

DATA PAPER

Late-Holocene Human Resilience in a Fluvial Environment: A Geoarchaeological Dataset for the Central Po Plain (N Italy)

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This paper presents a dataset collected and constructed as part of a PhD research project in Environmental Sciences. Applying a multidisciplinary approach that combines archaeological and geomorphological data, this project aimed to reconstruct the Late Holocene landscape evolution in the Central Po Plain (Italy). The dataset was collected digitising the information retrieved from various sources such as scientific literature, regional databases and terrain surveys. In particular, the geoarchaeological data consist of a record of 761 archaeological sites and a soil map reporting the different sediment types of the area. Natural and anthropogenic landscape features developed by human-environmental interplay are organised in paleochannels, watercourses and channelisation. This dataset represents one of the first open-access data collection available in Italy and can be reused by any researchers working in fluvial landscape studies.

Keywords: landscape archaeology; geoarchaeology; land-use change; fluvial geomorphology; Late Holocene; Po Plain; water management

(1) Context

The dataset was originally collected as part of the doctoral projects of the author, with the aim of understanding human-environmental dynamics in a fluvial context. The project methodology employed environmental archaeology techniques to reconstruct the main phases of the diachronic landscape evolution. Landscapes represent a worthwhile dataset about the millennial human-environment interaction. In this regard, past landscapes reconstruction allows to evaluate diachronically the impact of anthropogenic activities on modifying the natural assets of a region, even including early evidence of the inception of the Anthropocene [1]. The project methodology has been tested especially on floodplains because fluvial environments have always played a crucial role in human history: the necessity of fertile land and freshwater for agriculture has led populations to settle in floodplains more frequently than in other environments altering natural landscapes features.

The Po Plain (**Figure 1**) operates as a key area for the interpretation of environmental and cultural influences between the Mediterranean regions and continental Europe [2]. Its complex settlement and land-management history make it an ideal study-area to investigate the adaptive dynamics of human communities in alluvial areas. The natural factors that influenced the environmental development of the Central Po Plain fluvial landscape

are mostly due to alluvial geomorphological dynamics. Since the Pleistocene, the Apennine watercourses shaped the landscape developing alluvial megafans with their sediments. In the distal parts of Holocene alluvial fans are characterised by a telescopic shape, a result of subsequent aggradation –entrenchment phases due to the alternation of glacial-interglacial periods; each aggradational cycle [3] causes an incision on the top of the previous fan, while a new fan prograded in a more distal position [4]. In the study area, the alluvial ridges of the Enza, Crostolo and Tresinaro rivers, emerging from the flat floodplain, flank depression areas known in fluvial geomorphology as backswamps, which are characterised by deposits of fine silts and clays deposited after flood events [5].

The landscape evolution of this portion of the Central Po Plain (**Figure 1**) has a long-standing connection with human activities as well. Since the Bronze Age, [6] human communities settled in the Po Valley for its suitability to agriculture, altering the natural fluvial landscape and handling the flood hazard [6]. In the Roman period, the risk of inundation was managed and mitigated by the construction of embankments and drainages [7]. The transition from Roman into Early Medieval Period (6th – 10th centuries CE) represented a crucial moment for the reorganisation of human settlement strategies in Po Valley. Many authors point out that this transition led to a reduction of the cultivable and settled area due to the collapse

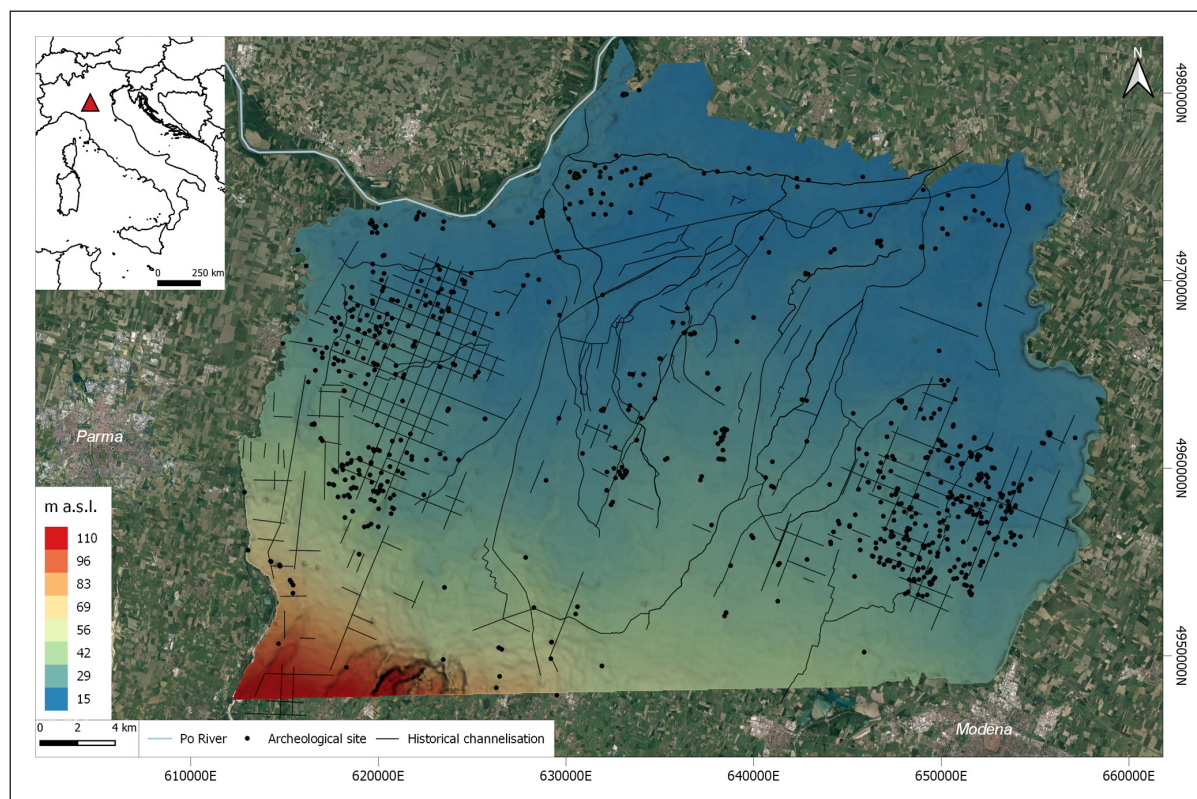


Figure 1: Location of the study area (red triangle in the top left box).

of the Po Valley Roman hydrogeological systems [8]. The Roman water management system was abandoned, and woods, swamps and uncultivated areas became the typical features of the Early Medieval landscape (6th – 10th centuries CE). Channelisation and reclamation works started only in the 10th century CE and intensified between the 12th and 13th centuries CE [9] as a consequence of a general increasing demand for cultivated lands throughout Europe [10]. In the Central Po Plain, large-scale ground reclamation is dated to Renaissance (15th century CE), it was renovated and updated many times in Modern Age (17th and 19th centuries CE), and it was completed only in the 20th century CE resulting in the modern completely artificial landscape [11].

Heterogeneous sources were used to build the dataset here described. In particular, archaeological records, historical maps and documents and geomorphological maps served as a useful starting point to construct the dataset in association with terrain surveys. The combination of geosciences data and archaeo-historical records were fundamental in understanding the Late Holocene landscape evolution of this portion of the Po Plain.

Spatial coverage

The research area considered is located in the Emilia Romagna region (Northern Italy) and is comprised between the Po river at North, the Enza and Secchia rivers at West and East respectively. The southern limit corresponds to the Apennines foothills.

Coordinates References System: World Geodetic System (WGS) 1984 – UTM zone 32N (EPSG: 32632)

Datum: World Geodetic System 1984

Area: 1193.64 Km²

Northern boundary: 4983531.8814447168260813
 Southern boundary: 4947676.0333488956093788
 Eastern boundary: 658783.7466718740761280
 Western boundary: 612200.2010981414932758

Temporal coverage

Bronze Age (1600 BCE) – Post-Medieval (1700 CE)

Whilst the majority of data falls within this time range, some sites and features exceed these chronological limits. Particularly, Neolithic and Chalcolithic archaeological sites are comprised in this digital archive for the relevance of prehistoric studies in the research area [4, 12, 13]. Similarly, the contemporary drainage system (20th – 21st century CE) is included in the dataset to have a full overview on the land and water management activities occurred in the area. Moreover, in the contemporary channelization many historical canals and ditches are recognizable since they have been renovated in the 19th – 20th century CE.

(2) Methods

The majority of data in this dataset was obtained directly from source publications. The data have been collected by using all known published archaeological excavations reports, maps and regional databases. The geopedological data have been retrieved from the Emilia Romagna regional geodatabase.

Steps

Archaeological and historical resources

Archaeological sites have been retrieved from various records (scientific literature, regional web databases,

terrain surveys) listed in the *List_of_References.txt* file. These data have been digitised in GIS, enabling the chronological analysis of landforms identified in the Central Po Plain. The 18th and 19th-century transcriptions of medieval chronicles (**Table 1**) represented an advantageous starting point in the identification of past landscape features such as described precisely fluvial landforms or unknown settlement locations.

The Post – Medieval historical cartography helped in understanding the geomorphological development of fluvial features as well as anthropogenic water management activities [9]. SfM-photogrammetry served as a contactless, highly flexible approach to digitise historical cartography [14] (retrieved at the Modena National Historical Archive, folder: “*Congregazione delle Acque e delle Strade, Reggio e Reggiano*”) producing High Definition (HD) digital copies that eased the georeferencing process in GIS (**Figure 2**).

Furthermore, the regional WMS format of the Historical Cadastral Map of Emilia Romagna Region 1850¹ represented a valuable source of information to detect historic channelization in the area. The Emilia Romagna Region topographic service derived this digital historic map (scale 1:50.000) elaborating 19th-century historic cadastral maps (**Table 2**).

Historical maps offer a glimpse into a long and dynamic history of landscape change [15]. Both archaeological and historical resources considered are reported in the *List_of_References.txt* file.

Geopedological resources

The term Geopedology refers to the integration of elements of geomorphology and pedology for soil and landscape studies [16]. Here the regional soil map has been implied to detect the maximum extension of the medieval swamps. The sediment deposition in floodplains

Table 1: List of 18th and 19th-century transcriptions of medieval chronicles.

Author	Book Title	Date of Publication
Affò, I.	<i>Istoria di Guastalla</i>	1786
Affò, I.	<i>Storia di Parma</i>	1792
Tiraboschi, G.	<i>Dizionario Topografico Degli Stati Estensi</i>	1824
Cantarelli, C.	<i>Cronaca di fra Salimbene Parmigiano Dell'ordine dei Minori</i>	1882
Torelli, P.	<i>Le Carte Degli Archivi Reggiani: Fino al 1050</i>	1921
Drei, G.	<i>Le Carte Degli Archivi Parmensi dei Secoli X–XI</i>	1923
Torelli, P. Gatta, F.S.	<i>Le Carte degli Archivi Reggiani 1051–1060</i>	1938

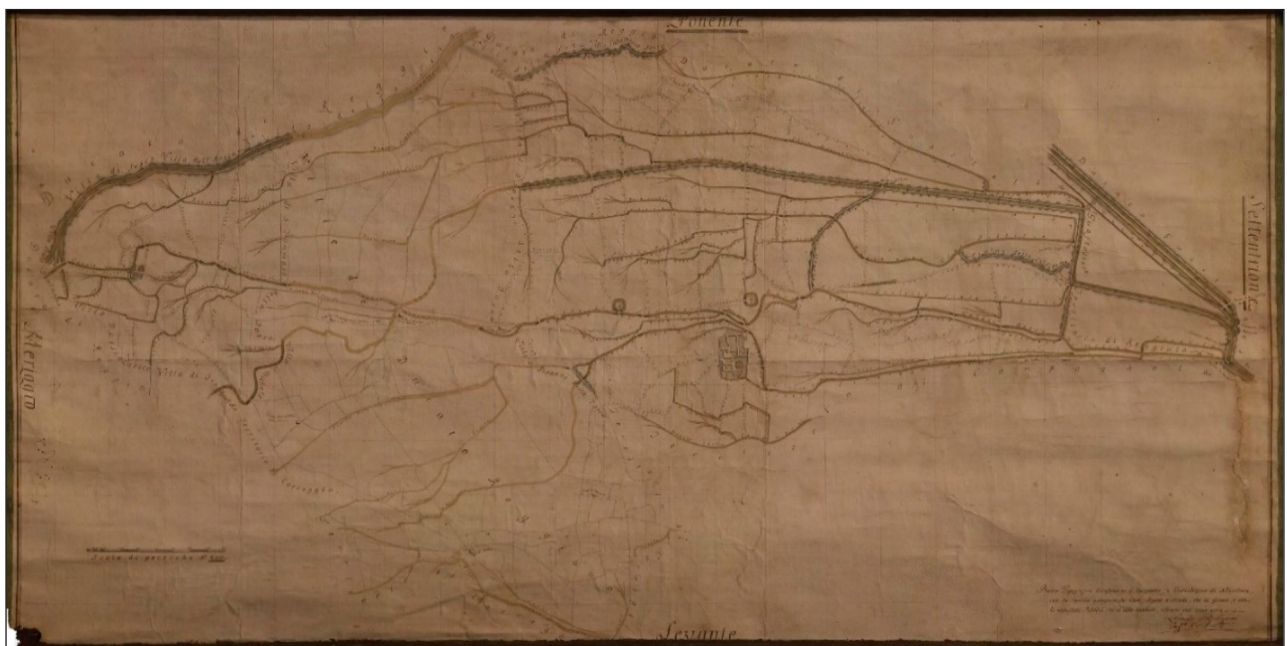


Figure 2: Topographic map of the Novellara (RE) municipality, 1774. “Congregazione delle Acque e delle Strade, Reggio e Reggiano – Grandi Mappe-4”. Courtesy of Ministero dei Beni e delle Attività Culturali e del Turismo–Archivio di Stato di Modena”. Authorisation prot. n. 1350 class. 28.01.02/21.2, 30 April 2019.

Table 2: List of the historical cadastral maps used to generate the *Historical Cadastral Map of Emilia Romagna Region 1850* by Emilia Romagna Region topographic service (Geoportale Emilia Romagna).

Source	Date	Scale
<i>Carta del Regno Sardo</i>	1853	1:50.000
<i>Carta del Regno Lombardo Veneto</i>	1833	1:86.400
<i>Carta del Ducato di Parma, Piacenza e Guastalla</i>	1828	1:86.400
<i>Carta del Ducato di Modena</i>	1849	1:86.400
<i>Carta del Gran Ducato di Toscana e dello Stato Pontificio</i>	1851	1:86.400

has a strong correlation with the river flow transport capacity and typically the finer fraction is deposited in a more distal position than the coarser fraction during flood events. The finer sediments provide an indication of waterlogged areas before Renaissance land reclamation since backswamps present a high concentration of clay and silty-clays sediments. On the other hand, the soil map provides a solid proxy for agricultural suitability. Since “heavy” and “light” soils require different types of plough, their distribution may have influenced human settlement dynamic in different epochs. Archaeological soil micromorphology (or micropedology) [17] enabled the micro-stratigraphical study of an early medieval rural village located at the limits of the medieval wetlands. This geoarchaeological technique led to understand the site process formation and the relationship between human settling practices and the fluvial geomorphology of the area [18].

Quality Control

The coordinates of sites were checked using the geographical information provided in the original publication when possible. Instead, we have georeferenced those archaeological sites missing geographical coordinates by using QGIS 3.4. Location and condition of archaeological and historical sites (when still recognisable on the surface) were checked directly with terrain survey. The medieval and post-medieval place names reported in the historical maps were checked with the use of historical documents. Thin Plate Spline (TPS) and cubic resampling methods (software QGIS 3.4) were employed to georeferencing the historical maps [19]. A minimum of three Ground Control Points (GCPs) [20] was detected but often the absence of a topographic regular grid made the georeferencing phase problematic. In this regard, the position of historic canals and ditches still active in the current drainage system served as reliable references. Moreover, to minimise the spatial inaccuracy of the historical maps the ‘back-dating’ approach has been employed: it consists in verifying and correcting the positions of the points in older maps (in this case, the historical maps retrieved at the Modena National Historical Archive) according to recent and most accurate cadastral maps (in this case WMS of the Historical Cadastral Map of Emilia Romagna Region – 1853) [15]. This method cannot resolve all the positional inaccuracies mainly due to scale differences [21] but represents the most reliable approach to georeference historical maps when other more accurate methods are not applicable [22].

Constraints

The level of accuracy of each record varies according to the sources used. In particular, uncertain periodization and localisation of some sites is mainly due to the incomplete information provided by the published excavation reports of sites investigated in the 19th and early 20th-century CE. Especially in case of medieval and post-medieval sites and channelisation dating is limited at *post quem* (i.e. after) or *ante quem* (i.e. before) data derived from historical cartography and documents. For example, if a chronicler reports that channelisation works began in the 1518 but not when they ended, we can consider the 1518 as a “post quem” year to date the opening of those canals. Similarly, in a map of the year 1518, all the drainages represented were active when the map was drawn, so the 1518 correspond to a “ante quem” year to date those features

(3) Dataset description

This digital archive includes all the data considered in the PhD project developed between the 2016 and 2019 at the Università degli Studi di Milano (Italy). The dataset contains especially the vectorial files of all the archaeological sites and the historical channelisation features recorded. Moreover, a GeoTiff of the Digital Elevation Model used in the project is included in the dataset along with all the original elevation checkpoints used to elaborate it. Finally, the regional soil map is stored in this dataset in a shapefile format. Lists of references and publications concerning the project results are stored in txt file format.

Object name

- *research_area*: a vector polygon layer representing the spatial extent of the study area from which the spatial dataset’s data have been collected (as .shp and with associated files).
- *elevation_checkpoints*: a vector point layer representing the regional elevation checkpoint considered to elaborate the Digital Elevation Model (as .shp and with associated files).
- *dem_50m*: a GeoTiff (.tif) raster layer representing the Digital Elevation Model (DEM, 50-m cell size) of the study area derived by the interpolation of *elevation_checkpoints.shp* through Inverse Distance Weighting (IDW) in GRASS 7² (using *r.idw*).
- *contemporary_drainage*: a vector line layer representing the contemporary drainage and irrigation systems active in the study area (as .shp and with associated files). The chronological period considered corresponds to: 20th – 21th century CE.

- *post_medieval_age_chs*: a vector line layer containing all the information retrieved in historical maps and documents about the post-medieval drainage systems in the area (as .shp and with associated files). The attribute table is organised in 3 columns: Name (the name of the canal if known); Dating (the date of opening if it is known. Otherwise dating is limited at *ante quem* or *post quem* data derived from medieval chronicles as well as cadastre; Condition (it refers to the current status of the features recorded). Concerning the Condition values, their meanings correspond to: *Active*: the feature is still active and presents the original shape; *Altered*: the feature is still active, but it was modified since its creation; *Buried*: the feature is no longer active; *Uncertain*: the feature location confidence is not 100%. The chronological period considered corresponds to: 15th century CE – 19th Century CE. In the attribute table, the column *Reference* reports the corresponding source listed in the *List_of_References.txt* file (es. TIRABASSI 1981).
- *medieval_age_chs*: a vector line layer containing all the information retrieved in historical maps and documents about the medieval drainage systems in the area (as .shp and with associated files). The attribute table follows the same structure adopted for *post_medieval_age_chs* vector layer. The chronological period considered corresponds to: 5th century CE – 15th Century CE. In the attribute table, the column *Reference* reports the corresponding source listed in the *List_of_References.txt* file (es. TIRABASSI 1981).
- *roman_age_chs*: a vector line layer representing the portions of the Roman drainage systems (i.e. in Latin “centuriation”) still recognisable in the contemporary fields pattern (as .shp and with associated files). The files contain only one column (ID) because no other data (dating or type) is necessary. The chronological period considered corresponds to 2nd century BCE – 5th century CE. In the attribute table, the column *Reference* reports the corresponding source listed in the *List_of_References.txt* file (es. TIRABASSI 1981).
- *watercourses*: a vector line layer representing the Enza River, Crostolo River, Po River and Secchia River (as .shp and with associated files).
- *palaeochannels*: a vector line layer representing the Enza River, Crostolo River, Po River and Secchia River palaeochannels (as .shp and with associated files).
- *soil_map*: a vector polygon layer representing the soil sediment types of the area (as .shp and with associated files). Soil texture is categorised with values from 1 (clay) to 7 (sand) according to the granulometry of the sediment (from the finer to the coarser). The attribute table is organised in 2 columns: *Type* (it refers to the soil texture type) and *Value* (it refers to the sediment granulometry from the finer (clay = 1) to the coarser (sand = 7)).
- *Bronze_age_sites*: a vector point layer representing all the Bronze Age archaeological sites (as .shp and with associated files). The attribute table is organised in four columns: *Location*, *Type*, *Dating* and *Condition*. All the archaeological sites were retrieved from published works and updated with terrain surveys. When data are not available (“n.a.” in the attribute table), it means that it was not possible to retrieve any information with 100% confidence precision. It was preferred to not record uncertain data. The chronological period considered corresponds to: 1600 – 1150 BCE. In the attribute table, the column *Reference* reports the corresponding source listed in the *List_of_References.txt* file (es. TIRABASSI 1981).
- *Neolithic_chalcolithic_sites*: a vector point layer representing all the Neolithic and Chalcolithic archaeological sites (as .shp and with associated files). The attribute table follows the same structure and rules adopted for *Bronze_age_sites* vector layer. In the attribute table, the column *Reference* reports the corresponding source listed in the *List_of_References.txt* file (es. TIRABASSI 1981). As mentioned above, Neolithic and Chalcolithic archaeological sites are reported as supplementary data for their relevance in Prehistoric studies in the area.
- *Iron_age_sites*: a vector point layer representing all the Iron Age archaeological sites (as .shp and with associated files). The attribute table follows the same structure and rules adopted for *Bronze_age_sites* vector layer. The chronological period considered corresponds to: 900 – 300 BCE. In the attribute table, the column *Reference* reports the corresponding source listed in the *List_of_References.txt* file (es. TIRABASSI 1981).
- *Roman_age_sites*: a vector point layer representing all the Roman Age archaeological sites (as .shp and with associated files). The attribute table follows the same structure and rules adopted for *Bronze_age_sites* vector layer. The chronological period considered corresponds to: 300 BCE – 500 CE. In the attribute table, the column *Reference* reports the corresponding source reference listed in the *List_of_References.txt* file (es. TIRABASSI 1981).
- *Medieval_age_sites*: a vector point layer representing all the Medieval Age archaeological sites (as .shp and with associated files). The attribute table follows the same structure and rules adopted for *Bronze_age_sites* vector layer. The chronological period considered corresponds to: 500 CE – 1400 CE. In the attribute table, the column *Reference* reports the corresponding source reference listed in the *List_of_References.txt* file (es. TIRABASSI 1981).
- *Post_medieval_sites*: a vector point layer representing all the Post-Medieval Age archaeological and historical sites (as .shp and with associated files). The attribute table follows the same structure and rules adopted for *Bronze_age_sites* vector layer. The chronological period considered corresponds to: 1400 CE – 1850CE. In the attribute table, the column *Reference* reports the corresponding source reference listed in the *List_of_References.txt* file (es. TIRABASSI 1981).
- *List_of_published_works*: a .txt file reporting the list of scientific publications that used the dataset presented in this paper.
- *List_of_References*: a .txt file reporting the source reference where the data were collected.

Data type

Primary and secondary data.

Format: ESRI shapefiles (.shp), GeoTiff (.tif), and text file (.txt).

Creation dates

Dataset was created between 01/10/2016 and 01/10/2019.

Dataset Creators

Filippo Brandolini, Data Collector, Università degli Studi di Milano (ORCID ID: 0000-0001-7970-8578).

Language

English.

License

CC0

Repository location

The dataset is available at JOAD Dataverse Repository of Harvard University Dataverse.

<https://doi.org/10.7910/DVN/JSYZ3H>

Publication date

21/02/2020

(4) Reuse potential

This dataset has been used for geospatial analysis to assess the role of alluvial geomorphology on Late-Holocene settlement strategies and to quantify the spatial correlation between Roman and Medieval sites [23]. Further geospatial analysis could investigate the relationship between geomorphology and archaeological sites in protohistoric or post-medieval periods, widening our knowledge about the socio-cultural factors that altered the natural landscape evolution of the area. Moreover, the detailed information regarding the periodisation of drainage systems could be reused in landscape management plans to promote conservation and public engagement of the cultural landscape features. Finally, the geopedological and archaeological data recorded represent an excellent case study for any researchers interested in alluvial environments and/or in archaeological quantitative analysis.

Notes

¹ WMS available at: http://servizigis.regione.emilia-romagna.it/ctwmetadatiRER/metadatoISO.ejb?stato_IdMetadato=iOrg01iEnP1idMetadato5101.

² GRASS Development Team, 2016. Geographic Resources Analysis Support System (GRASS) Software, Version 7.0. Open Source Geospatial Foundation. Electronic document: <http://grass.osgeo.org>.

Acknowledgements

This study and the PhD project were realised in the framework of the research program “Dipartimenti di Eccellenza 2018–2022” (WP4–Risorse del Patrimonio Culturale) awarded to the Dipartimento di Scienze della Terra “A.

Desio” of the University of Milan (Italy) by the Italian Ministry of Education, University, and Research (MIUR). The author thanks the staff of the Modena National Historical Archive for their support during the image acquisition of historical cartography. Finally, the author is grateful to the two anonymous reviewers for their constructive criticism and comments.

Competing Interests

The author is social media editor for Journal of Open Archaeology Data, which is on a voluntary basis. However, he did not participate in any part of the editorial process. The author declares that he has no competing interests.

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How to cite this article: Brandolini, F 2020 Late-Holocene Human Resilience in a Fluvial Environment: A Geoarchaeological Dataset for the Central Po Plain (N Italy). *Journal of Open Archaeology Data* 8: 4. DOI: <https://doi.org/10.5334/joad.62>

Published: 04 May 2020

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