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Four tree-ring chronologies for the Italian peninsula

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Tree-ring networks have been established not only in semiarid zones but also in humid, temperate and cold regions all over the world (Hughes et al. 1982, Jacoby & Hornbeck 1985). In Mediterranean countries chronology development has recently begun (Serre-Bachet 1990). In Italy, a few tree-ring chronologies exist for alpine and northern regions (Bebber 1985, Nola 1988). If we exclude tree-ring series obtained from a single specimen (e.g. Corona 1984, 1986) or from archaeological material, often dated against master chronologies developed for central Europe (e.g. Corona 1983), published tree-ring chronologies for the Italian peninsula are still limited to a handful of mountain sites (Bräker & Schweingruber 1989, Serre-Bachet 1985).

The scarcity of Italian tree-ring chronologies does not reflect a scarcity of forests. Total forest coverage amounts to over 8.6 million hectares, i.e. about 28% of the entire national territory (Bortolotti 1989). Since most flatland and low-hill sites are occupied by urban settlements or devoted to agricultural and industrial production, about 60% of Italy’s forests are located in mountainous areas, where human presence is reduced and the need to prevent soil erosion and landslides is increased. With regard to climatic conditions, approximately 20% of Italian forests are in regions with typical Mediterranean climate, while the remaining ones are in regions with cooler and moister climatic regimes (Susmel 1988). The present poster is my first contribution to the development of a network of tree-ring chronologies for the Italian peninsula using core samples extracted from living trees.

Methods

Sampling sites were selected throughout the Italian peninsula, between 40° and 46° north latitude and between 7° and 16.5° east longitude. Site selection criteria were: a) homogeneous horizontal distribution; b) broad altitude range, from sea level to timberline; c) presence of presumably old trees belonging to species with datable rings (Societa Botanica Italia- liana 1971, Nardi Berti 1979).

Wood cores 5-mm thick were extracted using a Swedish increment borer 40, 50, 60 or 75 cm long depending on trunk diameter. Tree selection focused on single or grouped trees which showed the best combination of old age and trunk health. Old age was defined by large stem diameter, strongly tapered trunk, large branches, flat crown top, dominant position among surrounding trees. Trunk health was defined by lack of large scars, wood mushrooms or bark stains. Some vigorous trees were often selected regardless of their age to compare their ring patterns with those of the old trees. Dead standing trees were also sampled to extend the tree ring record as far back in time as possible. Quantitative and qualitative information on sites (i.e. location, altitude, soil slope and exposure, stand composition and density, etc.) and trees (i.e. trunk diameter, tree height, crown health, core position, etc.) was recorded into a computerized database to allow easy access, retrieval and summary of field data.

All increment cores were glued to wooden mounts, sanded and polished until the smallest rings were clearly visible. Ring counting provided a first estimate of tree age; ring-widths were measured to the nearest 0.01 mm. Cross-dating was ascertained by skeleton plots (Stokes & Smiley 1968) and independently verified by another researcher and by numerical techniques (Holmes 1983). Chronologies were developed as follows:

\[
\bar{I}_t = \frac{\sum_{i=1}^{N} (\ln w_i - y_i)}{N}
\]

\(\bar{I}\): average ring-index or value of the master chronology; \(t\): calendar year; \(\ln\): logarithmic transformation, used to obtain homoscedastic time series (Davis 1986); \(w\): ring-width measurement, in 1/100 mm; \(y\): growth trend, simulated by a cubic spline with 50% variance reduction at a frequency of one cycle per 50 years; \(i\): specimen; \(N\): number of specimens available for year \(t\), with \(N \geq 5\).
Results

A total of 600 increment cores of 23 tree species have been collected from standing trees at 23 sites. The oldest living tree sampled to date is a 950-year-old palebark pine (Pinus leucodermis) at Mt. Pollino; individuals more than two century old have been identified at six sites for seven species. Four reference tree-ring chronologies have been developed so far (Fig.1, Tables 1 & 2) and other chronologies should be available in the near future.

Parco del Circeo and Tenuta di S. Rossore are two of the many umbrella pine plantations along the Tirreno Coast. They are at sea level, even-aged, on sandy soils with a shallow water table. The Circeo collection site is included in an abandoned botanical garden that has been invaded by Mediterranean hardwoods, whereas the S. Rossore collection site is artificially kept pure (Padula 1985). Parco d’Abruzzo and Campolino are two naturally seeded stands of, respectively, black pine (var. "Villetta Barrea") and Norway spruce in the Apennines (Società Botanica Italiana 1971). The former has been a National Park since 1923, the latter has been a Natural Reservation since 1972. Both are uneven-aged; Campolino is at timber line, Parco d’Abruzzo approaches the upper elevation limit for black pine. Spruces at Campolino are mixed with beech (Fagus sylvatica) and silver fir (Abies alba), especially in the lower half of the site. Black pines at Parco d’Abruzzo are often the only tree species on the rocky, steep slopes where they grow.


Standard deviation and mean sensitivity of tree-ring chronologies for high elevation conifers were lower than those for low elevation ones (Table 2). First-order autocorrelation was unusually small for Picea excelsa at Campolino, and was about 0.5 for every other chronology. The signal-to-noise ratio was below commonly reported values because of the limited number of available specimens, the conspicuous human disturbance, and the absence of a single climatic factor limiting tree growth at each site.

Table 1. Summary of site information for tree-ring chronologies.

<table>
<thead>
<tr>
<th>SITE &amp; SPECIES</th>
<th>LAT. (N)</th>
<th>LONG. (E)</th>
<th>TREES CORES</th>
<th>DIAM. RANGE (cm)</th>
<th>HEIGHT RANGE (m)</th>
<th>ELEVAT. RANGE (m)</th>
<th>SLOPE RANGE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parco d’Abruzzo Pinus nigra</td>
<td>41° 46'</td>
<td>13° 39'</td>
<td>16(2) 32(4)</td>
<td>41-76</td>
<td>5-22</td>
<td>1310-1760</td>
<td>55-110</td>
</tr>
<tr>
<td>Parco del Circeo Pinus pinea</td>
<td>41° 20'</td>
<td>13° 00'</td>
<td>9 18</td>
<td>70-89</td>
<td>25-27</td>
<td>-5-0</td>
<td>0</td>
</tr>
<tr>
<td>San Rossore Pinus pinea</td>
<td>43° 43'</td>
<td>10° 16'</td>
<td>7 14</td>
<td>86-151</td>
<td>21-27</td>
<td>0-1</td>
<td>0-20</td>
</tr>
<tr>
<td>Campolino Picea abies</td>
<td>44° 07'</td>
<td>10° 43'</td>
<td>14 28</td>
<td>45-93</td>
<td>10-28</td>
<td>1570-1720</td>
<td>0-64</td>
</tr>
</tbody>
</table>

1 Numbers within brackets refer to samples taken from dead trees.
Table 2. Statistics for tree-ring chronologies plotted in Fig.1.

<table>
<thead>
<tr>
<th>SITE &amp; SPECIES</th>
<th>YEARS</th>
<th>COMMON INTERVAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>FIRST</td>
<td>LAST</td>
</tr>
<tr>
<td>Parco d'Abruzzo</td>
<td>Pinus nigra</td>
<td>1750</td>
</tr>
<tr>
<td>Parco del Circeo</td>
<td>Pinus pinea</td>
<td>1878</td>
</tr>
<tr>
<td>San Rossore</td>
<td>Pinus pinea</td>
<td>1861</td>
</tr>
<tr>
<td>Campolino</td>
<td>Picea abies</td>
<td>1836</td>
</tr>
</tbody>
</table>


References


Fig. 1. Time-series graphs of master tree-ring chronologies developed to date. Average ring-indices were computed using at least five cross-dated samples. CAM: Parco d'Abruzzo. CAP: Campolino. PDC: Parco del Circeo. SRO: San Rossore.
Acknowledgements

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