



The paraglacial concept revisited: the record from the Mediterranean mountains of Southern Europe

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The paraglacial model was an important innovation in fluvial geomorphology introduced more than 40 years ago by Church and Ryder. It provides an important conceptual framework for considering the interactions between glacial and fluvial systems and vegetation development during transitions from cold to warm Quaternary stages. The Mediterranean mountains of southern Europe provide an ideal context to further explore and refine the nature and duration of paraglacial episodes because the region contains numerous well-dated records of glaciation, river behaviour, and vegetation change. Recent research in Greece and Montenegro has highlighted striking contrasts between the extent of Pleistocene glaciation in different cold stages. The Middle Pleistocene glaciations of MIS 12 and MIS 6, for example, were much larger than those of the last cold stage and we discuss the implications of this for long-term river behaviour in the region and the nature of paraglacial sedimentation in these and later cold stages.

This paper also examines the following questions in relation to the last glacial-interglacial transition: when did the paraglacial phase begin in the Mediterranean mountains and how long did it last? The local Last Glacial Maximum (LGM) in southern Europe was several thousand years earlier than the global LGM. Because these same mountains also formed the glacial refugia for Europe's trees, forest expansion was rapid at the end of glacial stages when the climate warmed. In the Voidomatis catchment of NW Greece, for example, slackwater sediments show how the river system shifted very rapidly from one dominated by glacial meltwater floods to one dominated by rainfall-generated floods under ice free conditions. The high sediment production and strong coupling between slopes and channels that characterized the glacial and paraglacial phases was abruptly terminated by the very rapid expansion of dense forests which stabilised moraines and valley floors. Finally we show how the paraglacial phase was strongly time-transgressive across the European continent as trees expanded from southern refugia to distant regions where the paraglacial window was much longer and closed more slowly. The paraglacial phase in the Mediterranean mountains was not only very brief, but it was over before deglaciation had begun in the river catchments of northern Europe. Thus the record of paraglacial activity in European river basins displays marked temporal and spatial variability.