species having clear, annual growth rings, but it works with wood that may be dry, wet (bog sites or shipwrecks), or burned (charcoal).

Crossdating is the fundamental principle on which all dendrochronology is based, and therefore, it deserves further explanation. The researcher has to be assured that rings from two or more specimens were formed in the same year. Neither simple ring-counts nor a single pattern of co-variation in ring-width, i.e., a 'signature', are sufficient (see Kuniholm 2001 for illustrations). In order to avoid the possibility of accidental, spurious 'matches', dendrochronologists prefer to compare specimens possessing at least 100 rings and multiple signatures rather than shorter-lived ones, which may not preserve enough signatures to guarantee the fit. These ring-patterns may be generated by a wide variety of causes, some of which yield a true signal, others merely noise.

The ring-patterns that are most usually crossdatable are the trees' synchronized response to some mutually-experienced climatic stimulus (Hughes et al. 2001). In some regions, it is principally rainfall or lack of it; in others, it is temperature; in yet others, it is some combination of the two. Around the Black Sea, precipitation from April to June seems to be the limiting factor (Hughes et al. 2001). This stimulus-and-response is therefore specific to a climatic region, and in this paper, the region in question runs from Georgia in the east along the northern Turkish coast to Greece and the former Yugoslavia in the west. We do not yet know whether we will obtain crossdating some day with trees in Romania and Ukraine. The climatic boundaries for dendrochronological crossdating have been best determined, in practice, by trial and error.

When continuous tree-ring chronologies do not exist from the present to antiquity, alternative methods of placement are needed. One of the best methods is radiocarbon wiggle-matching, which will be elaborated on below.

### 1.1 Preliminary Digression: Çatak in Southeastern Turkey and the Tigris Trout of James Prosek

Since students of the Black Sea may not be regular readers of the sports section in the New York Times, we draw the reader’s attention to an article by James Prosek entitled “Seeking God’s fish, a/k/a Tigris trout,” which appeared on Sunday, March 23, 2003. Prosek caught a trout—an image of which he kindly provided for the Columbia University conference—in the headwaters of the Tigris
River at Çatak, about 30 km east of Lake Van. The genetic ancestry of this trout traces back to the end of the last glaciation, or about 13,000 years ago, when the (then) freshwater lakes we now know as the Caspian and the Black Seas were connected. It is quite unthinkable that the trout, and its cousins in the headwaters of the Euphrates, migrated upriver from the Persian Gulf.

Prosek has now published Trout of the World (2003) in which this trout and its relatives are illustrated and discussed. The very simple point to be made here is that we all need to remember that modern coastlines and landforms are not necessarily those of remote antiquity. Thus, it is not at all outrageous to think of Early Bronze Age habitations ten meters under today's sea level.

1.2 Secondary Digression: Troy of Early Bronze Age I and Wiggle-matched Dates from the Schliemann Trench

This information was published in Studia Troica III (Korffmann and Kromer 1993) and again in Acta Archaeologica (Kuniholm 1996b). Our second point is to remind readers, for whom "wiggle-matching" may be a novel concept, of a remarkable V-shaped radiocarbon anomaly in Anatolian pines in the 29th century BC, which makes the placement of the Troy I chronology, with its radiocarbon dates forming a coeval and similarly remarkable V-shaped anomaly, a decade and a half before 2700 BC all the more secure.

2. SUBMERGED COASTAL SITES IN BULGARIA—EARLY BRONZE AGE KITEN

In 1998, we published the results of measurements from 85 oak and boxwood pilings collected in 1988 and 1989 from Burgas, Sozopol, Primorsko, and Kiten, about an hour’s drive north of the Turkish frontier. The geologists at this meeting showed images of the relatively shallow shelf which runs along the western edge of the Black Sea and on which the Kiten site and other similar sites were built. We were told at the time of collection by a team of Bulgarian archaeologists and divers that the pilings came from Early Bronze Age house foundations, now submerged about 8–10 meters beneath the surface of the Black Sea. The tree-rings formed a 285-year sequence encompassing four, possibly five, building phases. Wiggle-matching at the Heidelberg radiocarbon laboratory of nine 15-year-long ring sequences produced the results in Table 1, which were published in the James Harvey Gaul memorial volume (Kuniholm et al. 1998).

We emphasize that the accuracy of this wiggle-matched placement in time is provided by the same 29th century BC V-shaped anomaly in the radiocarbon calibration curve that has already been noticed in Trojan pines. Here, it is repeated in the Bulgarian oaks—see Kuniholm (1996b:332, Figure 8). The
archaeological context at Kiten was described to us by Professor Henrieta Todorova as “the forming phases of the Černa Voda-Ezerovo culture / Ezero VII-IX = 2900–2700 Cal. BC,” so the dates are in accord with the material assemblage, except that here we are able to be much more specific.

Table 1. Phases and dates for Kiten pilings (Kuniholm et al. 1998).

<table>
<thead>
<tr>
<th>PHASE</th>
<th>KITEN RELATIVE DATE</th>
<th>RADIOCARBON DATE*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>trees cut ca. 1073</td>
<td>= 2778 BC±10 (bark present)</td>
</tr>
<tr>
<td></td>
<td>7 year interval</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>trees cut ca. 1080</td>
<td>= 2771 BC±10 (very few exterior rings missing)</td>
</tr>
<tr>
<td></td>
<td>20 year interval</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>trees cut ca. 1100</td>
<td>= 2751 BC±10 (waney edge)</td>
</tr>
<tr>
<td></td>
<td>14 year interval</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>trees cut ca. 1114</td>
<td>= 2737 BC±10 (waney edge)</td>
</tr>
<tr>
<td></td>
<td>22 year interval</td>
<td></td>
</tr>
<tr>
<td>5?</td>
<td>trees cut ca. 1136</td>
<td>= 2715 BC±10 (very few exterior rings missing)</td>
</tr>
</tbody>
</table>

*NOTE: These radiocarbon dates were based on the 1993 calibration curve (Stuiver and Becker 1993). The now current 1998 calibration curve (Stuiver et al. 1998; the 2004 version is not yet available) yields a date one year earlier (i.e., 2716 BC) for the possible Phase 5.

Each of the dendrochronological phases at Kiten consists of at least ten trees, all ending in the same terminal year. Other specimens yielded dates between these phases, which suggests that some maintenance activities involving wood replacement were continuous. We were promised plans of the site by the excavator Kalin Porozhanov but as yet have not seen any. It would be instructive to study the spatial relationship to determine whether people were building and rebuilding as the water level rose, or whether the recovered wood assemblage is simply a series of pilings from four separate and approximately contemporary buildings. The small building model shown to us at Kiten does not make sense for a marshy environment because the house foundation appeared to be dug into the soil, making for a rather wet cellar. The function of the pilings on either side of the foundation is unclear to us.

Our dendrochronological work at Kiten does not exist in isolation. The Kiten tree-ring chronology crossdates with the Early Bronze Age site of Demircihüyük, with the latter ending at Kiten Relative Date 1146, or, using the wiggle-matched dates, 2705 BC±10 (Kuniholm 1987; Kuniholm et al. 1998).

The message from Kiten, then, is that throughout the 28th century BC, and as late as 2715 BC, people were able to build and live on the western shore of the Black Sea, even if somewhat damply. This land surface is currently ten meters below the surface of the Black Sea. We need the help of the geologists to explain why there was such a change: how much due to tectonic subsidence, how much due to rising sea level.
3. **SUBMERGED COASTAL SITES IN BULGARIA—ENEOLITHIC SOZOPOL**

We have a second collection of timber pilings, mostly oak, retrieved in 1988 by Aleksandar Durman and Hristina Angelova from an Eneolithic site (Quadrant D) about ten meters under water in Sozopol harbor. Again, we have not seen copies of the plans. The Sozopol oak forms a 224-year tree-ring chronology, and radiocarbon determinations made at the AMS facility at the University of Arizona place the end-date at 4140 BC±19 (calibrated). There is no phasing as we saw at Kiten. But again, it is worth noting that as of the mid-42nd century BC—or 14 centuries before Kiten—people were building and living next to a Black Sea that was much lower than it is today.

Our intuitive feeling is that although we are now looking at a salty replacement for what was once a freshwater lake (the kind of lake in which the Tigris trout’s ancestors might have swum), the change did not come as a single enormous splash, thereby filling the Black Sea with salt water up to its present brim. The last ten meters of sea-level change took place some time between 2700 BC and today. We leave to the geologists the explanation and estimation of what part of this is due to absolute sea-level change and what part to land movement.

4. **FUTURE WORK**

At the time of our visits to Bulgaria in 1988 and 1989, we were told by the divers of an off-shore “forest,” from which it was alleged that timbers could be produced for dendrochronological analysis. Perhaps inadequate knowledge of Russian made us misunderstand what was being said, and perhaps Dr. Angelova might be able to shed further light on this. Certainly, if any such material could be recovered and analyzed, this would be additional useful information for conditions along the Black Sea coastline at specific times in antiquity. The same applies to anything formerly terrestrial recovered by Dr. Ballard’s submersibles. Shipwrecks, of course, do not provide this kind of information other than that the wreck site was at one time navigable water.

**ACKNOWLEDGMENTS**

The Malcolm and Carolyn Wiener Laboratory for Aegean and Near Eastern Dendrochronology is supported by the National Science Foundation, the Malcolm H. Wiener Foundation, and individual Patrons of the Aegean Dendrochronology Project. For fundamental research permissions, we thank the appro-
priate governmental and religious authorities in all the countries in which we work, as well as the many excavators who not only take time out to explain the intricacies of their sites but who make us welcome at their excavation houses year after year.

REFERENCES


Korfmann, M., and B. Kromer

Kuniholm, P.I.


Kuniholm, P.I., and C.L. Striker

Kuniholm, P.I., B. Kromer, S.L. Tarter, and C.B. Griggs

Prosek, J.

Stuiver, M., and B. Becker

1998 INTCAL98 radiocarbon age calibration, 24,000–0 cal BP. *Radiocarbon* 40:1041–1083.