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PRELIMINARY QUANTIFICATION OF THE EROSION OF SANDY-GRAVELLY CLIFFS ON THE ISLAND OF PORQUEROLLES (PROVENCE, FRANCE) THROUGH DENDROGEOMORPHOLOGY, USING EXPOSED ROOTS OF ALEPPO PINE (*PINUS HALEPENSIS* MILL.)

ABSTRACT: ROVÉRA G., LOPEZ-SAEZ J., CORONA C., STOFFEL M. & BERGER F., *Preliminary quantification of the erosion of sandy-gravelly cliffs on the island of Porquerolles (Provence, France) through dendrogeomorphology, using exposed roots of Aleppo pine (Pinus halepensis Mill.)*. (IT ISSN 0391-9838, 2013).

This study is a first attempt to specify the geodynamic processes leading to the erosion of detrital quaternary cliffs on the island of Porquerolles, and to quantify the rate of erosion by means of dendrogeomorphology. The island is located in the Mediterranean Sea, off the coast of Provence (France). This method identifies the roots of Aleppo pine (*Pinus halepensis* Mill.) that have been unearthed by cliff retreat. The year of denudation is revealed by the net change in tracheid anatomy in tree rings, so that the retreating rates of cliffs can be established and the ratio between the distance of loosening and the number of years since denudation can be assessed. 13 root samples were used to determine that the cliff retreat is due to small rockfalls, at an average rate of 2.5 cm/a. This value is compared to other rates of erosion quantified on rocky or sandy shores. A review of the method and a comparison with methods based on photogrammetry and micrometrics are proposed.

KEY WORDS: Littoral geodynamics, Erosion rate, Mediterranean Sea, Quaternary cliff, Dendrogeomorphology, Tracheid root, Aleppo pine.

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INTRODUCTION

Coastal erosion is a phenomenon that has been studied for a long time, especially in France (*e.g.* Guilcher, 1954; Paskoff, 1993, 2004; Salomon, 2008). Although the Mediterranean coasts are little affected by rising tides, storms and associated large swells, they are significantly affected locally by erosion. The rate of coastal retreat has increased in recent decades so that expensive technical solutions are constantly being deployed to reduce this degradation. Four main factors have been identified: a reduced sediment supply from the mainland, a progressive rise in sea level, the effect of human development on the coastline, and the increasing number of tourists (Rigoni, 2003; Sdage Rhône Méditerranée Corse, 2005; Lambert & *alii*, 2007; Tsimplis & *alii*, 2008; Brunel & Sabatier, 2009; Letetrel & *alii*, 2010; Brunel, 2012). Coastal retreat can be assessed diachronically using archive documents (*e.g.* «cadastre»), and photogrammetric or Lidar surveys (Catalao & *alii*, 2002; Hénaff & *alii*, 2002; Costa & *alii*, 2004; Pierre & Lahousse, 2004; Pierre, 2006; Young & *alii*, 2009). For an accurate estimation of ablation at fine scales on areas of distinct lithologies, the practice of micrometrics can be applied (Stephenson & Finlayson, 2009).

In this study, we aim to assess the rates of erosion of small cliffs made of sand and gravel on the island of Porquerolles (Provence, France) by means of a dendrogeomorphological approach. This is based on the use of Aleppo pine roots located on the coastline, which have been unearthed by the progressive retreat of the cliffs. Another objective of this paper is to provide a methodological discussion as dendrogeomorphology has never been applied to quantify coastal erosion. The first results and a first as-