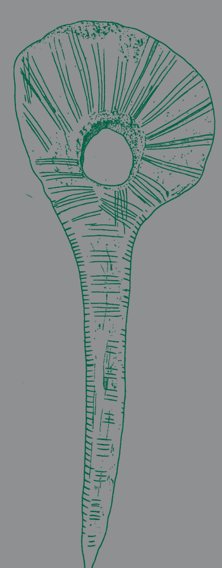
ISTITUTO ITALIANO DI PREISTORIA E PROTOSTORIA

RIVISTA DI SCIENZE PREISTORICHE

numero speciale

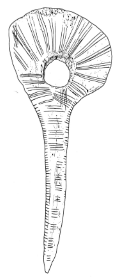
Preistoria e Protostoria della Liguria



LXXIII - S3 - 2023 - Firenze

Il volume raccoglie la rielaborazione, sottoposta a *referee*, dei testi presentati in occasione della LIII Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria, tenutasi a Genova dal 16 al 19 ottobre 2018

Istituto Italiano di Preistoria e Protostoria



Preistoria e Protostoria della Liguria

a cura di Fabio Negrino e Vincenzo Tiné

RIVISTA DI SCIENZE PREISTORICHE LXXIII - S3 - 2023 - Firenze

Il volume raccoglie la rielaborazione, sottoposta a *referee*, dei testi presentati in occasione della LIII Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria, tenutasi a Genova dal 16 al 19 ottobre 2018

Presidenti
Fabio Negrino, Vincenzo Tiné

Comitato Scientifico
Daniele Arobba, Maria Bernabò Brea, Angiolo Del Lucchese, Andrea De Pascale, Marco Firpo, Vincenzo Formicola, Roberto Maggi, Piera Melli, Fabio Negrino, Elena Rossoni-Notter, Vincenzo Tiné

Segreteria organizzativa
Eleonora Sessa, Ivano Rellini, Sabrina Armenio, Anna Baggetta, Mattia Burlando, Alessandra Coleschi, Chiara Dodero, Angelita Mairani, Francesca Margagliano, Alice Nicora, Aurora Nigro, Michela Olivari, Martina Parise, Elisa Triolo

Con il contributo di
Fondazione De Mari
Università degli Studi di Genova
Rotary Club di Albenga
Rotary Club di Imperia
Università di Montreal
Istituto Internazionale di Studi Liguri

Redazione
Daniela Puzio

Link alle brevi note:
https://www.openprehistory.org/wp-content/uploads/2023/07/Preistoria-e-Protostoria-della-Liguria-BREVI-NOTE.pdf

Soprintendenza Archeologia Belle Arti e Paesaggio
per la città metropolitana di Genova
e le province di Imperia, La Spezia e Savona

Con il contributo di

Associato
all'Unione Stampa

ISBN 978-88-6045-101-9

c/o Museo Archeologico Nazionale di Firenze
Via della Pergola, 65, 50121 Firenze
www.iipp.it, email: iipp@iipp.it – segreteria@iipp.it

Presentazione

Il terzo numero speciale della Rivista di Scienze Preistoriche, "*Preistoria e Protostoria della Liguria*", edito a cura di Fabio Negrino e Vincenzo Tiné, pubblica i contributi presentati nel corso della LIII Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria, svoltasi dal 16 al 20 ottobre 2018 in collaborazione con la Soprintendenza Archeologia Belle Arti e Paesaggio per la città metropolitana di Genova e le province di Imperia, La Spezia e Savona e l'Università di Genova e tenutasi presso la Sala Conferenze della Biblioteca Nazionale Universitaria.

Il volume presenta, a cinquant'anni di distanza dalla XVI Riunione Scientifica dell'IIPP, un nuovo quadro, aggiornato e compiuto, delle conoscenze sulla preistoria e la protostoria della regione ed è arricchito dagli esiti più significativi delle ricerche condotte nei territori limitrofi: Départment des Alpes-Maritimes, Piemonte meridionale, Appennino emiliano, Lunigiana e Garfagnana.

Introdotto da una parte generale – fondamentale – dedicata a cinque relazioni cronologicamente articolate dal Paleolitico all'Età del Ferro, il volume si sviluppa poi in quattro sezioni tematiche dedicate a: *Siti, materiali, produzioni, relazioni e scambi; Ambiente, risorse, paesaggio, popolazione; Arte, pratiche rituali e funerarie; Storia delle ricerche.*

Tale suddivisione rispecchia l'articolazione in sessioni decisa dal Comitato Scientifico della Riunione – composto da Daniele Arobba, Maria Bernabò Brea, Angiolo Del Lucchese, Andrea De Pascale, Marco Firpo, Vincenzo Formicola, Roberto Maggi, Piera Melli, Fabio Negrino, Elena Rossoni Notter e Vincenzo Tiné – grazie alla quale gli esiti degli studi più recenti si affiancano all'edizione critica degli scavi condotti in regione negli ultimi cinquant'anni, senza tralasciare l'apporto fondamentale che gli studiosi diedero a partire dal XIX secolo per la conoscenza della preistoria e protostoria della Liguria.

Particolare importanza rivestono, poi, i contributi interdisciplinari, frutto delle ricerche condotte da teams di ricerca internazionali, incentrati sui più importanti contesti pre-protostorici della Liguria.

La ricaduta di interesse è vasta, i temi affrontati molteplici, la consapevolezza di quanto fosse attesa quest'opera innegabile.

Ne è prova l'attenzione che le è stata rivolta da Enti, Associazioni e Istituzioni nazionali e internazionali, che si ringraziano per la loro liberalità nell'aver contribuito alla realizzazione della Riunione Scientifica e alla pubblicazione di questo volume: Regione Liguria, Soprintendenza Archeologia, Belle Arti e Paesaggio della Liguria, Fondazione De Mari, Istituto Internazionale di Studi Liguri, Rotary Club di Imperia, Rotary Club di Albenga, Università di Genova e Università di Montreal.

Monica Miari
Presidente dell'Istituto Italiano di Preistoria e Protostoria

Rivista di Scienze Preistoriche - LXXIII S3 - 2023
Preistoria e Protostoria della Liguria - pp. 5-6

Presentazione

Questo volume raccoglie buona parte dei contributi presentati nel corso della LIII Riunione Scientifica dell'Istituto Italiano di Preistoria e Protostoria, dedicata alla "Preistoria e alla Protostoria della Liguria" e tenutasi a Genova tra il 16 e il 19 ottobre 2018, nella sala conferenze della Biblioteca Universitaria di Genova.

A distanza di cinquant'anni dalla precedente Riunione Scientifica ligure, svoltasi tra il 3 e il 5 novembre 1973, si è tornati a delineare una sintesi delle numerose attività di indagine e di studio che hanno coinvolto i siti di questa regione, inquadrandoli in un contesto di conoscenze aggiornato, sia sul piano della metodologia, sia su quello dei paradigmi interpretativi. Ai lavori congressuali hanno partecipato oltre duecento ricercatori, italiani e stranieri, afferenti a università, soprintendenze, musei e altri enti di ricerca. Lo spettro dei dati presentati ha compreso tutto l'arco temporale della preistoria e della protostoria liguri, dal Paleolitico all'età del Ferro, conseguente ad analisi di siti e contesti ma anche a nuovi studi ambientali, antropologici, economici, ideologici e inerenti alla storia delle ricerche. Alla classica serie delle relazioni introduttive, che, nella tradizione delle riunioni scientifiche dell'I.I.P.P. hanno sintetizzato e aggiornato i dati regionali per ambiti cronologici, hanno fatto seguito le sezioni dedicate a "Siti, materiali, produzioni, relazioni e scambi", "Ambiente, risorse, paesaggio, popolazione", "Arte, pratiche rituali e funerarie" e "Storia delle ricerche".

In margine al convegno è stata organizzata una mostra fotografica dedicata agli scavi al Riparo Bombrini e all'Arma Veirana, realizzata dal Gruppo Fotografico DLF Genova. Sabato 20 ottobre si sono svolte le escursioni sul territorio, mirate alla visita di musei e siti del Toiranese, del Finalese e del comprensorio tra Tigullio e Alta Val di Vara.

Il presente volume di atti, di oltre mille pagine e comprensivo di ben 75 contributi, esce cinque anni dopo lo svolgimento della relativa Riunione Scientifica. La stesura dei lavori da parte degli autori, i doppi referaggi e le revisioni della redazione sono stati rallentati dagli anni difficili della pandemia, che hanno colpito duramente anche il mondo della ricerca e della tutela. Rappresenta quindi un traguardo importante non solo per la Liguria e il suo retaggio storico-archeologico ma anche per tutte le persone che hanno creduto e investito in questo progetto, nato in seno all'Istituto ma sviluppato grazie a una proficua sinergia tra Soprintendenza della Liguria e Università di Genova ovvero tra le rappresentanze locali di due Ministeri che sono parte di uno stesso Stato ma non sempre agiscono in perfetta armonia nella gestione del patrimonio. L'incredibile e pluristratificata burocrazia che governa nel nostro paese il regime delle cc.dd. "concessioni di scavo" è l'indice macroscopico di questa difficoltà ad operare insieme per il raggiungimento dello stesso obiettivo di conoscenza e protezione. Qualcosa di superfluo in Liguria, per fortuna, grazie ad una tradizione di stretta interdipendenza Università/Soprintendenza, tradotta in tante imprese comuni nel campo della ricerca e della museografia, anche e soprattutto in questi primi anni delle nuove Soprintendenze unificate, quando la salvaguardia dell'identità professionale dell'archeologica pubblica è divenuta prioritaria, aldilà dell'appartenenza organica a questo o a quell'ente.

Oltre che una chiara testimonianza dell'importante attività scientifica svolta negli ultimi cinquant'anni nella nostra regione, questo volume è, quindi, anche l'esempio di una collaborazione propriamente sinergica per non dire proprio amichevole e di stretta colleganza tra enti e persone, espressione di un condiviso interesse per lo studio, la conservazione e comunicazione/valorizzazione di beni culturali unici e imprescindibili per una corretta comprensione della nostra storia più antica, la più lunga ma anche la più difficile da indagare.

Il congresso e la pubblicazione di questo volume sono stati possibili grazie al sostegno della Regione Liguria, della Fondazione De Mari di Savona, dell'Istituto Internazionale di Studi Liguri, dei Rotary Club di Albenga e Imperia, delle Università di Montreal e di Genova, della Soprintendenza Archeologia, Belle arti e Paesaggio della Liguria. Un particolare ringraziamento va alla Biblioteca Universitaria, organo del Ministero della Cultura, che ci ha ospitati nel 2018 e a tutti gli studenti dell'Università di Genova che ci hanno aiutato nella complessa gestione della segreteria del Convegno e della redazione degli Atti, a quanti hanno partecipato ai lavori in presenza e a coloro che, sfogliando le pagine di questo libro, sapranno trarne spunti e idee affinché la conoscenza sul nostro più antico passato, faticosamente acquisita, porti i suoi frutti nella società e nella cultura di oggi.

Fabio Negrino
Dipartimento di Antichità, Filosofia, Storia – Università di Genova

Vincenzo Tiné
Soprintendenza Archeologia, Belle Arti e Paesaggio della Liguria

Dedicato a tutti i maestri che ci insegnarono con entusiasmo
ad indagare e interpretare le più antiche, le più difficili
e recondite testimonianze della storia.

In memoria di Amilcare Bietti e Anna Maria Bietti Sestieri.

Comunicazioni

Sessione 3

Ambiente, risorse, paesaggio, popolazione

Rivista di Scienze Preistoriche - LXXIII S3 - 2023
Preistoria e Protostoria della Liguria - pp. 385-406

RIVISTA DI SCIENZE PREISTORICHE

https://www.openprehistory.org/categoria-prodotto/numeri-speciali/

Nicholas Branch[(1)], Carlo Montanari[(2)], Michael Simmonds[(1)], Roberto Maggi[(3)], Fabio Negrino[(4)], Thomas Hoyle[(5)]

Towards an improved understanding of the Late Pleistocene and Early Holocene eco-climatic context of human activities in the Northern Apennines, Italy

(1) Department of Geography and Environmental Science, Whiteknights, University of Reading, Reading, RG6 6AH, UK.
(2) Department of Earth, Environment and Life Sciences (DISTAV), University of Genova, Corso Europa 26, 16132, Genova, Italy.
(3) già Soprintendenza Archeologica della Liguria. CIR-LASA (Laboratorio di Archeologia e Storia Ambientale), Università di Genova, via Balbi 6, 16126 Genova.
(4) Department of Antiquities, Philosophy, History, University of Genova, Via Balbi 2, 16126, Genova, Italy.
(5) ArcStrata, Basingstoke, RG24, UK.

Parole chiave: Italia nord-occidentale, Pleistocene superiore, Olocene, analisi palinologica, stratigrafia di eventi

Keywords: North-western Italy, Late Pleistocene, Holocene, pollen analysis, event stratigraphy

Abstract - Towards an improved understanding of the Late Pleistocene and Early Holocene eco-climatic context of human activities in the Northern Apennines, Italy - Two well-dated palaeoenvironmental records from Liguria in the northern Apennines (NW Italy) were used to reconstruct the timing and nature of sedimentary changes and vegetation succession during the upper Late Pleistocene and Early Holocene. The results from Pian del Lago and Rovegno have provided clear signals for multiple abrupt climatic events: Interstadials at *~43,440-41,950* cal. BP, *~37,130-36,650* cal. BP, *~36,050-35,160* cal. BP, *~33,860-32,650 cal*. BP, *~26,880-26,400* cal. BP, *~23,030 to 22,800* cal. BP, *~14,660-12,480* cal. BP (Lateglacial Interstadial); Stadials at *~22,540-19,300* cal. BP, *~19,300-17,480* cal. BP, *~17,480-14,660* cal. BP and *~12,480-11,560* cal. BP (Lateglacial Stadial - 'Younger Dryas' chronozone). The presence of these events suggests that the northern Apennines were probably sensitive to many of the extreme climate events recorded in other parts of Europe and the Mediterranean. The data have provided important new information on the climatic and environmental context of human activities in the Italian Maritime Alps and northern Apennines especially at the transition between the Middle to Upper Palaeolithic, and during subsequent socio-economic and cultural developments during the Late Mousterian, Proto-Aurignacian, Aurignacian, Gravettian, Epigravettian, Mesolithic and Early Neolithic.

Introduction

Despite the growing body of high-quality palaeoenvironmental data for the northern Apennines (NW Italy) (e.g. Braggio Morucchio and Guido 1975; Braggio Morucchio-Guido-Montanari 1978; Gentile *et alii* 1988; Cruise 1990a, b; Braggio-Guido-Montanari 1991; Lowe 1992; Bertolani-Marchetti *et alii* 1994; Lowe-Branch-Watson 1994; Lowe *et alii* 1994; Watson 1996; Guido *et alii* 2003, 2004a, b, c, 2013, 2020; Branch, 2004, 2013; Bertoldi *et alii* 2007; Bellini *et alii* 2009; Bellini - Mariotti-Lippi - Montanari 2009; Cruise *et alii* 2009; Guido-Molinari-Montanari 2009; Vescovi-Ammann-Ravazzi 2010; Vescovi-Petra Kaltenrieder-Tinner 2010; Branch and Marini 2013; Branch *et alii* 2014) there is a paucity of records spanning the upper Late Pleistocene and Early Holocene (~45,000-7000 cal. BP). The scarcity of sites with sedimentary records spanning this period can be attributed to several factors: (1) the intensity of field survey, detection of sites with long sedimentary records, and challenges of sampling sites in remote mountainous locations that require mechanised coring methods; (2) hiatuses in sedimentary records perhaps due to periods of aridity or erosion; (3) localised geomorphological or hydrological characteristics preventing sedimentation in topographic depressions; (4) sensitivity of the northern Apennines to abrupt climate change during the Würm glaciation, especially the influence of Atlantic storm tracks (Renssen and Isarin 2001; Moreno *et alii* 2014).

Here we present a comparison and discussion of the pollen-stratigraphical and sedimentary results from two unique upper Late Pleistocene and Early Holocene sequences in the northern Apennines: a new record from Pian del Lago (from *~43,400* cal. BP; see Guido *et alii* 2020), and an updated record from Rovegno (from *~22,540* cal. BP; see Branch 2004). At the present day, these sites are located in very different eco-climatic zones in Liguria despite being at a similar elevation: Pian del Lago, Mediterranean mountain coastal area; Rovegno, continental mountain area but ameliorated by Mediterranean effects.

The improved dataset from Pian del Lago and Rovegno provided an opportunity to assess spatial and temporal variations in vegetation succession at an intra-regional level, and contribute to current debates about vegetation change in south-western Europe as a response to known periods of abrupt climate change (e.g. Cacho *et alii* 2001; Rasmussen *et alii* 2014). It also permitted an evaluation of the relationships between environmental change and cultural and socio-economic developments during the Late Middle Palaeolithic, Upper Palaeolithic, Mesolithic and Early Neolithic in NW Italy, especially the response of human groups in the northern Apennines to climate change for which there is very little information (Badino *et alii* 2019).

Study sites

Pian del Lago (44° 19' 17" N, 9° 29' 08" E; also known as Lago di Bargone) is located near the village of Bargone, Casarza Ligure, at around 830 m and less than 3 km away from the coast (fig. 1). The site is a small mire basin, approximately 150 m in length (longest axis) and 125 m in width with no inflow or outflow. The catchment area is about 0.035 km^2. The watershed ridge, marking the boundary of the catchment, reaches fairly high altitudes, considering the proximity of the sea: Mount Roccagrande (971 m) and M. Tregin on the western side, the M. Alpe (1093 m), M. Zenone (1055 m), and M. Pu (1001 m) on the eastern side. The mountains are mainly ophiolitic with radiolarite (with veins of manganese). The origin of the basin was originally attributed to periglacial phenomena, which would be consistent with other northern Apennine wetlands. However, Faccini, Piccazzo, Robbiano (2009) instead recognized deep gravitational slope deformations (DSGSD), which is a geomorphological feature characterising other Ligurian landscapes.

The vegetation cover is dominated by Atlantic heathland with *Erica arborea*, *Juniperus communis*, *E. herbacea*, *Calluna vulgaris*, bracken etc. and mesophilic scrubland with *Buxus sempervirens*. The area surrounding the plateau is mainly treeless, except for the local reforestation with *Pinus nigra.* At slightly lower elevations meso-thermophilic mixed forests of *Quercus cerris*, *Q. pubescens*, *Q. ilex*, *Ostrya carpinifolia*, and mainly abandoned orchards of *Castanea sativa* are widespread. The plateau hosting the small wetland is partially occupied by grassland, formerly a pastureland, invaded by a post-cultural scrubland dominated by *Buxus sempervirens* and heathland with *Erica arborea, E. carnea, Calluna vulgaris* and *Pteridium aquilinum*. The mire includes hygro-hydrophilous vegetation: sedge populations (e.g. *Carex* cf. *caespitosa*), stands of rushes (e.g. *Juncus articulatus*), *Typha latifolia* and *Molinia coerulea.*

Rovegno (44^0 34' 33" N 9^0 17' 12" E) is located at an altitude of 812 m on the eastern side of the upper Trebbia valley and near to the small town of Rovegno (fig. 1). The site is a small mire basin, approximately 75 m in length (longest axis) and 55 m in width, and with a catchment area of approximately 0.6 km^2. Two streams that drain in a northwest direction towards the Fosso del Riccio and River Trebbia dissect the basin. Southeast of the basin the topography rises to 825 m and forms the Pian di Prao, a plain that extends to approximately 875 m below the slopes of Poggio Carmine (1097 m). The geology consists of Lower Cretaceous and Upper Jurassic Ophiolitic complexes and Jasper outcrops, extensive colluvial deposits and some Palaeocene sandstones ('Casanova'). The Carta Geologica d'Italia (Foglio 83) has also mapped areas of glacial drift deposits, mainly in the area between Fontanigorda and Casanova. The present day mire vegetation is dominated by species of Poaceae, *Equisetum,* and *Ranunculus* and *Mentha aquatica*. The dryland vegetation is dominated by *Castanea sativa*, *Corylus avellana* (coppiced) and *Fagus sylvatica* (coppiced), with

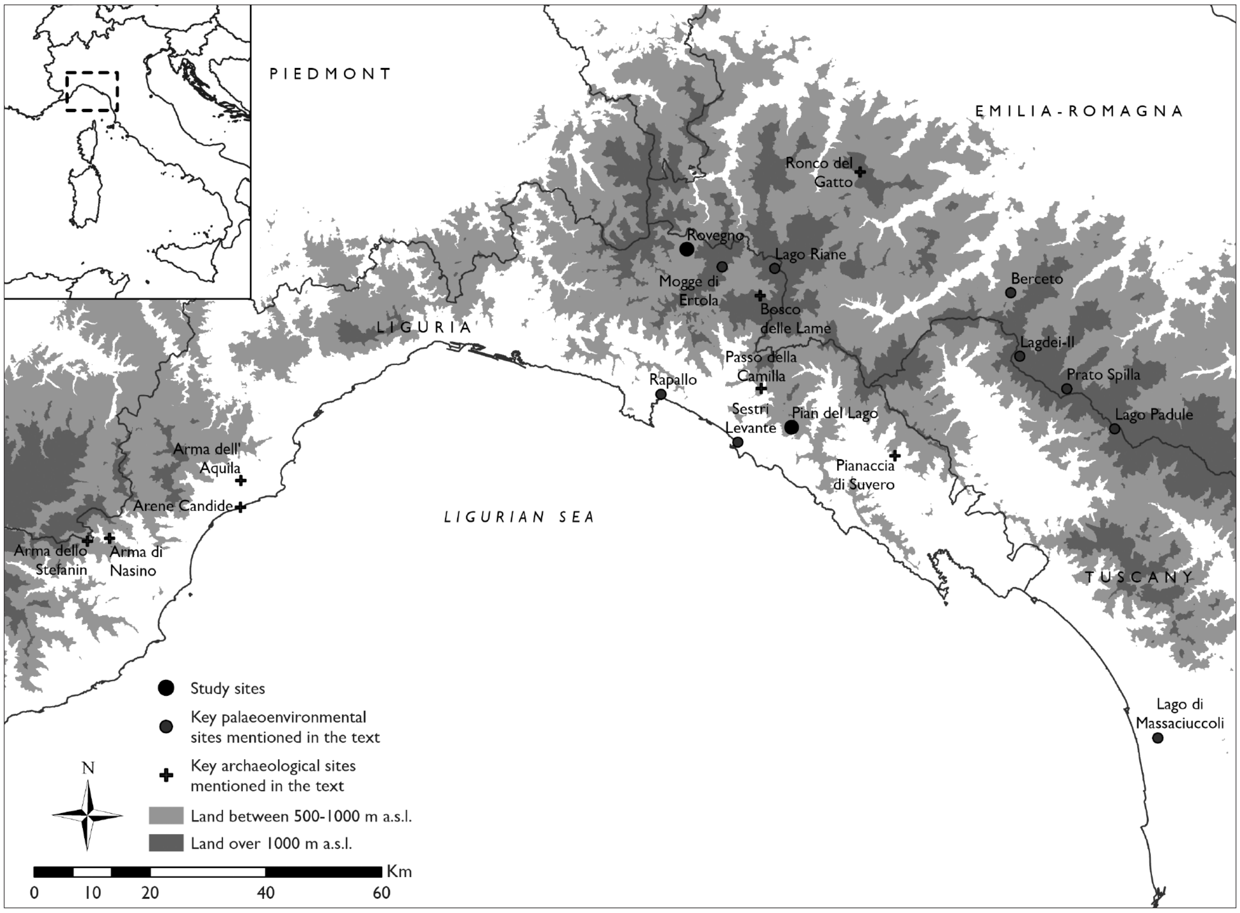


Fig. 1 - Ubicazione dei siti studiati (Pian del Lago e Rovegno), e dei siti chiave paleoambientali e archeologici dell'Appennino settentrionale e delle Alpi Marittime citati nel testo.

Location of the study sites (Pian del Lago and Rovegno), and key palaeoenvironmental and archaeological sites in the northern Apennines and Maritime Alps mentioned in the text.

Pinus sylvestris, *Quercus sp.*, *Prunus spinosa* and *Pteridium aquilinum*.

Field and laboratory methodologies

Core samples were obtained using either a rotary drilling rig (Pian del Lago - PdL) or a 'Russian' peat sampler and Stitz piston corer (Rovegno - ROV), and the physical properties, composition and humification of the sediments recorded. Sub-samples were removed from the cores for organic matter determination using the loss-on-ignition method (Bengtsson and Enell 1986). Sub-samples for pollen analysis were taken at 5 cm and 10 cm intervals from Pian del Lago but due to variable pollen preservation, not all of the sub-samples were analysed. At Rovegno, sub-samples were removed at 8 cm intervals from 400-303 cm and 100-75 cm, and at 4cm intervals from 303-100 cm. Pollen grains and spores were extracted following standard procedures involving sub-sampling ~2 cm^3 (PdL) or ~1 cm^3 (ROV) of sediment (Moore-Webb-Collinson 1991; Branch *et alii* 2005). With only some exceptions, a minimum of 300 pollen grains were counted (aquatic and fern taxa were excluded from this pollen sum). Pollen identification was completed to the lowest taxonomic level possible using reference materials and pollen atlases held at the Universities of Reading and Genova (Punt 1976; Punt and Clarke 1980, 1981, 1984; Punt-Blackmore-Clarke 1988; Punt and Blackmore 1991; Reille 1992–1998; Punt-Blackmore-Hoen 1995).

Pollen percentages were calculated, and the results plotted using TILIA and TILIA.GRAPH version 2.1.1 (Grimm 1993). Local pollen-assemblage zones (LPAZs) were identified using stratigraphically constrained cluster analysis (Grimm 1987). Micro-charcoal particles were recorded during the

Tab. I - Datazioni radiocarboniche e Uranio-Torio di Pian del Lago e Rovegno.
Results of the radiocarbon and U-series dating for Pian del Lago and Rovegno.

Lab code (dates marked * excluded from age model)	Depth (cm)	Material	δ13C (‰)	Radiocarbon age (BP)	U/Th age BP	Calibrated age range cal BP (95.4% confidence)
Pian del Lago:						
LTL3092A	100	Clay	-27.0	534 ± 45		650-500
LTL4200A	180	Peat	-27.5	3483 ± 50		3890-3630
LTL4201A	290	Peat	-25.3	8892 ± 60		10200-9770
LTL4202A	380	Silty clay	-28.1	9625 ± 75		11200-10740
U-series1	400	Diatomite			13840 ± 750	14220-13200
U-series2	432	Diatomite			21260 ± 320	21580-20930
U-series3	464	Diatomite			21550 ± 370	21920-21170
LTL12573A	471	Clay	-29.0	29917 ± 150		34310-33710
*LTL4365A	529	Clay	-27.1	32755 ± 300		37900-36060
*LTL4203B	530	Clay	-26.5	33081 ± 280		38220-36420
*LTL4203A	530	Clay	-26.3	34214 ± 500		40000-37320
LTL4204A	730	Sandy clay	-30.1	29687 ± 170		35430-34860
LTL3093A	960	Clay	-32.0	31122 ± 300		36030-34760
LTL12574A	1110	Clay	-29.9	31458 ± 200		35840-34860
LTL1536A	1281	Peat	-35.5	40844 ± 650		45560-43240
Rovegno:						
Beta-106212	116	Herbaceous peat	-28.8	4380 ± 80		5287-4835
CAMS-164199	190	Herbaceous peat	-25	5635 ± 35		6488-6318
CAMS-164200	235	Herbaceous peat	-25	11435 ± 40		13387-13163
Beta-104794	240	Herbaceous peat	-27.5	11690 ± 70		13720-13390
CAMS-164201	255	Organic lake sediment	-25	12530 ± 35		15099-14501
CAMS-164202	270	Organic clayey silt	-25	12800 ± 35		15410-15107
CAMS-164203	285	Organic clayey silt	-25	13915 ± 40		17056-16621

pollen analysis and influx (particles cm^{-2} yr^{-1}) was calculated for Pian del Lago based on a combined count of particle fractions (10-25µm, 25-125µm and >125µm). For Rovegno, only presence or absence of particles >5µm were recorded because the micro-charcoal concentrations were low.

Chronological control for the sequence was provided by a Bayesian age-depth model based on conventional AMS ^{14}C dating (Pian del Lago and Rovegno) and on Uranium series dates (Pian del Lago only; tab. I). All radiocarbon samples were prepared using standard acid-alkali-acid pre-treatment and were quoted in accordance with international standards (Stuiver and Kra 1986). The radiocarbon ages were calibrated to the calendar timescale and a Bayesian age-depth model was generated using the R package (R Core Team 2016) Bacon v.2.3.4 (Blaauw and Christen 2011) and the IntCal13 radiocarbon calibration curve (Reimer *et alii* 2013). The U-series dating procedures used at Pian del Lago have been described in Guido *et alii* (2020), and follow standard methodologies outlined in Ivanovich and Harmon (1992), Neymark and Paces (2000), Neymark-Amelin-Paces (2000), and Neymark *et alii* (2002).

Results and nterpretation: Pian Del Lago

Quercus decid. (12-43%) and *Fagus* (11-26%) with *Abies* (10-27%) and *Pinus* (10-19%) dominated PdL-1a (> *~43,400* cal. BP) (fig. 2). These were succeeded by *Pinus* and deciduous *Quercus.* The presence of mixed forest throughout the zone is indicated by the presence of *Quercus ilex, Alnus, Carpinus, Ulmus, Sor-*

bus, Tilia and Ericaceae. The local wetland was colonised by Poaceae and Cyperaceae forming a sedge-grass swamp (fig. 2). The expansion of coniferous woodland dominated by *Abies* and *Pinus* (both >40%) during PdL-1b (> *~43,400-41,940* cal. BP) was concomitant with a decline of the mesophilous broadleaved woodlands. Cyperaceae and Poaceae indicate the persistence of grass-sedge swamp, fringed by *Alnus*. Throughout this period, erosion of the surrounding landscape is indicated by the deposition of mineral-rich sediments albeit with a higher organic matter content in PdL-1b (Guido *et alii* 2020).

From *~41,940-35,470* cal. BP (PdL-2), *Pinus* (including *mugo/sylvestris*) is widely dominant (15-85%) with *Abies* (2-44%) and *Corylus*, deciduous *Quercus, Fagus, Castanea, Ulmus,* Ericaceae and *Ephedra* forming mixed woodland and shrubland (fig. 2). *Alnus* and *Salix*, together with Cyperaceae (3-32%) and Poaceae (2-29%), dominated the wetland. There is a diverse assemblage of herbaceous taxa including Asteroideae, Caryophyllaceae, *Plantago*, *Artemisia,* Chenopodiaceae, Cichorioideae and Ranunculaceae, which indicates the presence of open spaces, at least around the swamp. During PdL-3 (*~35,470-33,250* cal. BP) there was a decline in *Pinus* (45-2%) and *Abies* (2-5%) with deciduous woodland and shrubland present throughout, notably *Corylus* (10-20%), Ericaceae (5-10%), *Quercus* and *Betula* (fig. 2). There was a significantly increased proportion of herbaceous taxa, including Caryophyllaceae, Ranunculaceae, Asteroideae, *Artemisia* and Cichorioideae. The wetland continued to be dominated by Poaceae (up to 55%), Cyperaceae with *Typha, Alnus* and *Salix,* and there is clear evidence for landscape instability indicated by the deposition of gravel, Serpentinite rock and the low organic matter values (<10%) (*~34,790-34,020* cal. BP). The microscopic charred particle values (up to 13,000 / cm^{-2} / yr^{-1}) indicate that throughout PdL-2 and PdL-3 fire was possibly important in influencing vegetation succession in contrast to the preceding period.

Pinus woodland (including *mugo/sylvestris*, 10-55%) expanded during PdL-4 (*~33,250-26,880* cal. BP) together with a diverse range of other tree and shrubland taxa, including Ericaceae, *Corylus*, *Carpinus, Abies*, deciduous *Quercus, Ulmus, Betula, Juniperus, Buxus* and *Fagus* (fig. 2). Herbaceous taxa reach 57% of the pollen values and are dominated by Poaceae, Chenopodiaceae, Cichorioideae, Apiaceae, Asteroideae and *Artemisia*. The wetland continued to be dominated by Cyperaceae together with Poaceae, *Alnus* and *Salix*, and there is a further period of Serpentinite rock deposition from *~30,750-26,880* cal. BP. During PdL-5 (*~26,880-12,480* cal. BP), *Pinus* remained dominant with a diverse range of woodland taxa including *Abies, Betula, Picea*, *Quercus* decid., *Corylus*, *Alnus* and *Fagus*. *Artemisia* pollen values (10-17%) are notably higher than in previous zones together with Poaceae as well as Apiaceae, Chenopodiaceae and Asteroideae. The wetland taxa included Cyperaceae, Juncaceae, *Typha, Myriophyllum* and *Equisetum*, and the organic matter of the sediments are initially higher but progressively decline prior to and during the diatomite formation (fig. 2).

From *~12,480-11,600* cal. BP (PdL-6a), *Pinus* (*mugo/sylvestris*) dominated with a decline in both *Abies* and *Picea* (fig. 2). Other tree and shrub taxa include *Betula, Fraxinus, Ephedra* and *Juniperus*. There was an increase in *Artemisia* (up to 25%) together with Poaceae, Chenopodiaceae (6%), Apiaceae and Asteroideae. On the wetland, Cyperaceae and Juncaceae dominate with *Alnus* and *Salix*. The transition to the Early Holocene during PdL-6b (*~11,600-10,760* cal. BP) was characterised by a significant increase in *Abies* and deciduous *Quercus*, and a corresponding decline in *Pinus*. Mixed woodland and shrubland comprised *Betula*, *Picea, Castanea, Fraxinus* and *Juniperus*. Although there was a slight decline in *Artemisia*, Chenopodiaceae and Asteroideae, there continued to be a diverse range of taxa including Poaceae, *Plantago* and Apiaceae. The wetland included *Salix* and *Alnus* with Cyperaceae, Juncaceae and *Typha*. During PdL-6c (*~10,760-9550* cal. BP) *Pinus* (*mugo/sylvestris,* 20-30%), *Abies* (20-25%) and deciduous *Quercus* (5-15%) dominated together with *Betula*, *Corylus, Fraxinus* and *Tilia*. Herbaceous taxa were mainly composed of Poaceae, *Artemisia* (still up to 15%), Chenopodiaceae and Apiaceae. The wetland continued to comprise *Alnus, Salix*, Cyperaceae and *Typha*. Throughout zones PdL-5 and PdL-6, mineral-rich fine-grained sediments were deposited (clay and silt) interrupted only by the formation

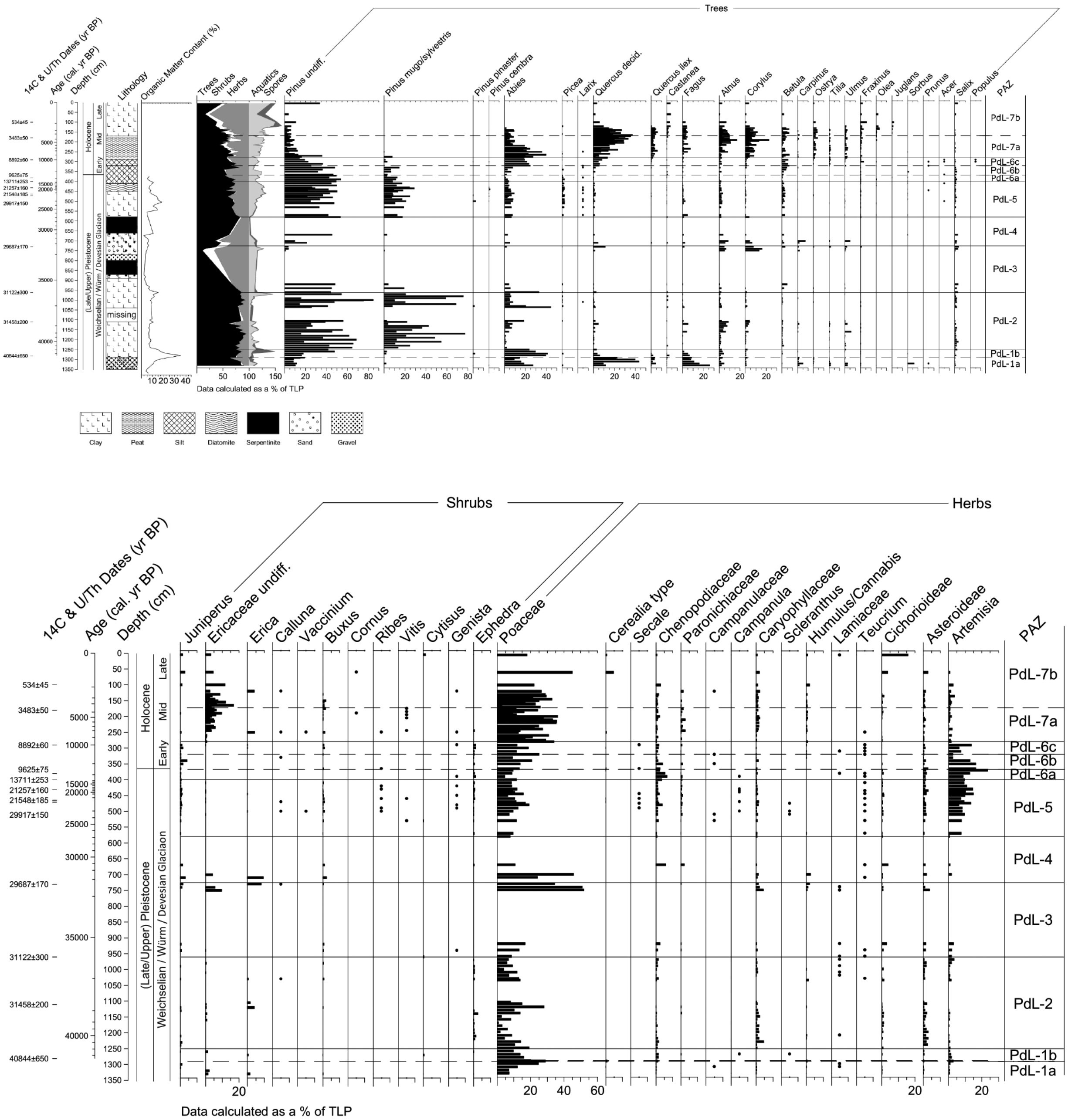


Fig. 2 - Cronologia assoluta, litostratografia, materia organica (%), diagramma palinologico e microcarboni (particelle cm^{-2} yr^{-1}) di Pian del Lago (continua nella pagina seguente).

The radiocarbon and U-series age model, lithostratigraphy, organic matter (%), pollen data (pollen sum = % TLP) and microcharcoal data (particles cm^{-2} yr^{-1}) for Pian del Lago (follows in the next page).

of diatomite from *~21,850-14,360* cal. BP (fig. 2). Microscopic charred particle values are once again higher during this period, which suggests that towards the end of the late glacial period and at the transition to the Early Holocene the frequency, and possibly the magnitude, of fire events increased.

PdL-7a and -7b (*~9550-3205* cal. BP and *~3205-0* cal. BP) span the remaining part of the Holocene (fig. 2). The Middle and Late Holocene part of the sequence has already been studied in detail (Cruise *et alii* 2009) and will not be rehearsed here, and the findings of Guido *et alii* (2020) confirm that prior to *~6000* cal. BP (Early Holocene) *Abies* (up to 45%) replaced *Pinus* as the dominant tree, whilst deciduous

Fig. 2 - Cronologia assoluta, litostratografia, materia organica (%), diagramma palinologico e microcarboni (particelle cm^{-2} yr^{-1}) di Pian del Lago (continua nella pagina seguente).

The radiocarbon and U-series age model, lithostratigraphy, organic matter (%), pollen data (pollen sum = % TLP) and microcharcoal data (particles cm^{-2} yr^{-1}) for Pian del Lago (follows in the next page).

Quercus (up to 40%), *Corylus* (up to 20%), *Betula, Ulmus, Ostrya* and *Tilia* formed mixed temperate woodland; *Quercus ilex* significantly reappears. During this prolonged period, peat formation occurred until *~3205* cal. BP when there is evidence for a renewal of landscape erosion possibly due to an intensification of human activity. Microscopic charred particle values are high throughout this period, which suggests that sustained human burning of the vegetation cover was having an impact on the environment leading to the formation of a culturally maintained landscape.

RESULTS AND INTERPRETATION: ROVEGNO

The radiocarbon ages of 13,915 ±40 BP (285 cm; ROV-2) and 12,800 ±35 BP (270 cm; ROV-3) indicate that ROV-1 and ROV-2 may span the period *~22,540-15,400* cal. BP (fig. 3). Open *Pinus* woodland declined (20% down to 3%) after *~19,700* cal. BP (transition to ROV-2) and was replaced by herb-rich grassland and increasingly *Juniperus* shrubland (3%). Tall and short herb communities are represented by pollen taxa including *Ranunculus* type (45-58%), *Artemisia* (19-26%), Chenopodiaceae (6%) and Apiaceae (2%), *Rumex*

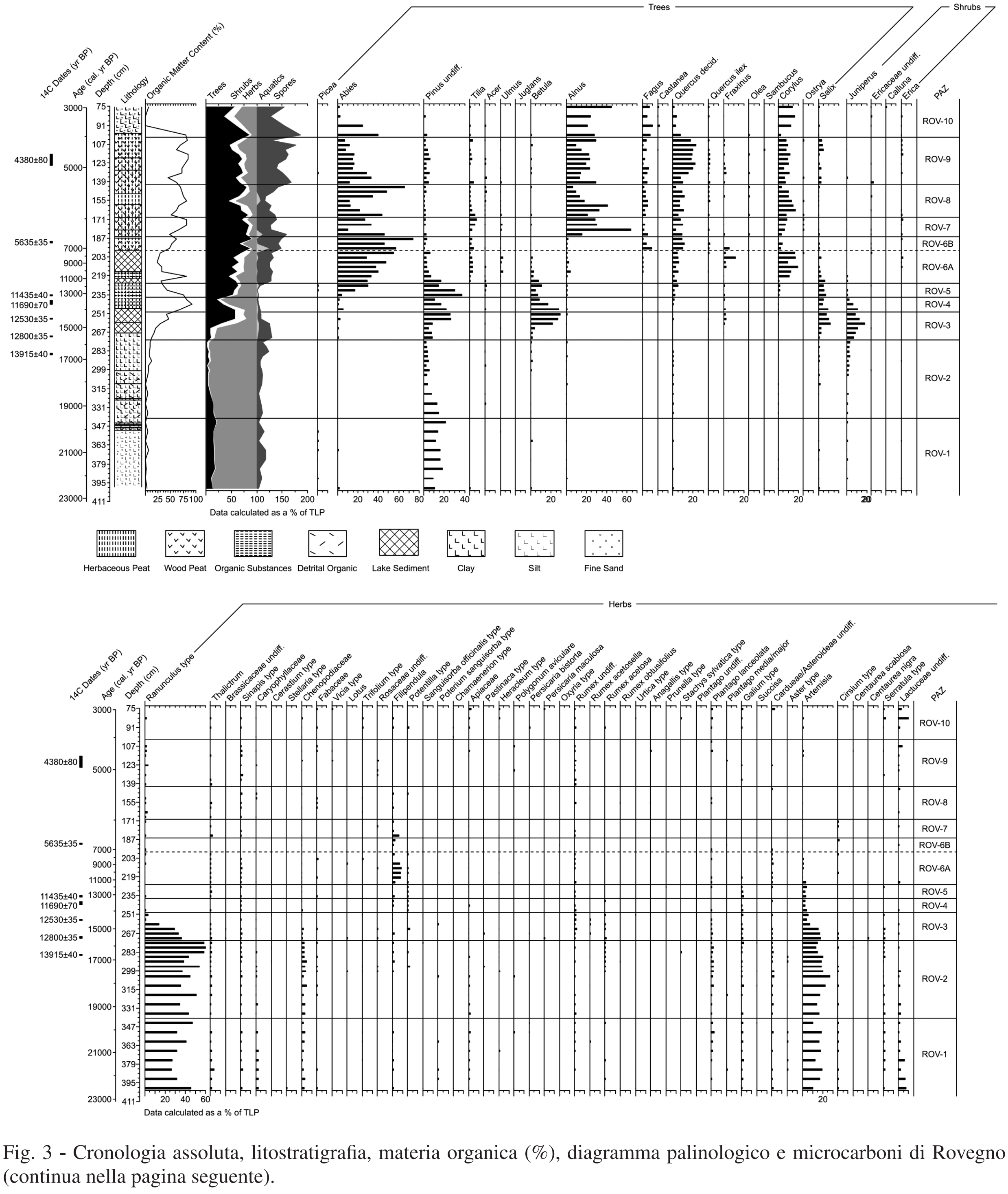


Fig. 3 - Cronologia assoluta, litostratigrafia, materia organica (%), diagramma palinologico e microcarboni di Rovegno (continua nella pagina seguente).

The radiocarbon age model, lithostratigraphy, organic matter (%), pollen data (pollen sum = % TLP) and microcharcoal data for Rovegno (follows in the next page).

(2%) and *Plantago lanceolata* (3%). This interpretation is supported by the presence of coniferous wood macrofossils (indeterminate) within the sediments, indicating the local growth of woodland. Throughout ROV-1 and ROV-2, herbaceous taxa and algal cysts of *Pediastrum* (up to 16%) indicate sediment deposition into a freshwater lake basin. This interpretation is supported by the mineral rich composition of the sediment and the low organic matter content. The assemblages indicate that the basin was fringed by marginal aquatic vegetation, such as *Caltha* and *Sparganium* type, and shallow-water aquatics, such as *Menyanthes trifoliata*. The age of the sediments and pollen

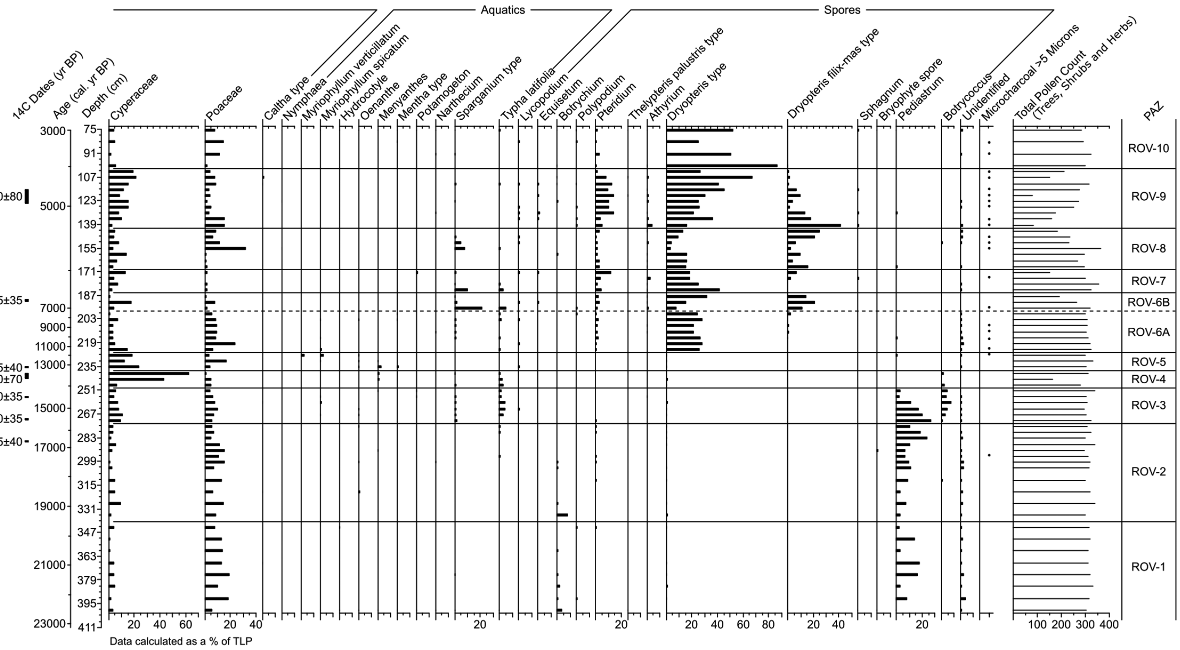


Fig. 3 - Cronologia assoluta, litostratigrafia, materia organica (%), diagramma palinologico e microcarboni di Rovegno (continua nella pagina seguente).

The radiocarbon age model, lithostratigraphy, organic matter (%), pollen data (pollen sum = % TLP) and microcharcoal data for Rovegno (follows in the next page).

data indicate colonization of steppic plant communities associated with cold and/or dry climatic conditions.

ROV-3 was marked by declining herbaceous taxa, and the expansion of pioneer *Juniperus* (16%) and *Salix* (11%) shrubland, succeeded by *Pinus* (26%) and *Betula* (28%) woodland (*~15,400-13,950* cal. BP). Together with the increasingly organic rich composition of the lake sediments, and an increase in *Botryococcus*, *Typha latifolia* and *Sparganium* type, the evidence indicates that the environment may have been responding to climatic amelioration towards the end of the last glacial period (fig. 3). The succession from *Juniperus* shrubland to *Betula* and *Pinus* woodland indicates stabilization of the landscape and the formation of increasingly closed woodland. This is supported by the declining values of herbaceous pollen taxa, such as *Artemisia* (16% down to 3%) and *Ranunculus* type (35% down to 1%).

ROV-4, spanning ~680 years (*~13,950-13,270* cal. BP), indicates a reversal in environmental conditions signified by a reduction in *Pinus* (11%) and *Betula* (8%) woodland, although the earliest stages of the *Abies* expansion occur at this time (fig. 3). The deposition of increasingly mineral-rich organic sediments, and the expansion of Cyperaceae and *Menyanthes*, suggests lowering of water levels (<50 cm) and erosion of the surrounding landscape. ROV-5, from *~13,270-11,360* cal. BP, indicates a continuation of those sedimentary changes initiated in the previous zone, denoted by declining organic matter content and a reduction in Cyperaceae (sedge-swamp), succeeded by the temporary formation of a lake. The vegetation succession is complex with evidence for a temporary expansion of *Pinus* (35%), followed by increasing pollen values of *Abies* (30%), deciduous *Quercus* and *Corylus* suggesting the formation of mixed coniferous-deciduous woodland. The zone marks the transition from the Late Würm Lateglacial to the Early Holocene.

During ROV-6A (*~11,360-6970* cal. BP), the transition to herbaceous peat formation (dominated by *Sparganium* type and *Typha latifolia*) and finally fine organic-rich lake sediment at *~10,100* cal. BP indicates a further significant hydrological change at Rovegno (fig. 3). A lithological change occurred at 219 cm (*~10,700* cal. BP) where a substantial increase in the organic matter content (81%) corresponds to the formation of well humified herbaceous peat and an increase in Poaceae. From *~6970-6300* cal. BP, the formation of wood peat (ROV-6B) signifies a major lowering of the water level and the formation of more terrestrial conditions. Variations in pollen taxa indicate fluctuations in the local vegetation communities from open, shallow water (*Myriophyllum spicatum*) to a mire community dominated by *Sparganium* type and *Typha latifolia*.

The expansion of thermophilous tree pollen taxa during ROV-6A and ROV-6B, such as *Tilia* (5%)*, Ulmus* (3%) and *Fraxinus* (2-10%), supports the age model and signifies the onset of ameliorating climatic conditions during the early postglacial (fig. 3). The colonization and succession from shrubland (dominated by *Corylus*; 16%) to woodland, dominated by *Abies* (30-75%), deciduous *Quercus* (6-11%) and *Tilia*, is consistent with other palaeoecological records from the northern Apennines (e.g. Lowe 1992; Watson 1996). The expansion of *Fagus* from *~6970* cal. BP is also notable (8%), although the percentage values suggest that it only formed a minor component of the woodland community. The presence of microscopic charred particles throughout this period may be due to natural or (Middle Neolithic) human induced burning of the vegetation cover, which may have contributed to the soil erosion at this time.

During ROV-7 to ROV-10, the mire community at Rovegno becomes fully established (*~6300-3000* cal. BP). The presence of *Alnus*, *Salix* and aquatic pollen taxa indicates the establishment of an *Alnus* carr woodland. However, there are several fluctuations in the mire vegetation, indicated by the values of Cyperaceae (2-20%) and Poaceae (1-32%), occurring at the transition between the zones. These suggest the onset of wetter conditions on the mire surface. This interpretation is supported by a reduction in organic matter values at *~6300, ~5930, ~5200* and *~3650* cal. BP, indicating the deposition of mineral-rich sediments (colluvium) derived from erosion of the surrounding slopes (fig. 3). During this period, deciduous *Quercus* (5-25%) and *Abies* (8-66%) formed mixed woodland. However, the history of *Abies* was punctuated by periods of decline delineated by the zone boundaries and, as noted above, by erosional events. Arguably, these changes in woodland structure may reflect the impact of human activity from the Late Neolithic onwards.

Discussion

Upper Late Pleistocene (~>43,000-11,700 cal. BP)

The upper Late Pleistocene is recognised in a range of global palaeoclimatic archives as a period of major variations in temperature and precipitation as a result of changes in atmospheric and oceanic circulation (Rasmussen *et alii* 2014). At Pian del Lago and Rovegno, the series of sedimentary and vegetation changes recorded are therefore believed to be related to periods of abrupt climate change during this period, characterised by relatively mild (interstadial) climatic conditions, in contrast to intervening colder climate (stadial) (Moreno *et alii* 2014). We believe that they can be correlated with several of the well-recorded climatic fluctuations known as Dansgaard-Oeschger (D–O) events (Dansgaard *et alii* 1982; Rasmussen *et alii* 2014) (fig. 4 and 5). Pian del Lago has already been discussed in detail by Guido *et alii* (2020) and the event stratigraphy proposed is primarily based upon correlation with key Mediterranean marine records (e.g. Cacho *et alii* 2001), and Greenland ice core data (Rasmussen *et alii* 2014). Comparison of the findings from Pian del Lago with Rovegno permits us to enhance the event stratigraphy proposed by Guido *et alii*, and provides an opportunity for comparison with palaeovegetation records across the northern Apennines, and evaluation of the impact of periods of climate and environmental change on human communities.

The presence of six interstadial events (tab. II) at Pian del Lago prior to the onset of sedimentation at Rovegno (*~22,540* cal. BP) and all other sites in the northern Apennines with the exception of Berceto (Bertoldi *et alii* 2007) highlights the significance of this site for our understanding of past climate change and vegetation succession (Guido *et alii* 2020). The identification of NAI-7 (*~43,440-41,950* cal. BP), NAI-6 (*~37,130-36,650* cal. BP), NAI-5 (*~36,050-35,160* cal. BP), NAI-4 (*~33,860-32,650* cal. BP), NAI-3 (*~26,880-26,440* cal. BP) and NAI-2 (*~23,030-22,800* cal. BP) was based on the expansion of warmth-loving taxa (interstadial), and in some instances a decline in taxa indicative of colder climatic conditions (stadial) (fig. 4). Significantly, the diversity and dominance of taxa varied between interstadials at Pian del Lago, and there were clear spatial and temporal differences with

Tab. II - Event stratigraphy dell'Appennino settentrionale.
Event stratigraphy for the northern Apennines.

Pian del Lago local pollen assemblage zone (LPAZ) (Guido *et alii* 2020)	**Rovegno local pollen assemblage zone (LPAZ)**	**Event stratigraphy - northern Apennines (Guido *et alii* 2020)**	**Updated event stratigraphy - northern Apennines (this study)**	**INTIMATE event stratigraphy (Rasmussen *et alii* 2014)**
PdL-6b *~11,600-10,760* cal. BP	ROV-6A *~11,360-6970* cal. BP	Start of Holocene	Start of Holocene	Start of Holocene
PdL-6a *~12,480-11,600* cal. BP	ROV-5 *~13,270-11,360* cal. BP	NAS-1 *~12,480-11,560* cal. BP	NAS-1 *~12,480-11,560* cal. BP	GS-1 *~12,896-11,703* a b2k
PdL-5 *~26,880-12,480* cal. BP	ROV-4 *~13,950-13,270* cal. BP	NAI-1 *~14,360-12,480* cal. BP	NAI-1 *~14,660-12,480* cal. BP	GI-1 (1a-1e) *~14,692-13,099* a b2K
	ROV-3 *~15,400-13,950* cal. BP		NAS-2 *~17,480-14,660* cal. BP	GS-2.1a *~17,480-14,692* a b2k
	ROV-2 *~19,300-15,400* cal. BP		NAS-3 *~19,300-17,480* cal. BP	GS-2.1b ~20,900-17,480 a b2k
	ROV-1 *~22,540-19,300* cal. BP		NAS-4 *~22,540-19,300* cal. BP	GS-2.1c ~22,900-20,900 a b2k
		NAI-2 *~23,030-22,800* cal. BP	NAI-2 *~23,030-22,800* cal. BP	GI-2.1 *~23,020-22,900* a b2k
		NAI-3 *~26,880-26,400* cal. BP	NAI-3 *~26,880-26,400* cal. BP	No event
PdL-3 *~35,470-33,250* cal. BP		NAI-4 *~33,860-32,650* cal. BP	NAI-4 *~33,860-32,650* cal. BP	GI-6 (*~33,740-33,360*) and GI-5 *~32,500-32,040* (5.2) and *~30,840-30,600* (5.1) a b2k
PdL-2 *~41,950-35,470* cal. BP		NAI-5 *~36,050-35,160* cal. BP	NAI-5 *~36,050-35,160* cal. BP	GI-7 *~35,480-34,880* a b2k
		NAI-6 *~37,130-36,650* cal. BP	NAI-6 *~37,130-36,650* cal. BP	GI-8 *~38,220-36,580* a b2k
PdL-1b *~43,440-41,950* cal. BP		NAI-7 *~43,440-41,950* cal. BP	NAI-7 *~43,440-41,950* cal. BP	GI-11 *~43,340-42,240* a b2k

sites in south-western Europe (e.g. Follieri-Magri-Sadori 1988, 1990; Follieri *et alii* 1998; Allen-Watts-Huntley 2000; Gianotti *et alii* 2015). This may be due to several factors especially climatic variations between interstadials (temperature, precipitation and humidity), elevation, proximity to the coast and temperature gradients depending upon latitude.

The onset of sedimentation at Pian del Lago from >*~43,400* cal. BP occurs shortly after an important transition in European prehistory that commenced ~45,000 years ago: the beginning of the Upper Palaeolithic (Hublin *et alii* 2020). Characterised by evidence for dramatic social and cultural developments, along with the spread of Anatomically Modern Humans (AMH) in Europe and the demise of Neanderthals (Higham *et alii* 2014; Hublin 2014). NAI-7 (*~43,440-41,950* cal. BP; PdL-1b) can be correlated with GI-11 (*~43,340-42,240* a b2k), and is considered, together with GI-12 (*~46,860-44,280* a b2k), to have been one of the warmest periods of the upper Late Pleistocene (fig. 4; tab. II). According to Zilhão (2014), "It is probably not a coincidence that the transition to the UP [Upper Palaeolithic] began in western Eurasia exactly at this time" (p. 1757). However, the persistence of late Middle Palaeolithic Neanderthal occupation in the northern Apennines is indicated by radiocarbon dates from archaeological sites suggesting that Liguria

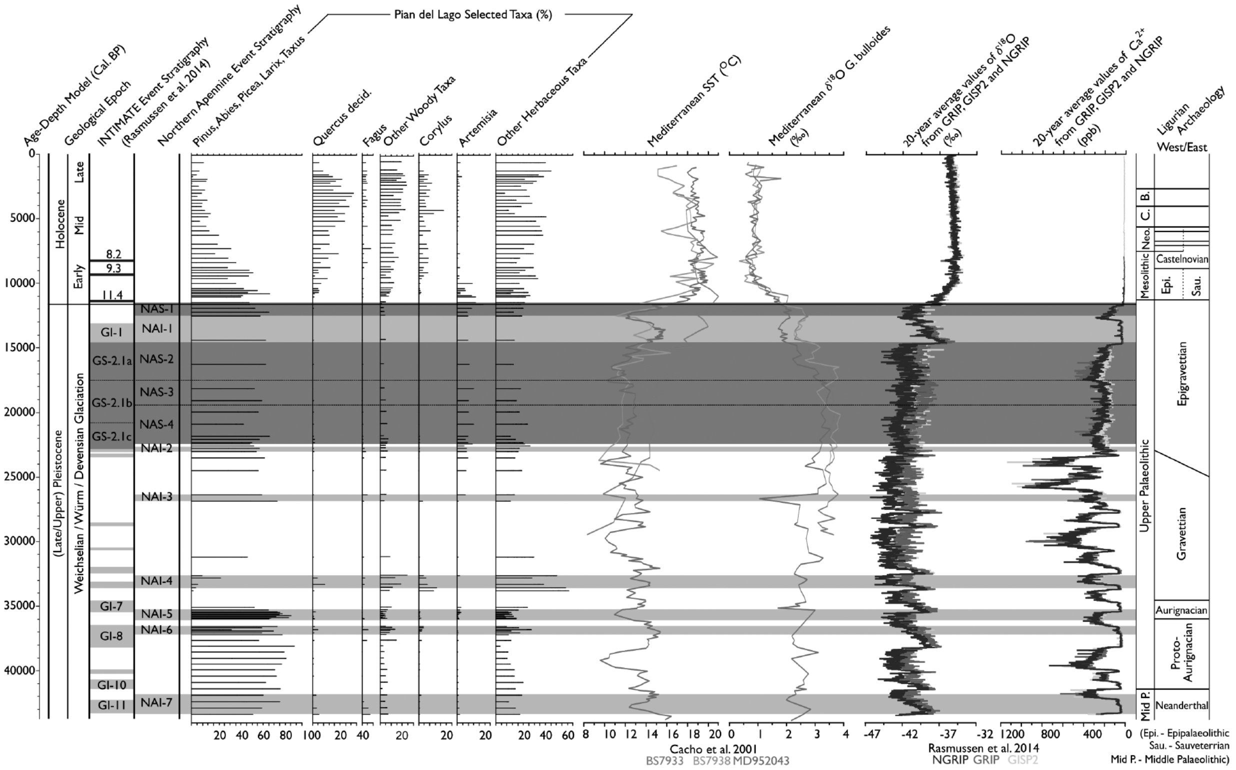


Fig. 4 - Correlazione della serie paleoambientale di Pian del Lago con la event stratigraphy INTIMATE (Rasmussen *et alii* 2014), la serie marina del Mediterraneo (Cacho *et alii* 2001) e lo schema sintetico della successione culturale in Liguria (da Guido *et alii* 2020 modificato).

Correlation of the Pian del Lago palaeoenvironmental record with the INTIMATE event stratigraphy (Rasmussen et alii *2014), Mediterranean marine records (Cacho* et alii *2001), and archaeological scheme for Liguria (adapted from Guido* et alii *2020).*

was a refugium (Higham *et alii* 2014; Negrino and Riel-Salvatore 2018). Alongside well stratified sites located in western Liguria, Mousterian lithic artefacts from different open air sites are well documented including those in eastern Liguria around Pian del Lago (Vicino 1983) and in the Vara Valley (Negrino 2002), and from Ronco del Gatto in the Emilian Apennines (Negrino *et alii* 2017). The precise chronological relationship with the palaeoenvironmental findings from Pian del Lago remain uncertain however.

Upper Palaeolithic archaeological sites in Italy spanning the Proto-Aurignacian (~41,500-36,000 cal. BP) and Aurignacian (~36,000-34,000 cal. BP) are few in number (Marciani *et alii* 2019), and are very rare in the Italian Maritime Alps and northern Apennines (Douka *et alii* 2012; Falcucci *et alii* 2017; Negrino and Riel-Salvatore 2018). During this period, the Campanian Ignimbrite super-eruption at ~39,300 years ago in Naples led to climate cooling and a cessation in human occupation in many parts of Europe and Asia (Marti *et alii* 2016). The so called 'volcanic winter' caused a reduction in temperatures by ~6-9^{0}C in Eastern Europe and ~2-4^{0}C in Western Europe, which would have been exacerbated by the event having occurred during GS-9 (*~39,900-38,220* a b2k) (PdL-2 at Pian del Lago) (fig. 4; tab. II). However, the eruption did not have a prolonged and important impact on the continuity of human occupation in Italy (Badino *et alii* 2019), despite the tephra fallout and climate cooling apparently reducing habitable areas in Europe by 30% (Lowe *et alii* 2012; Marti *et alii* 2016). Cooling of this magnitude would have affected the northern Apennines and would undoubtedly have contributed to changes in vegetation cover and created harsher conditions for occupation. However, radiocarbon dates from northern Apennine archaeological sites spanning *~41,500-35,000* cal. BP, which includes several stadials and interstadials, implies a persistence of occupation in the study area even during the period covered by the Campanian Ignimbrite super-eruption (Riel-Salvatore and Negrino 2018). Although given the relatively short

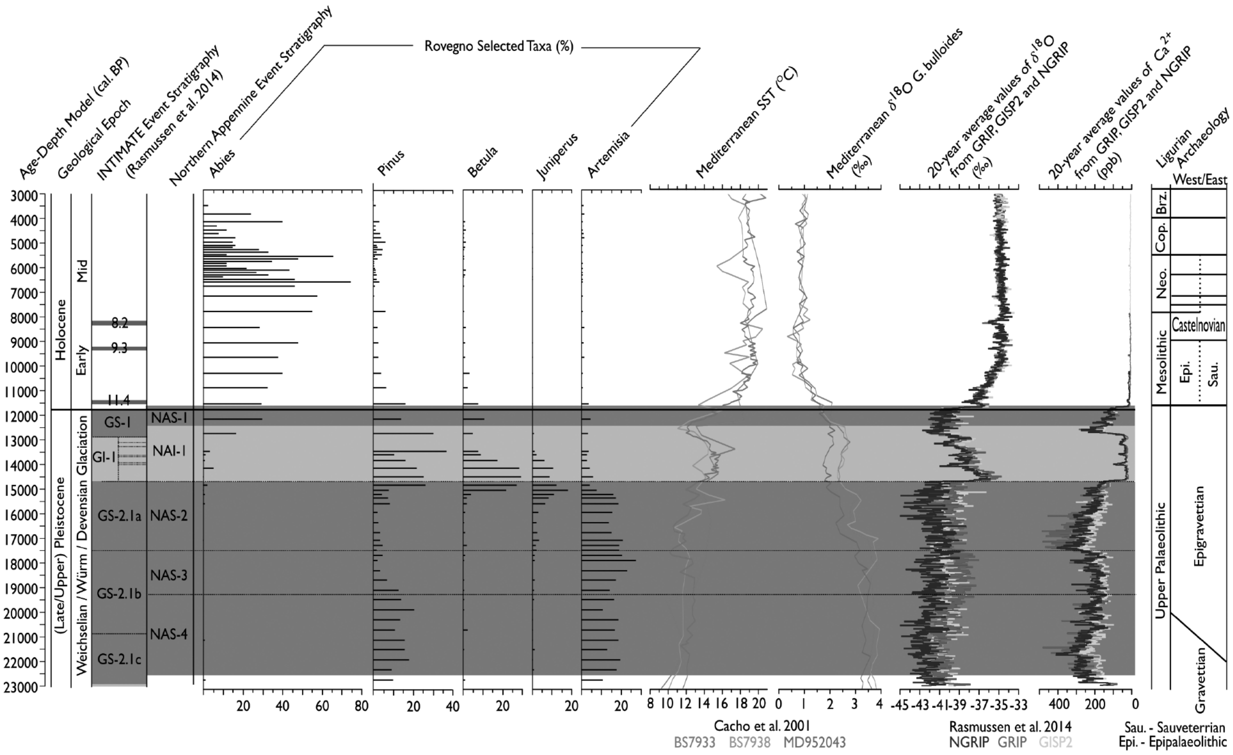


Fig. 5 - Correlazione della serie paleoambientale di Rovegno con la event stratigraphy INTIMATE (Rasmussen *et alii* 2014), la serie marina del Mediterraneo (Cacho *et alii* 2001), e lo schema sintetico della successione culturale in Liguria.
Correlation of Rovegno palaeoenvironmental record with the INTIMATE event stratigraphy (Rasmussen et alii *2014), Mediterranean marine records (Cacho* et alii *2001), and archaeological scheme for Liguria.*

duration of the event it is highly likely that a human response would be difficult to recognise in the archaeological record from the region. Establishing the presence of cryptotephra from the eruption should form the basis of future research at Pian del Lago together with a re-examination of the archaeological chronology from selected key sites. This would permit testing of the hypothesis that occupation was unaffected by the eruption. During the Early Upper Palaeolithic (~40,300-34,700 cal. BP), based upon the data from Pian del Lago, we can conclude that the environmental context of human activities consisted of a vegetation cover that varied from *Abies* and *Pinus* woodland with *Fagus, Quercus* (both deciduous and evergreen) and *Picea* during NAI-7, to *Corylus* and *Abies* dominated shrubland and woodland with *Pinus*, *Quercus*, *Alnus* and *Fagus* (NAI-6), and finally *Abies* and *Pinus* woodland (NAI-5) (fig. 4; tab. II).

The emergence of the Gravettian from ~34,700 cal. BP has also been linked to warmer climatic conditions towards the end of GI-7 (GI-7a, ~34,880 a b2K) (Zilhão 2014) and NAI-5 (fig. 4; tab. II). However, given dating uncertainties it is also possible that the transition occurred during the cooler climate of GS-7 (~34,740-33,740 a b2K) in Italy (see Douka *et alii* 2012; Talamo *et alii* 2014). Lithic tools around Pian del Lago and Ronco del Gatto have only been tentatively assigned to the Gravettian, however there are unequivocal finds from western Liguria, and especially Arene Candide and the Balzi Rossi area (Bietti 1994; Douka *et alii* 2012). The relationship between occupation and periods of climatic amelioration recorded at *~33,860-32,650* cal. BP (NAI-4), *~26,880-26,400* cal. BP (NAI-3) and *~23,030-22,800* cal. BP (NAI-2) remain unclear (fig. 4; tab. II). However, at Mochi in western Liguria, there appears to be a possible correlation between the initiation of occupation during the Gravettian (30,500-30,200 cal. BP or earlier) and GS-5.1 (~30,600-28,900 a b2K) (Douka *et alii* 2012).

Nevertheless, during the Gravettian (~34,700-23,000 cal. BP), based upon the data from Pian del Lago, we can conclude that the vegetation cover in this part of the northern Apennines varied from *Abies* and *Pinus* woodland during NAI-5, to *Corylus, Pinus* and *Quercus* woodland and shrubland (NAI-4), *Pinus, Abies, Betula, Picea, Fagus* and deciduous *Quercus* woodland (NAI-3), and finally *Pinus* and *Abies* woodland (NAI-2) (fig. 4; tab. II). The identification of a cold, arid phase at Arene Candide from ~31,000-27,000 cal. BP attributed to Heinrich 3 (~30,000-29,000 cal. BP) may equate with the period between NAI-4 and NAI-3 (Rellini *et alii* 2013). A major erosional event at Pian del Lago (*~33,220-26,880* cal. BP) has been tentatively correlated with Heinrich 3 (Guido *et alii* 2020) and may signify widespread cooling across the Italian Maritime Alps and northern Apennines. Therefore, despite the evidence for multiple interstadial and stadial events from ~31,000-27,000 cal. BP according to the ice core event stratigraphy, it is possible that the Italian Maritime Alps and northern Apennines instead witnessed a prolonged cold period from GS-5.2 to GS-3 (see Rasmussen *et alii* 2014).

The onset of sedimentation at Rovegno (*~22,540* cal. BP) is correlated with PdL-5 at Pian del Lago (tab. II). The record indicates that from *~22,540-14,660* cal. BP, the vegetation was initially dominated by open *Pinus* woodland (ROV-1). The main distinction with Pian del Lago is the absence of *Abies* woodland, which highlights significant spatial variation in vegetation composition. This was succeeded at Rovegno by predominantly herbaceous vegetation cover (e.g. *Artemisia*) and declining *Pinus* woodland from *~19,300* cal. BP (ROV-2) suggesting a significant change in the environment. Importantly this also coincides with woodland decline at Pian del Lago and the formation of diatomite. It is tempting to correlate these changes with GS-2.1b (~20,900-17,480 a b2k; Rasmussen *et alii* 2014), which suggests a widespread temporary transformation of the environment as a response to climate cooling (NAS-3, *~19,300-17,480* cal. BP) (fig. 5; tab. II). Peak values of *Artemisia* were attained by *~17,480* cal. BP at Rovegno, which were succeeded by increasing shrubland taxa (e.g. *Juniperus*) to *~14,660* cal. BP (ROV-3). For this reason, we have recorded the presence of a further stadial event (NAS-2) in the northern Apennines from *~17,480-14,660* cal. BP (fig. 5; tab. II). This event can be correlated with GS-2.1a (*~17,480-14,692* a b2k), which is characterised by notable changes in both the marine and ice core records indicating widespread climatic change (Cacho *et alii* 2001; Rasmussen *et alii* 2014). The persistence of *Artemisia*, and other herbaceous taxa, at both sites throughout this period indicates the presence of open steppe woodland and shrubland following the Last Glacial Maximum. The significant difference was the prevalence of *Pinus* at Pian del Lago until *~10,640* cal. BP, whereas *Pinus* remains a minor component at Rovegno until *~15,400* cal. BP (ROV-3) when it increases, before finally declining from *~11,360* cal. BP (ROV-6A). At Prato Spilla C, the pollen record has similarly provided evidence for *Pinus* woodland, probably forming an open steppe with a range of herbaceous taxa, especially *Artemisia* and Poaceae (Lowe 1992). Whilst at Lago Grande di Monticchio (located in the southern Apennines), *Artemisia* and Poaceae open steppe is also evident with drought tolerant *Pinus* and *Juniperus*, from 25,900-14,300 cal. BP (Allen-Watts-Huntley 2000).

The Epigravettian commences ~23,000 cal. BP, but only after the Last Glacial Maximum, and was characterised by an increase in human occupation in the Alps and in the Apennines (Palma di Cesnola 2001). This appears to be consistent with other parts of Europe and has been linked to post Last Glacial Maximum "adaptive success, reflected in demographic expansion, triggered by and leading to technological innovation or economic intensification, in turn bringing about further population growth" (Zilhão 2014: 1778). That population growth occurred during a prolonged period of adverse climatic conditions, especially from ~22,900-14,692 a b2k (GS-2.1), seems contradictory. However, palaeoclimatic records from both the marine and ice core data indicate a general improvement in climatic conditions following the LGM (Rasmussen *et alii* 2014), and the vegetation response throughout Italy suggests that the environment was conducive to widespread occupation with a greater variety of possible resources. This is evidenced by wood charcoal records from the cave sites of Arene Candide, Arma di Nasino, Arma dell' Aquila and Arma dello Stefanin, which indicates the exploitation of a wide range of woodland taxa (Barker *et alii* 1990).

The results from Rovegno reveal that the termination of the Würm glacial stage occurred at *~14,660* cal. BP and was marked by a succession to *Betula* woodland (ROV-3), and a decline in *Artemisia* and other herbaceous taxa. The timing of the transition correlates exceptionally well with Greenland Interstadial 1 (GI-1), which spans the period 14,692-12,896 a b2K (Rasmussen *et alii* 2014), and may therefore indicate that NAI-1 commences earlier than suggested by Guido *et alii* (2020) (fig. 5; tab. II). The Mediterranean SST data provide further support for a major climatic change in the region during this time (Cacho *et alii* 2001). The absence of a clear signal for NAI-1 at Pian del Lago is surprising (fig. 4); despite the different environmental context of Rovegno and Prato Spilla C (Lowe 1992) this is unlikely to be due to a subdued environmental reaction. The vegetation succession at Rovegno also indicates a 'gradual' interstadial transition that is similar to Prato Spilla C (from ~>*14,350* cal. BP) where the event was characterised by the expansion of warm mixed forest including *Quercus*, *Tilia*, *Betula* and *Corylus* (Lowe 1992). Whether the transition was 'abrupt' or 'gradual' may reflect temperature differences experienced between sites located north and south of the winter sea-ice margin (at latitude 45^0 N in GS-2.1a) and the influence of Atlantic storm tracks (Renssen and Isarin 2001; Moreno *et alii* 2014). The close proximity of the northern Apennines to this latitude suggests that the region was possibly highly sensitive to changes in climate in the Atlantic at this time.

The very low pollen values of warmth-loving taxa at Rovegno during the Lateglacial Interstadial is surprising with only 'traces' of *Quercus*, *Acer* and *Fraxinus*. Nevertheless, the decline of *Betula* and transition to *Abies* woodland can be correlated with the onset of GI-1c3 (13,954 a b2k) and may signify further climate warming during the middle part of the interstadial (Rasmussen *et alii* 2014) (fig. 5; tab. II). Similarly, at Lagdei-II, Bertoldi *et alii* (2007) record the dominance of *Pinus* and *Betula* during the interstadial. In contrast, at Prato Spilla C, the vegetation cover was characterised by the expansion of warm mixed forest with *Quercus* increasing throughout zone PSp C-2 (Lowe 1992). This could equate to the interstadial warming trend (from GI-1e to GI-1a) identified in Mediterranean marine data (Cacho *et alii* 2001) and observed in other terrestrial records (Moreno *et alii* 2014), including those from Berceto (Bertoldi *et alii* 2007). The variations in the vegetation cover between Rovegno (*Betula – Pinus*), Prato Spilla C (*Abies-Pinus-Quercus*), Berceto (*Pinus-Picea-Quercus-Betula*) and Lagdei-II (*Pinus-Betula-Picea*) may partially reflect pollen recruitment area, but most probably indicate real spatial deviations across the northern Apennines due to a range of factors, including differences in aspect, elevation, geology and location. At Lago Grande di Monticchio, a warm mixed forest was also present from 14,300-12,800 cal. BP comprising *Betula* and *Quercus* (Allen-Watts-Huntley 2000). According to Allen *et alii*, the interstadial climate was probably characterised by a reduction in seasonal drought permitting the expansion of woodland taxa. Variation in the timing of the onset and cessation of the Lateglacial Interstadial between sites is significant however and may be attributed partly to age model uncertainties, but also the rate of transmission of this climatic event and its regional signature. Nevertheless, the data from the northern Apennines broadly agree with other records from south-western Europe indicating the prevalence of a warmer/wetter climate at this time (Moreno *et alii* 2014).

The transition to the Lateglacial Stadial or 'Younger Dryas' (conventionally ~12,900-11,700 a b2k; Rasmussen *et alii* 2014) has been recorded in a number of terrestrial and marine sequences in Italy and indicates the prevalence of a colder/drier climate (e.g. Lowe 1992; Ponel and Lowe 1992; Lowe and Watson 1993; Lowe-Branch-Watson 1994; Lowe *et alii* 1994; Cita *et alii* 1996; Watson 1996; Watts *et alii* 1996; Watts-Allen-Huntley 1996; Bertoldi *et alii* 2007; Vescovi-Ammann-Ravazzi 2010; Vescovi-Petra Kaltenrieder-Tinner 2010; Moreno *et alii* 2014). It is also recognised in the Greenland ice core records (GS-1) and Mediterranean SST data (e.g. Cacho *et alii* 2001; Rasmussen *et alii* 2014). At Rovegno, the renewal of cold, arid climatic conditions is less well defined by the vegetation changes despite the lithological evidence for landscape erosion from ~*13,270* cal. BP (ROV-5). The absence of a significant increase in herbaceous taxa is surprising, instead the record indicates an expansion in *Abies* following a temporary rise in *Pinus*. In contrast, at Pian del Lago, the event is denoted by a rise in *Artemisia* and Chenopodiaceae, an absence of broadleaved trees and a reduction in *Abies*, from ~*12,480-11,600* cal. BP (PdL-6a) (fig. 4; tab. II). Based upon a comparison with other terrestrial records from Italy, the results from Rovegno certainly have similarities to the wooded steppe recorded at Lago Grande di Monticchio, inferred from the presence of *Pinus*, *Betula* and *Quercus* but with the persistence of steppe herbs (e.g. *Artemisia*) and shrubs (Allen-Watts-Huntley 2000). At Prato Spilla C (PSp C-3), the marked decline of woodland taxa and the expansion of a range of steppe herbs remains the clearest example of the 'Younger Dryas' stadial in the northern Apennines with the data from Pian del Lago broadly consistent with the trend observed (Lowe 1992). This variation between localities may confirm the hypothesis proposed by Lowe that some sites were less sensitive to climate change at this time, perhaps due to their geomorphology, aspect and altitude. The location of Rovegno below the natural tree line may have been a factor, whereas Prato Spilla C is situated at higher elevation proximal to the tree line and cirque glaciers (Lowe 1992). However, it should be noted that the timing of the event at Prato Spilla C is inconsistent with the record from Pian del Lago. In this study we have created a new age model for Prato Spilla C, which places PSp C-3 from *~14,080-12,570* cal. BP suggesting that the radiocarbon chronology for this part of the sequence is incorrect. Until a robust chronology is established for Prato Spilla C based upon new radiocarbon dates, the termination of the 'Younger Dryas' chronozone is provisionally placed at ~350 cm (top of PSp C-4), following the demise of *Artemisia* (*~11,850* cal. BP) and the onset of peat formation.

The onset of the Late Würm Lateglacial (~14,600-11,700 a b2k; Rasmussen *et alii* 2014) witnessed a further significant change in the European Upper Palaeolithic. In Italy, the Late Epigravettian was characterised by ubiquitous microlithic projectile points and evidence for decreased mobility, which is supported by findings from the Ligurian-Provencal arc (Tomasso *et alii* 2014). During the Lateglacial Interstadial (NAI-1, *~14,660-12,480* cal. BP) (tab. II), ameliorating climatic conditions in the Italian Maritime Alps and northern Apennines are clearly indicated by the isotopic data from Arene Candide that reveal a mean annual temperature of 8-10^{0}C and the exploitation of a wide range of thermophilous tree taxa (Barker *et alii* 1990). Once again, therefore, it is tempting to draw clear correlations between climate change and technological development linked to changes to social, cultural and economic practices. Despite the presence in the northern Apennines of tephra from the Neapolitan Yellow Tuff (~14,120 cal. BP), there is no clear association between vegetation succession, changes in the human history and this major volcanic event in the Naples area (Davies *et alii* 2002; Schmidt *et alii* 2002). The onset of the Lateglacial Stadial (NAS-1, *~12,480-11,560* cal. BP; Guido *et alii* 2020) does not appear to have caused a significant change in the human history of the Italian Maritime Alps with continuity of occupation suggested by funerary remains from Arene Candide (Sparacello *et alii* 2018). This is perhaps surprising given the evidence for environmental change across south-western Europe, but may attest to the resilience of human populations to climate change at this latitude.

Early Holocene (~11,700-7000 cal. BP)

The onset of the Holocene at Pian del Lago (PdL-6b) and Rovegno (ROV-5) was characterised by the expansion of cool-temperate mixed coniferous - deciduous woodland dominated by *Abies.* This is broadly consistent with other sites in the northern Apennines (e.g. Cruise 1990a, b; Lowe 1992; Watson 1996; Bertoldi *et alii* 2007; Branch 2013), including previous work at Pian del Lago (Cruise *et alii* 2009). In contrast, at Lago Grande di Monticchio, *Abies* did not expand until ~9500 cal. BP within an established temperate deciduous forest (Allen-Watts-Huntley 2002).

The broadly synchronous expansion of *Corylus* at Pian del Lago (PdL-6c) and Rovegno (ROV-6A) (*~10,700* cal. BP) is another notable feature of many Early Holocene pollen records in the northern Apennines e.g. Lago Riane (Branch 2013), Prato Spilla 'A' (Lowe *et alii* 1994) and Lago Padule (Watson 1996). This occurs during the major expansion of broadleaved trees including deciduous *Quercus, Quercus ilex, Alnus, Fagus, Ostrya, Tilia, Ulmus* and *Fraxinus*. The cause of the *Corylus* rise has been the subject of considerable debate (e.g. Huntley 1993; Finsinger *et alii* 2006). Climate change has been increasingly favoured as the cause with enhanced seasonality (drier and warmer summers) causing natural fires and a summer water deficit (Peyron *et alii* 1996; Roberts *et alii* 2008). At Lago Riane, it has been suggested that drought may have promoted the growth, flowering and nut production of *Corylus* stimulating its expansion (Branch 2013). Alternative explanations include competition between species, migration rates and the location of glacial refugia, as well as Mesolithic human activities.

A notable feature of the Pian del Lago record, which is not apparent at Rovegno, is the evidence for seemingly frequent burning during the Mesolithic (*~11,000-7800* cal. BP). At this time, the northern Apennines was the primary zone for human activity with key archaeological sites at Pianaccia di Suvero, Passo della Camilla and Bosco della Lame (e.g. Biagi and Maggi 1984; Maggi and Negrino 1994, 2016; Maggi 1999). Given that the archaeological evidence indicates human activity proximal to lakes and peatlands, the Pian del Lago record may therefore support the findings from other sites, such as Mogge di Ertola (Cevasco *et alii* 2013; Guido *et alii* 2013; De Pascale *et alii* this volume), for human impact including burning of vegetation. However, the increased frequency of burning, human activity and vegetation succession was occurring against a background of climate change, especially the presence of three rapid climate change events spanning the Mesolithic at '11.4' (~11,520-11,400 a b2k), '9.3' (~9350-9240 a b2k) and '8.2' (~8300-8140 a b2k); these have been widely recognised in terrestrial, marine and ice core records across the northern hemisphere (e.g. Bond *et alii* 1997; Mayewski *et alii* 2004; Valsecchi and Tinner 2010; Moreno *et alii* 2014; Rasmussen *et alii* 2014). At Pian del Lago, the '9.3' and '8.2' events have possibly been recorded by increased *Artemisia, Pinus mugo, Juniperus* and *Betula*, and a decline in *Abies* (respectively), although there is no clear evidence for the '11.4' event (Guido *et alii* 2020). Similarly at Rovegno, there is a marked decline of *Abies* at '8.2', which is comparable to that detected at Lago Riane (Branch 2013) and other sites in the northern Apennines (Lowe 1992; Watson 1996). This suggests that vegetation succession was at least partially driven by climate change, and it has been suggested that the change in abundance of *Abies* was due to the onset of colder, and possibly drier, climatic conditions because of its sensitivity to prolonged winter frosts (Branch 2013). The archaeological record is insufficiently precise however to identify whether these events had a marked impact on human populations, but given the changes in climate and vegetation it is reasonable to assume that plant and animal resources would have been affected perhaps necessitating adaptive strategies.

The remainder of the Early Holocene (to *~7000* cal. BP) was generally characterised by the dominance of *Abies* woodland. A distinctive mixed deciduous woodland community is also present in records from the northern Apennines comprising varying amounts of *Quercus*, *Tilia, Acer, Ulmus*, *Fraxinus, Fagus* and *Corylus*. Despite the importance of this community throughout the Early Holocene, it is highly likely that with the expansion of *Abies*, deciduous taxa were mainly growing at lower elevations indicating the development of two distinctive forest belts (Watson 1996). The available archaeological evidence indicates that human occupation was mainly confined to the western Ligurian and French coasts by 7800-7600 cal. BP and reached the Maritime Alps around the middle of the millennium (Binder *et alii* 2017; Huet 2017; Maggi and Tinè this volume). Therefore, the presence of cereal pollen between *~8450-7880* cal. BP and *~8050-7550* cal. BP at Pian del Lago (Cruise *et alii* 2009) is of considerable importance. Similarly, pollen evidence for early cereals has been recorded at Sestri Levante from 8170-7940 cal. BP and slightly later at Rapallo (Bellini - Mariotti-Lippi - Montanari 2009) in a context that might suggest the earliest evidence for cultivation in the north Tyrrhenian area (Maggi and Nisbet 2021). At Mogge di Ertola, human activity is suggested at the Mesolithic-Neolithic transition (Guido *et alii* 2013; De Pascale *et alii* this volume). Buried soils also record human activity from 8030-7870 cal. BP at Pozza dell'Orso, and from 7570-7430 cal. BP at Ferrada (Maggi and Negrino 2016; Maggi and Tinè this volume). These palaeoecological data from eastern Liguria imply that human activities were perhaps more widespread than indicated by the archaeological record, and involved human impact on the vegetation cover and cereal cultivation from the Late Mesolithic and Early Neolithic in this part of the northern Apennines. Human occupation near to Pian del Lago is clearly indicated by a site just a few hundred metres away that G. Odetti (see Colombi-Odetti-Salonio 1999) attributes to the Middle Neolithic (7000-6300 cal. BP).

Conclusions

The palaeoenvironmental records from Pian del Lago and Rovegno have provided clear signals for multiple abrupt climatic events: Interstadials at *~43,440-41,950* cal. BP, *~37,130-36,650* cal. BP, *~36,050-35,160* cal. BP, *~33,860-32,650 cal*. BP,

~26,880-26,400 cal. BP, *~23,030 to 22,800* cal. BP, *~14,660-12,480* cal. BP (Lateglacial Interstadial); Stadials at *~22,540-19,300* cal. BP, *~19,300-17,480* cal. BP, *~17,480-14,660* cal. BP and *~12,480-11,560* cal. BP (Lateglacial Stadial - 'Younger Dryas' chronozone). The event stratigraphy proposed (tab. II) represents an enhanced version of that proposed by Guido *et alii* (2020); critically it confirms the presence of further stadial events in the northern Apennines during the upper Late Pleistocene. It is reasonable to assume that between each of the listed interstadials there were further periods of cooler climate (see Rasmussen *et alii* 2014); however, at Pian del Lago the evidence is unclear due to poor pollen preservation and occasionally significant changes in the sedimentary history. During the Early Holocene, there is no pollen-stratigraphic evidence to support the presence of the ~11,400 cal. BP rapid climate change event, although the changes in vegetation succession at a number of northern Apennine sites indicate possible signatures for the ~9300 cal. BP and ~8200 cal. BP events. The reason(s) for the absence of the '11.4' event remains uncertain, but it may be due to chronological uncertainties, temporal resolution of the pollen data or the sensitivity of the sites and the region as a whole.

The records from Pian del Lago and Rovegno are supported by other terrestrial sequences in Italy, although there are notable spatial and temporal differences in taxa recorded that may reflect latitude, location of glacial refugia and local site-specific characteristics including elevation, aspect and soil development. Importantly, the presence of these climate events suggests that the northern Apennines were probably sensitive to many of the changes recorded in other parts of Europe and the Mediterranean. However, despite broad consistency in the pollen data, there remain concerns over the chronological reliability of specific sites, which means that establishing the precise timing for the onset and termination of events, and comparison with sites across south-western Europe, is challenging. In addition, many of the sites in the northern Apennines would benefit for higher resolution analyses that could possibly reveal short-term climatic variations during the Late Pleistocene and Early Holocene. This would enable a better understanding of vegetation responses to abrupt climate change (see Moreno *et alii* 2014).

Furthermore, the paucity of quantified palaeoclimatic data for the northern Apennines means that the conclusions reached in this research are highly subjective. The palaeoentomological study conducted at Prato Spilla 'D' remains the only attempt to provide quantitative data, indicating a maximum average temperature for the warmest month of 9-13^{0}C, and an average winter minimum of -16 to -2^{0}C for the Lateglacial 'Younger Dryas' Stadial (Ponel and Lowe 1992). Further data from Pian del Lago and Rovegno would permit improvement of current palaeotemperature reconstructions for this part of south-western Europe, especially the Mediterranean region, during the upper Late Pleistocene and Early Holocene. This could be achieved through analysis not only of Coleoptera, but also Cladocera and Chironomidae, as well as pollen-based climate modelling. In addition, chronological modelling would be significantly improved not only through further radiocarbon and U-series dating but also tephrochronology.

The data from Pian del Lago and Rovegno have provided important new information on the climatic and environmental context of human activities in the Italian Maritime Alps and northern Apennines. However, the paucity of well-dated archaeological sites, especially in the surrounding area, has placed considerable uncertainty on the chronological correlations. Further research in the region should seek to improve the chronology, which will permit improved evaluation of the impact of climate change and major volcanic events on cultures and their economies.

Acknowledgements

The drilling campaign at Pian del Lago was carried out in 2005 in the frame of the Natura 2000 Network and within the EU Project "La storia dell'uomo e della natura", funded by the Ligurian Government, with a grant from EU for the regional enhancement (FESR-DOCUP) (misura 2.6b del Docup Ob.2 2000/2006) lead by M. G. Mariotti. We would like to thank Professor Dominik Fleitmann (formerly University of Reading now at the University of Basel) for funding the new radiocarbon dates from Rovegno, and to Dr Matthew Canti, Dr Jean-Luc Schwenninger and Prof John Lowe for assisting with the field investigations at Rovegno. We are also grateful for helpful comments from two anonymous referees.

Bibliographic references

Allen J.R.M., Watts W.A., Huntley B. (2000) – Weichselian palynostratigraphy palaeovegetation and palaeoenvironment: the record from Lago Grande di Monticchio, Southern Italy, *Quaternary International* 73-74: 91-110.

Badino F., Pini R., Ravazzi C., Margaritora D., Arrighi S., Bortolini E., Figus C., Giaccio G., Lugli F., Marciani G., Monegato G., Moroni A., Negrino F., Oxilia G., Peresani M., Romandini M., Ronchitelli A., Spinapolice E.E., Zerboni A., Benazzi S. (2019) – An overview of Alpine and Mediterranean palaeogeography, terrestrial ecosystems and climate history during MIS 3 with focus on the Middle to Upper Palaeolithic transition, *Quaternary International* 551: 7-28. DOI: https://doi.org/10.1016/j.quaint.2019.09.024

Barker G., Biagi P., Clark G., Maggi R., Nisbet R. (1990) – From hunting to herding in the Val Pennavaira (Liguria - Northern Italy), in Biagi P. ed – *The Neolithisation of the Alpine Region*. Brescia: Museo Civico Di Scienze Naturali: 99-121.

Bellini C., Cevasco R., Moreno D., Guido M.A., Montanari C. (2009a) – Mogge di Ertola, Aveto valley, Ligurian Apennines: Evidence of past cultural landscapes, in Krzywinski K., O'Connell M., Kuster H. eds. – *Cultural Landscapes of Europe, Fields of Demeter, Haunts of Pan.* Bremen: Aschenbeck Media: 108-109.

Bellini C., Mariotti Lippi M., Montanari C. (2009b) – The Holocene landscape history of the NW Italian coasts, *The Holocene* 19 (8): 1161-1172.

Bengtsson L., Enell M. (1986) – Chemical analysis, in Berglund, B.E. ed. – *Handbook of Holocene Palaeoecology and Palaeohydrology*. West Sussex: J. Wiley: 423-454.

Bertolani-Marchetti D., Dallai D., Mori Secci M., Trevisan Grandi G. (1994) – Palynological evidence and forest events in the Upper Tuscan/Emilian Apennines in the context of the whole Apennines Holocene history, *Fitosociologia* 26: 145-164.

Bertoldi R., Chelli A., Roma R., Tellini C. (2007) – New data from Northern Apennines (Italy) pollen sequences spanning the last 30,000 yrs, *Il Quaternario, Italian Journal of Quaternary Sciences* 20 (1): 3-20.

Biagi P., Maggi R. (1984) – Aspects of the Mesolithic age in Liguria, *Preistoria Alpina* 19: 159-168.

Bietti A. (1994) – The Upper Pleistocene Deposit of the Arene Candide Cave (Savona, Italy): New Studies on the 1940-42 Excavations, *Quaternaria Nova* IV: 9-370.

Binder D., Lanos P., Angeli L., Gomart L., Guilaine J., Manen C., Maggi R., Muntoni M., Panelli C., Radi G., Tozzi C., Arobba D., Battentier J., Brandaglia M., Bouby L., Briois F., Carré A., Delhon C., Gourichon L., Marinval P., Nisbet R., Rossi S., Rowley-Conwy P., Thiébault S. (2017) – Modelling the earliest western spread of Mediterranean Impressed Wares: new dates and Bayesian chronological model, *Documenta Praehistorica* XLIV: 54-77. DOI: 10.4312/dp.44.4

Blaauw M., Christen J.A. (2011) – Flexible paleoclimate age-depth models using an autoregressive gamma process, *Bayesian Analysis* 6 (3): 457-474.

Bond G., Showers W., Cheseby M., Lotti R., Almasi P., deMenocal P., Priore P., Cullen H., Hajdas I., Bonani G. (1997) – A pervasive millennial-scale cycle in North Atlantic Holocene and glacial climates, *Science* 278: 1257-1266.

Braggio G., Guido, M.A., Montanari, C. (1991) – Palaeovegetational evidence in the Upper Nure valley (Ligurian-Emilian Apennines, Northern Italy), *Webbia* 46: 173-185.

Braggio Morucchio G., Guido M.A. (1975) – Analisi palinologica dei depositi lacustri postglaciali del Lago delle Agoraie di Mezzo (Appenino Ligure), *Archivio Botanico e Biogeografico Italiano* 51: 48-73.

Braggio Morucchio G., Guido M.A., Montanari C. (1978) – Studio palinologico e vegetazione della torbiera del Lajone Presso Piampaludo (Gruppo M. Beigua, Appennino Ligure Occidentale), *Archivio Botanico e Biogeografico Italiano* 54: 115-136.

Branch N.P. (2004) – Late Wurm Lateglacial and Holocene environmental history of the Ligurian Apennines, Italy, in Balzaretti R., Pearce M., Watkins S. eds. – *Ligurian Landscapes: Studies in Archaeology, Geography and History.* London: University of London, Accordia Research Institute: 7-69.

Branch N.P. (2013) – Early-Middle Holocene vegetation history, climate change and human activities at Lago Riane (Ligurian Apennines, NW Italy), *Vegetation History and Archaeobotany* 22: 315-334.

Branch N.P., Canti M.G., Clark P., Turney C.S.M. (2005) – *Environmental Archaeology, Theoretical and Practical Approaches.* London: Arnold.

Branch N.P., Marini N.A.F. (2013) – Mid-late Holocene environmental change and human activities in the northern Apennines, Italy, *Quaternary International* 353: 34-51.

Branch N.P., Black S., Maggi R., Marini N.A.F. (2014) - The Neolithisation of Liguria (NW Italy): An environmental archaeological and palaeoenvironmental perspective, *Environmental Archaeology* 19: 196-213.

Cacho I., Grinalt J.O., Canals M., Sbaffi L., Shackleton N.J., Schönfeld J., Zahn R. (2001) – Variability of the western Mediterranean Sea surface temperatures during the last 25,000 years and its connection with the Northern Hemisphere climatic changes, *Paleooceanography and Paleoclimatology* 16: 40-52.

Cevasco A., De Pascale A., Guido M. A., Montanari C., Maggi R., Nicosia C. (2013) – Le Mogge di Ertola (Appennino ligure): un contributo all'archeologia del fuoco e all'archeologia dell'acqua, in Cevasco R. ed. – *La natura della montagna. Scritti in ricordo di Giuseppina Poggi.* Sestri Levante: Oltre Edizioni: 413-427.

Cita M.B., De Lange G., Sala M.C., Osio A., Mariani A.R., Marotta P.A. (1996) – The record of the last glaciation in two deep-sea cores from the Sicily Channel of Capo Rossello (Central Mediterranean), *Il Quaternario, Italian Journal of Quaternary Sciences* 9: 493-498.

Cruise G.M. (1990a) – Holocene peat initiation in the Ligurian Apennines, northern Italy, *Review of Palaeobotany and Palynology* 63: 173-182.

Cruise G.M. (1990b) – Pollen stratigraphy of two Holocene peat sites in the Ligurian Apennines, northern Italy, *Review of Palaeobotany and Palynology* 63: 299-313.

Cruise G.M., Macphail R.I., Linderholm J., Maggi R., Marshall P.D. (2009) – Lago di Bargone, Liguria, N Ialy: A reconstruction of Holocene environmental and land-use history, *The Holocene* 19 (7): 987-1003.

De Pascale A., Guido M.A., Montanari C., Nicosia C., Maggi R. (in this volume) – Le Mogge di Ertola (Rezzoaglio - GE): un archivio per novemila anni di storia ambientale, in Atti Preistoria e Protostoria della Liguria.

Dansgaard W., Clausen H.B., Gundestrup N., Hammer C.U., Johnsen S.F., Kristinsdottir P.M., Reeh N. (1982) – A new Greenland deep ice core, *Science* 218: 1273-1277.

Douka K., Grimaldi S., Boschian G., Del Lucchese A. Higham T.G.G. (2012) – A new chronostratigraphic framework for the Upper Palaeolithic of Riparo Mochi (Italy), *Journal of Human Evolution* 62 (2): 286-299.

Davies S.M., Branch N.P., Lowe J.J., Turney C.S.M. (2002) – Towards a European tephrochronological framework for Termination 1 and the Early Holocene, *Philosophical Transactions of the Royal Society of London* 360: 767-802.

Faccini F., Piccazzo M., Robbiano A. (2009) – A deep-seated gravitational slope deformation in the upper Bargonasco Valley (Ligurian Apennines), *Geografia Fisica e Dinamica Quaternaria* 32: 73-82.

Falcucci A., Conard N. J., Peresani M. (2017) – A critical assessment of the Protoaurignacian lithic technology at Fumane Cave and its implications for the definition of the earliest Aurignacian, *PLoS ONE* 12 (12): https://doi.org/10.1371/journal.pone.0189241.

Finsinger W., Tinner W., van der Knapp W.O., Ammann B. (2006) – The expansion of hazel (Corylus avellana L.) in the southern Alps: a key for understanding its early Holocene history in Europe?, *Quaternary Science Reviews* 25: 612-631.

Follieri M., Magri D., Sadori L. (1988) – 250.000 year pollen record from Valle di Castiglione (Roma), *Pollen et Spores* 30: 329-356.

Follieri M., Magri D., Sadori L. (1990) – Pollen stratigraphical synthesis from Valle di Castiglione (Roma), *Quaternary International* 3-4 (1989): 81-84.

Follieri M., Giardini M., Magri D., Sadori L. (1998) – Palynostratigraphy of the last glacial period in the volcanic region of central Italy, *Quaternary International* 47-48: 3-20.

Gentile S., Guido M.A., Montanari C., Paola G., Braggio Morucchio G., Petrillo M. (1988) – Ricerche geobotaniche e saggi di cartografia della vegetazione del piccolo bacino di Lago Riane (Liguria), *Braun-Blanquetia* 2: 77-104.

Gianotti F., Forno M.G., Ivy-Ochs S., Monegato G., Pini R., Ravazzi C. (2015) – Stratigraphy of the Ivrea morainic amphitheatre (Italy): an updated synthesis, *Alpine and Mediterranean Quaternary* 28 (1): 29-58.

Grimm E.C. (1987) – CONISS: A FORTRAN 77 program for stratigraphically constrained cluster analysis by the method of incremental sum of squares, *Computers and Geosciences* 13: 13-25.

Grimm E.C. (1993) – *TILIA Version 2.0.b.4 (software).* Springfield: Illinois State Museum.

Guido M.A., Menozzi B.I., Montanari C., Scipioni S. (2003) – Il sito di 'Mogge di Ertola' come potenziale fonte per la storia ambientale del crinale Trebbia-Aveto, *Archeologia Postmedievale* 6: 111-116.

Guido M.A., Mariotti Lippi M., Menozzi B.I., Placereani S., Montanari C. (2004a) – *Il paesaggio vegetale montano della Liguria centro-occidentale nell'Età del Ferro: area del Monte Beigua (Savona),* in De Marinis R.C., Spadea G. eds. – *I Liguri. Un antico popolo europeo tra Alpi e Mediterraneo.* Catalogo della mostra di Genova, 23 ottobre 2004-23 gennaio 2005. Ginevra-Milano: Skira: 91-95.

Guido M.A., Mariotti Lippi M., Menozzi B.I., Placereani S., Montanari C. (2004b) – Ambienti costieri nella Riviera ligure di Levante tra le Età del Bronzo e del Ferro: aree di Rapallo e di Chiavari, in De Marinis R.C., Spadea G. eds. – *I Liguri. Un antico popolo europeo tra Alpi e Mediterraneo*. Catalogo della mostra di Genova, 23 ottobre 2004-23 gennaio 2005. Ginevra-Milano: Skira: 78- 81.

Guido M.A., Mariotti Lippi M., Menozzi B.I., Placereani S., Montanari C. (2004c) – Il paesaggio vegetale della costa toscana settentrionale negli ultimi tre millenni a.C., in De Marinis R.C., Spadea, G. eds. – *I Liguri. Un antico popolo europeo tra Alpi e Mediterraneo.* Catalogo della mostra di Genova, 23 ottobre 2004-23 gennaio 2005. Ginevra-Milano: Skira: 84- 85.

Guido M., Molinari C., Montanari C. (2009) – Primi dati palinologici per la storia ambientale tardo-pleistocenica della Liguria orientale, in Di Marzio P., Fortini P., Scippa G.S. eds. – *Le scienze botaniche nella cultura e sviluppo economico del territorio*. Atti 104° Congresso della Società Botanica Italiana, Campobasso, 16-19 settembre 2009. Firenze: Società botanica italiana: 272.

Guido M. A., Menozzi B. I., Bellini C., Placereani S., Montanari C. (2013) – A palynological contribution to the environmental archaeology of a Mediterranean mountain wetland (NW Apennines, Italy), *The Holocene* 23: 1517-1527.

Guido M.A., Molinari C., Moneta V., Branch, N. Black S., Simmonds M., Stastney P., Montanari C. (2020) – Climate and vegetation dynamics of the Northern Apennines (Italy) during the Late Pleistocene and Holocene, *Quaternary Science Reviews* 231: 106-206.

Higham T., Douka K., Wood R., Ramsey C.B., Brock F., Basell L., Camps M., Arrizabalaga A., Baena J., Barroso-Ruíz C., Bergman C., Boitard C., Boscato P., Caparrós M., Conard N.J., Draily C., Froment A., Galván B., Gambassini P., Garcia-Moreno A., Grimaldi S., Haesaerts P., Holt B., Iriarte-Chiapusso M.J., Jelinek A., Jordá Pardo J.F., Maíllo-Fernández J.M., Marom A., Maroto J., Menéndez M., Metz L., Morin E., Moroni A., Negrino F., Panagopoulou E., Peresani M., Pirson S., de la Rasilla M., Riel-Salvatore J., Ronchitelli A., Santamaria D., Semal P., Slimak L., Soler J., Soler N., Villaluenga A., Pinhasi R., Jacobi R. (2014) – The timing and spatiotemporal patterning of Neanderthal disappearance, *Nature* 512 (7514): 306-309.

Hublin J.-J. (2014) – The modern human colonization of western Eurasia: when and where?, *Quaternary Science Reviews* 118: 194-210.

Hublin J.-J., Sirakov N., Aldeias V., Bailey S., Bard E., Delvigne V., Endarova E., Fagault Y., Fewlass H., Hajdinjak M., Kromer B., Krumov I., Marreiros J., Martisius N. L., Paskulin L., Sinet-Mathiot V., Meyer M., Pääbo S., Popov V., Rezek Z., Sirakova S., Skinner M. M., Smith G. M., Spasov R., Talamo S., Tuna T., Wacker L., Welker F., Wilcke A., Zahariev N., Mcpherron S. P., Tsanova T. (2020) – Initial Upper Palaeolithic Homo sapiens from Bacho Kiro Cave, Bulgaria, *Nature* 581: 299-302.

Huet T. (2017) – *Les gravures piquetées du mont Bego (Alpes Maritimes). Organisation spatiale et sériation (VI-II millanaire av. J.-C.).* Memories de la Société Préhistorique Française 63. Paris: Société préhistorique française.

Huntley B. (1993) – Rapid Early-Holocene migration and high abundance of hazel (Corylus avellana L.): alternative hypotheses, in Chambers, F.M. ed. – *Climatic change and human impact on the landscape*. London: Chapman and Hall: 205-215.

Ivanovich M., Harmon R. S., eds. (1992) – *Uranium Series Disequilibrium Applications to Environmental Problems.* Oxford: Oxford University Press.

Lowe J.J. (1992) – Pollen stratigraphy and radiocarbon dating of late-glacial and early Holocene lake sediments from the northern Apennines, Italy, *Boreas* 21: 319-334.

Lowe J.J., Watson C. (1993) – Lateglacial and early Holocene pollen stratigraphy of the northern Apennines, Italy, *Quaternary Science Reviews* 12: 727–738.

Lowe J.J., Branch N., Watson C. (1994) – The chronology of human disturbance of the vegetation of the northern Apennines during the Holocene, in Biagi P., Nandris J. eds – *Highland zone exploitation in southern Europe.* Brescia: Museo Civico Di Scienze Naturali: 171-189.

Lowe J.J., Davite C., Moreno D., Maggi R. (1994) – Holocene pollen stratigraphy and human interference in the woodlands of the northern Apennines, Italy, *The Holocene* 4: 153-164.

Lowe J., Barton N., Blockley S., Bronk Ramsey C., Cullen V.L., Davies W., Gamble C., Grant K., Hardiman M., Housley R., Lane C.S., Lee S., Lewis M., MacLeod A., Menzies M., Müller W., Pollard M., Price C., Roberts A.P., Rohling E.J., Satow C., Smith V.C., Stringer C.B., Tomlinson E.L., White D., Albert P., Arienzo I., Barker G., Boric D., Carandente A., Civettal L., Ferrier C., Guadelli J-L., Karkanas P., Koumouzelis M., Müller U.C., Orsi G., Pross J., Rosip M., Shalamanov-Korobarq L., Sirakov N., Tzedakis P.C. (2012) – Volcanic ash layers illuminate the resilience of Neanderthals and early modern humans to natural hazards, *Proceedings of the National Academy of Sciences* 109: 13532-13537.

Maggi R., (1999) – Coasts and uplands in Liguria and Northern Tuscany from the Mesolithic to the Bronze Age, in Tykot R.H., Morter J., Robb J.E. eds. – *Social Dynamics of the Prehistoric Central Mediterranean.* London: Accordia Research Institute: 47-65.

Maggi R., Negrino F. (1994) – Upland settlement and technological aspects of the eastern ligurian Mesolithic, *Preistoria Alpina* 28 (1992): 373-396.

Maggi R., Negrino F. (2016) – The paradoxical pattern of the Mesolithic evidence in Liguria: piecing together the puzzle, *Preistoria Alpina* 48: 133-138.

Maggi R., Nisbet R. (2021) – Gestire le risorse ambientali a fini alimentari. La complessità ligure (VII-III millennio cal BC), in *Studi di Preistoria e Protostoria 6, Preistoria del cibo*, Firenze, Istituto Italiano di Preistoria e Protostoria: 179-192.

Maggi R., Tinè V. (this volume) – La Liguria Neolitica, in Atti Preistoria e Protostoria della Liguria.

Marciani G., Ronchitelli A., Arrighi S., Badino F., Bortolini E., Boscato P., Boschin F., Crezzini J., Delpiano D., Falcucci A., Figus C., Lugli F., Negrino F., Oxilia G., Romandini M., Riel-Salvatore J., Spinapolice E. E., Peresani M., Moroni A., Benazzi S. (2019) – Lithic techno-complexes in Italy from 50 to 39 thousand years BP: an overview of cultural and technological changes across the Middle-Upper Palaeolithic boundary, *Quaternary International* 551: 123-149. DOI: https://doi.org/10.1016/j.quaint.2019.11.005

Marti A., Folch A., Costa A., Engwell S. (2016) – Reconstructing the plinian and co-ignimbrite sources of large volcanic eruptions: a novel approach for the Campanian Ignimbrite, *Scientific Report* 6: 212-220.

Mayewski P.A., Rohling E.E., Stager J.C., Karlen W., Maasch K.A., Meeker L.D., Meyerson A., Gasse F., van Kreveld S., Holmgren K., Lee-Thorp J., Rosqvist G., Rack F., Staubwasser M., Schneider R.R., Steig E.J. (2004) – Holocene climate variability, *Quaternary Research* 62: 243-255.

Moore P.D., Webb J.A., Collinson M.E. (1991) – *Pollen Analysis*. London: Blackwell Scientific Publications.

Moreno A., Svensson A., Brooks S., Connor S., Engels S., Fletcher W., Genty D., Heiri O., Labuhn I., Perşoiu A., Peyron O., Sadori L., Valero-Garcés B., Wulf S., Zanchetta G. and data contributors (2014) – A compilation of Western European terrestrial records 60-8 ka BP: towards an understanding of latitudinal climatic gradients, *Quaternary Science Reviews* 106: 167-185.

Negrino F. (2002) – *Ritrovamenti paleo-mesolitici in Valle Lagorara e nell'alta Val di Vara*, in Campana N., Maggi R. eds. – *Archeologia in Valle Lagorara. Diecimila anni di storia intorno a una cava di diaspro.* Origines 19. Firenze: Istituto Italiano di Preistoria e Protostoria: 357-364.

Negrino F., Colombo M., Cremaschi M., Serradimigni M., Tozzi C., Ghiretti A. (2017) – Estese officine litiche del Paleolitico medio-superiore sui rilievi appenninici di Monte Lama-Castellaccio-Pràrbera (Bardi, Parma), in Bernabò Brea M. eds. – *Preistoria e Protostoria dell'Emilia-Romagna I.* Studi di Preistoria e Protostoria 3. Firenze: Istituto Italiano di Preistoria e Protostoria: 59-68.

Negrino F., Riel-Salvatore J. (2018) – From Neandertals to anatomically modern humans in Liguria (Italy): the current state of knowledge, in Borgia, V., Cristiani, E. eds. – *Out of Italy, Advanced Studies on the Italian Palaeolithic*. Leida: Sidestone Press Academics: 159-180.

Neymark L.A., Paces, J.B. (2000) – Consequences of slow growth for 230Th/U dating of quaternary opals, Yucca Mountain, NV, USA, *Chemical Geology* 164: 143-160.

Neymark L.A., Amelin Y.V., Paces J.B. (2000) – 206Pb-230Th- 234U-238U and 207Pb-235U geochronology of Quaternary opal, Yucca Mountain, Nevada, *Geochimica et Cosmochimica Acta* 64: 2913-2928.

Neymark L.A., Amelin Y., Paces J.B., Peterman Z.E. (2002) – U-Pb ages of secondary silica at Yucca Mountain, Nevada: implications for the paleohydrology of the unsaturated zone, *Applied Geochemistry* 17: 709-734.

Colombi N., Odetti G., Salonio A. (1999) – Un vaso a bocca quadrata in provincia di Genova, *Studi Genuensi* 14 (1998): 61-71.

Palma di Cesnola (2001) – *Le Paléolithique supérieur en Italie*. Grenoble: Editions Jérôme Millon.

Peyron O., Guiot J., Cheddadi R., Tarasov P., Reille M., de Beaulieu J.-J., Bottema S., Andrieu V. (1996) – Climatic reconstruction in Europe for 18,000 yr B.P. from pollen data, *Quaternary Research* 49: 183-196.

Ponel P., Lowe J.J. (1992) - Coleopteran, pollen and radiocarbon evidence from the Prato Spilla 'D' succession, N, Italy, *Comptes Rendus de l'Acadèmie de Sciences, Paris, Serie II* 615: 1425-1431.

Punt W., ed. (1976) – *The Northwest European Pollen Flora I.* Amsterdam: Elsevier Science Publishers.

Punt W., Blackmore S., eds. (1991) – *The Northwest European Pollen Flora VI.* Amsterdam: Elsevier Science Publishers.

Punt W., Clarke G.C.S., eds. (1980) – *The Northwest European Pollen Flora II.* Amsterdam: Elsevier Science Publishers.

Punt W., Clarke G.C.S., eds. (1981) – *The Northwest European Pollen Flora III.* Amsterdam: Elsevier Science Publishers.

Punt W., Clarke G.C.S., eds. (1984) – *The Northwest European Pollen Flora IV.* Amsterdam: Elsevier Science Publishers.

Punt W., Blackmore S., Clarke G.C.S., eds. (1988) – *The Northwest European Pollen Flora V.* Amsterdam: Elsevier Science Publishers.

Punt W., Blackmore S., Hoen P.P., eds. (1995) – *The Northwest European Pollen Flora VII.* Amsterdam: Elsevier.

R Core Team (2016) – *R: A Language and Environment for Statistical Computing.* Vienna: R Foundation for Statistical Computing.

Rasmussen S.O., Bigler M., Blockley S.P., Blunier T., Buchardt S.L., Clausen H.B., Cvijanovic I., Dorthe Dahl-Jensen D., Johnsen S.J., Fischer H., Gkinis V., Guillevic M., Hoek W.Z., Lowe J.J., Joel B. Pedro Popp T., Seierstad I.K., Steffensen J.P., Svensson A.M., Vallelonga P., Vinther B.M., Walker M.J.C., Wheatley J.J., Winstrup M. (2014) – A stratigraphic framework for abrupt climatic changes during the LastGlacial period based on three synchronized Greenland ice-core records: refining and extending the INTIMATE event stratigraphy, *Quaternary Science Reviews* 106: 14-28.

Reille M. (1992–1998) – *Pollen et spores d'Europe et d'Afrique du Nord. Laboratoire de botanique historique et palynology.* Marseille: CNRS.

Reimer P.J., Bard E., Bayliss A., Beck J.W., Blackwell P.G., Bronk Ramsey C., Caitlin E Buck C.E., Cheng H., Edwards R., Friedrich M., Grootes P.M., Guilderson T.P., Haflidason H., Hajdas I., Hatté C., Heaton T.J., Hoffmann D.L., Hogg A.G., Hughen K.A., Kaiser K.F., Kromer B., Manning S.W., Niu M., Reimer R.W., Richards D.A., Scott E.M., Southon J.R., Staff R.A., Turney C.S.M., van der Plicht J. (2013) – IntCal13 and Marine13 Radiocarbon Age Calibration Curves 0-50,000 Years Cal BP, *Radiocarbon* 55 (4): 1869-1887.

Rellini I., Firpo M., Martino G., Riel-Salvatore J., Maggi R. (2013) – Climate and environmental changes recognized by micromorphology in Paleolithic deposits at Arene Candide (Liguria, Italy), *Quaternary International* 315: 42-55.

Renssen H., Isarin R.F.B. (2001) – The major phases of the last deglaciation at 14.7 and 11.5 ka cal BP in Europe: climate reconstruction and AGCM experiments, *Global Planetary Change* 30: 117-153.

Riel-Salvatore J., Negrino F. (2018) – Human adaptations to drastic climatic change in Liguria across the Middle-Upper Paleolithic transition, *Journal of Quaternary Science* 33 (3): 313-322.

Roberts N., Jones M.D., Benkaddour A., Eastwood W.J., Filippi M.L., Frogley M.R., Lamb H.F., Leng M.J., Reed J.M., Stein M., Stevens L., Valero-Garcés V., Zanchetta G. (2008) – Stable isotope records of Late Quaternary climate and hydrology from Mediterranean lakes: the ISOMED synthesis, *Quaternary Science Reviews* 27: 2426-2441.

Schmidt R., van den Bogaard C., Merkt J., Muller J. (2002) – A new Lateglacial chronostratigraphic tephra marker for the south-eastern Alps: The Neapolitan Yellow Tuff (NYT) in Langsee (Austria) in the context of a regional biostratigraphy and palaeoclimate, *Quaternary International* 88: 45-56.

Sparacello V.S., Rossi S., Pettitt P., Roberts C., Riel-Salvatore J., Formicola V. (2018) – New insights on Final Epigravettian funerary behavior at Arene Candide Cave (Western Liguria, Italy), *Journal of Anthropological Sciences* 96: 1-24.

Stuiver M., Kra R. (1986) – Calibration Issue, *Radiocarbon* 28 (2B): 805-1030.

Talamo S., Peresani M., Romandini M., Duches R., Jequier C., Nannini N., Pastoors A., Picin A., Vaquero M., Weniger G-C., Hublin J-J. (2014) – Detecting Human Presence at the Border of the Northeastern Italian Pre-Alps. 14C Dating at Rio Secco Cave as Expression of the First Gravettian and the Late Mousterian in the Northern Adriatic Region, *Plos One* 9: 1-11.

Tomasso A., Naudinot N., Binder D., Grimaldi S. (2014) – Unité et diversité dans l'Épigravettien récent de l'arc liguro- provençal, in Langlais M., Naudinot N., Peresani M. eds. – *Les groupes culturels de la transition Pléistocène-Holocène entre Atlantique et Méditerranée*. Proceedings of the conference of the Société préhistorique française, Bordeaux, 24-25 May 2012. Paris: Société préhistorique française (Séances de la Société préhistorique française, 3): 155-184.

Valsecchi V., Tinner W. (2010) – Vegetation responses to climatic variability in the Swiss Southern Alps during the Misox event at the early-mid Holocene transition, *Journal of Quaternary Science* 25: 1248-1258.

Vescovi E., Ammann B., Ravazzi C. (2010) – A new Lateglacial and Holocene record of vegetation history from Lago del Greppo, northern Apennines, Italy, *Vegetation History and Archaeobotany* 19: 219-233.

Vescovi E., Petra Kaltenrieder P., Tinner W. (2010) – Late-Glacial and Holocene vegetation history of Pavullo nel Frignano (Northern Apennines, Italy), *Review of Palaeobotany and Palynology* 160: 32-45.

Vicino G. (1983) – Il Paleolitico, in Maggi, R. ed. – *Preistoria nella Liguria orientale.* Recco: Siri Editore: 25-32.

Watson, C.S. (1996) – The vegetational history of the northern Apennines, Italy: Information from three new sequences and a review of regional vegetational change, *Journal of Biogeography* 23: 805-841.

Watts W.A., Allen J.R.M., Huntley B., Fritz S.C. (1996) – Vegetation history and climate of the last 15,000 years at Laghi di Monticchio, southern Italy, *Quaternary Science Reviews* 15: 113-132.

Watts W.A., Allen J.R.M., Huntley B. (1996) – Vegetation history and palaeoclimate of the last glacial period at Lago Grande di Monticchio, southern Italy, *Quaternary Science Reviews* 15: 133-154.

Zilhão J. (2014) – The Upper Palaeolithic of Europe, in Renfrew C., Bahn, P. eds. – *The Cambridge World Prehistory. Volume 3. West and Central Asia and Europe.* Cambridge: University Press: 1753-1785.

RIVISTA DI SCIENZE PREISTORICHE
Preistoria e Protostoria della Liguria -
Vol. LXXIII - S3 - 2023

INDICE

SESSIONE 4 – ARTE, PRATICHE RITUALI E FUNERARIE

SESSIONE 5 – STORIA DELLE RICERCHE

BREVI NOTE (https://www.openprehistory.org/wp-content/uploads/2023/07/Preistoria-e-Protostoria-della-Liguria-BREVI-NOTE.pdf)

SESSIONE 2 – SITI, MATERIALI, PRODUZIONI, RELAZIONI E SCAMBI

Finito di stampare in Italia nel mese di luglio 2023
per conto di Edifir-Edizioni Firenze

RIVISTA DI SCIENZE PREISTORICHE
dell'Istituto Italiano di Preistoria e Protostoria

REDAZIONE E AMMINISTRAZIONE
c/o Museo Archeologico Nazionale, via della Pergola 65 – 50121 Firenze
+39 055 2340765 - www.openprehistory.org - www.iipp.it

Prezzo per l'Italia e per l'estero € 90,00

ISSN 0035-6514
e-ISSN 2282-457X
ISBN 978-88-6045-101-9