



Characterization of archaeological waterlogged wooden objects exposed on the hyper-saline Dead Sea shore



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ABSTRACT

Archaeological waterlogged wood objects exposed on the Dead Sea shore exhibit little visual evidence of degradation when first exposed, and after prolonged exposure and dehydration. An investigation on the state of preservation of this material was recognised as a necessary step towards its long-term conservation. Micromorphological observations, ATR FTIR, ash content, and physical tests showed that deterioration is limited and is mostly non-biological in nature. Natural bulking and impregnation with lake minerals and salts appear to play a significant role in the physical stability of these woods when dried, and apparently inhibit microbial colonization and subsequent degradation. In contrast, archaeological wood examined from a typical Mediterranean marine environment showed advanced stages of degradation by bacteria, with the wood structure extensively compromised.

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1. Introduction

The Dead Sea is a hyper-saline inland desert lake located at the lowest terrestrial place on Earth (Fig. 1). The lake and its surroundings have a harsh desert climate, extremely rugged terrain, and rich mineral resources.

The archaeological record of the Dead Sea basin is extremely long and diverse, indicating a continuous human presence at least from the Neolithic Period (9750–4500 BCE) to the present time (Nissenbaum, 1993; Taute, 1994; Gichon, 2000: 93–101; Recchi and Gopher, 2002; Hirschfeld, 2006; Barkai et al., 2007; Schaub and Chesson, 2007; Schyle, 2007; Vardi and Cohen-Sasson, 2012). This human presence was associated with the exploitation of the region's rich natural resources, e.g., salt, bitumen (natural asphalt), and flint, as well as the cultivation of dates and aromatic plants at several lakeshore oases.

A severe and ongoing drop in the lake water level since the 1960's (Klein, 1982; Bookman et al., 2006: 167–168) has led to the exposure of vast areas of the former lakebed, and with it a diverse collection of

ancient and historical objects. Of particular importance are several well preserved anchors made of stone, waterlogged wood and rope, dating from the 8th century BC to the 12th century AD (Hadas, 1992, 1993; Hadas et al., 2005; Oron et al., 2008). Together with cargo remains, shoreline finds and other types of evidence, these anchors add significantly to our knowledge of the basin's history and illuminate the lake's unique maritime cultural landscape (Oron et al., 2015a, 2015b).

Waterlogged wood finds from the Dead Sea may be found while still wet or damp near the waterline, or completely dry, having been exposed for several years, or even decades, such as the anchors in Fig. 2a and b. Both appear visually and physically intact, with their three-dimensional integrity little changed. This seemingly un-degraded condition is unusual, and contrasts with similar finds from other marine environments, which are normally found chemically and biologically degraded, and prone to rapid disintegration upon uncontrolled drying (Hoffmann and Jones, 1990; Blanchette and Hofmann, 1994; Gelbrich et al., 2008; Björdal, 2012).

The excellent state of preservation of wooden finds from the Dead Sea raises questions regarding their physical and chemical nature. The aim of the study was to characterize the deterioration found in archaeological waterlogged wooden objects and other waterlogged wood found in and along the shoreline of the Dead Sea, using protocols commonly used for the evaluation of archaeological waterlogged wood

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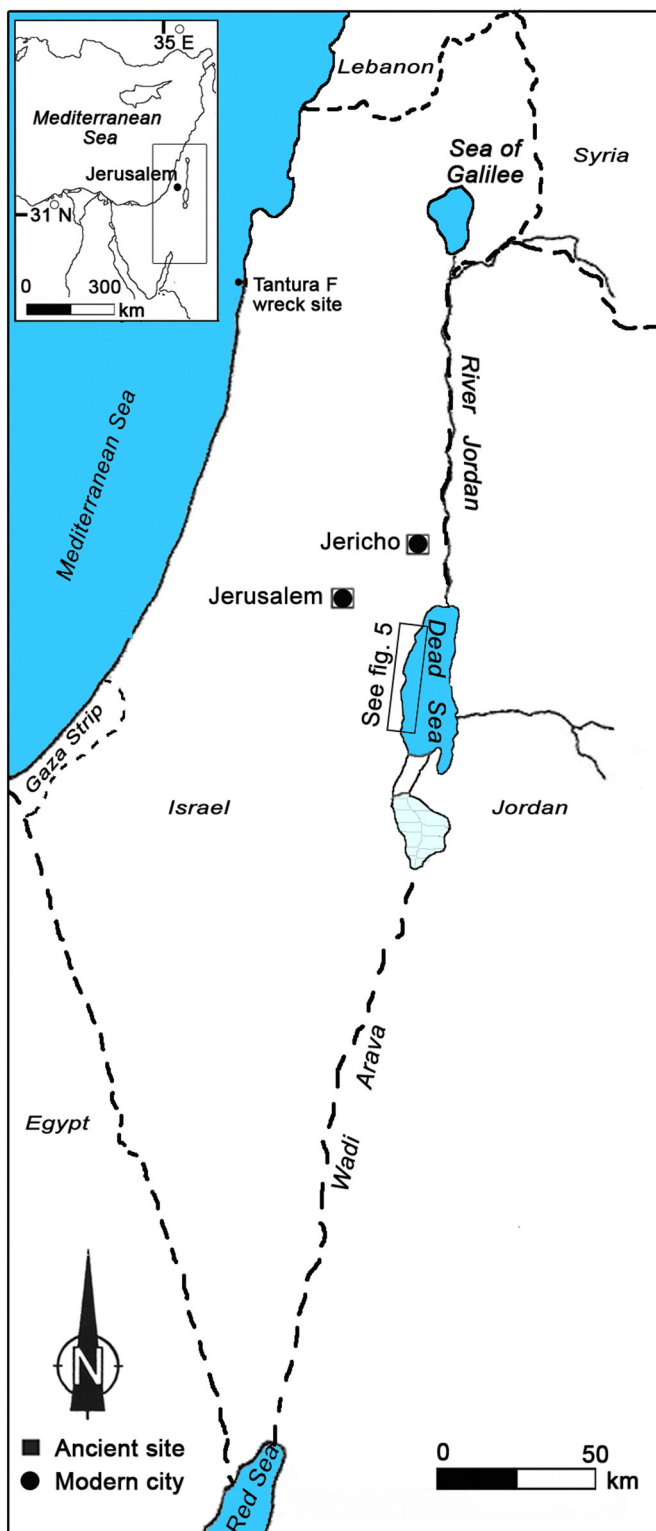


Fig. 1. Map of research area showing the eastern Mediterranean (inset) and the Dead Sea region (A. Oron).

material. This information is fundamental to the development of suitable long-term conservation methods for the lake's waterlogged wood cultural remains. For comparative purposes, waterlogged archaeological wood from the Late Byzantine Tantara F shipwreck found in the Mediterranean Sea (hereafter termed 'Tantara F') was also studied (Barkai and Kahanov, 2007; Barkai et al., 2010; Lipshitz, 2012).



Fig. 2. Composite anchors. a) Composite anchor (Anchor A, Oron et al., 2008, sample DS 8, ^{14}C dating: cal 898–1048 CE [97.9%]) made of stone, wood and rope as found still wet at the waterline. b) Composite anchor (Samar Springs anchor C, Oron et al., 2008, ^{14}C dating: cal 1032–1160 CE [100.0%]) made of stone, wood and rope as found fully dehydrated after several years of exposure (scale 20 cm, photos A. Oron).

2. Materials and methods

2.1. Study material

The rarity and intact nature of the archaeological wooden objects from the Dead Sea restricts their sampling to minute segments of wood suitable mainly for tree species analysis and density measurements. Data for the study were thus collected either in-situ directly from these objects when possible, or otherwise from readily available archaeological waterlogged driftwood found along the lake shore that could be destructively tested (Fig. 3). The latter originates from the densely forested banks of the Jordan River and from other freshwater sources around the lake (Zohary, 1962: 144–152, 165–177). Its presence in the lake is linked with powerful flash floods common to the region, and from the erosion of the soft marl banks of the Jordan River, which result in the washing of large amounts of this vegetation into the lake every year. Waterlogged objects and driftwood finds exposed by the receding shoreline are often found heavily encrusted with layers of lake minerals (Fig. 4).

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