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CHEMICAL ELEMENTS AND HEAVY METALS IN EUROPEAN LARCH TREE RINGS FROM REMOTE AND POLLUTED SITES IN THE EUROPEAN ALPS

ABSTRACT: LEONELLI G., BATTIPAGLIA G., CHERUBINI P., MORRA DI CELLA U. & PELFINI M., *Chemical elements and heavy metals in European larch tree rings from remote and polluted sites in the European Alps*. (IT ISSN 0391-9838, 2011).

Air pollution dispersal in the European Alps has been studied both for glacial and forest environments. In this study, chemical elements and heavy metals in the tree rings were analyzed for seven sites of European larch (*Larix decidua* Mill.) in the Italian European Alps. At three sites in the proximities of the Mont Blanc Tunnel (MBT) entrance the analyses were performed at the yearly scale on the periods 1950-1970 (comprising the MBT opening in 1965) and 1985-2008 (comprising the 3-yr MBT closure after the 1999 car accident) with the aim to check if trees recorded at the yearly scale variations in chemical elements and changes in heavy metals concentrations over time. At the regional scale, the analyses on heavy metals were conducted without annual resolution for most sites on the common periods 1950-1970 / 1985-1998 with the aim to detect possible ongoing trends and differences between some Alpine sites. Chemical elements concentrations at Entrèves (EN) sites varied significantly between heartwood and sapwood with generally higher concentrations in sapwood. At EN sites no clear patterns were found for heavy metals before and after the MBT opening and during its 3-yr closure. We found

that the "high" site (ENH) was generally less polluted than the "close" (ENC) and the "far" (ENF) sites. At site ENC we found higher values of Cr, Ni and Cu, whereas at site ENF we found higher values for all the other elements analyzed. The analysis of heavy metals at the regional scale revealed generally no significant temporal changes in concentrations except for Cr and Cu, showing higher values in the recent period. On comparing the heavy metals concentration between the seven sites, the Palud site showed almost always the highest concentrations, except for Ni and Cu that were higher in two remote sites close to glacial environments in the Gressoney and Valtellina valleys. Dendrochemical analysis revealed that the temporal information in the tree rings is covered by too many signals and no environmental changes are recorded at the yearly scale by European larch. However tree rings may provide useful information on ongoing long-term trends and on the spatial definition of pollutant dispersal in the Alpine environment.

KEY WORDS: Tree ring, Chemical elements, Heavy metals, Air pollution, European larch, European Alps.

RIASSUNTO: LEONELLI G., BATTIPAGLIA G., CHERUBINI P., MORRA DI CELLA U. & PELFINI M., *Elementi chimici e metalli pesanti negli anelli di accrescimento di larice europeo da siti remoti e inquinati nelle Alpi*. (IT ISSN 0391-9838, 2011).

La dispersione degli inquinanti atmosferici nelle Alpi è stata studiata sia per gli ambienti glaciali sia per quelli forestali. In questo lavoro, sono stati analizzati elementi chimici e metalli pesanti negli anelli di accrescimento di esemplari di larice europeo (*Larix decidua*) provenienti da sette siti nelle Alpi italiane. In tre siti in prossimità dell'ingresso del Tunnel del Monte Bianco (TMB) sono state effettuate analisi a scala annuale sui periodi 1950-1970 (comprendente l'apertura del TMB nel 1965) e 1985-2008 (comprendente la chiusura di 3 anni dopo l'incidente d'auto avvenuto nel 1999) con lo scopo di verificare se gli alberi avessero registrato a scala annuale variazioni di concentrazione di elementi chimici e di metalli pesanti nel tempo. A scala regionale l'analisi sui metalli pesanti è stata effettuata senza risoluzione annuale per la maggior parte dei siti, sui periodi comuni 1950-1970 / 1985-1998 con lo scopo di determinare possibili trend in corso ed eventuali differenze tra alcuni siti Alpini. Gli elementi chimici analizzati ai siti di Entrèves (EN) sono risultati variare significativamente tra duramen e alburno, con concentrazioni generalmente maggiori nell'alburno. Ai siti EN non si sono trovate particolari variazioni per i metalli pesanti prima e dopo l'apertura del TMB e durante la sua chiusura di 3 anni. Il sito «alto» (ENH) è risultato generalmente meno inquina-

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