GEOMORPHOLOGICAL AND ANTHROPIC CONTROL OF THE DEVELOPMENT OF SOME ADRIATIC HISTORICAL TOWNS (ITALY) SINCE THE ROMAN AGE

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Abstract: The geomorphological analysis of historically urbanized areas is the best scientific way to understand how the extant geomorphological factors conditioned urbanization. It also provides a baseline to enable comparisons to be made with the modern environment. This paper considers four urbanized historical sites on the Adriatic coast (Italy) that owe their urban development to particular geomorphological and environmental conditions that were modified over the centuries from the Roman age to the present day. The focus here is on the evolution of the shoreline and associated geomorphic variables (streambeds and river mouths migration). These factors are fundamental for determining the development of a city, both as basic boundary elements – therefore including defence and protection – and also for the development of harbours.

Key words: urban geomorphology; historical towns; coastal sites; Italy

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Introduction

The reconstruction of the historical events of a territory can never be separated from the analysis of changes in the physical landscape (Panizza, Piacente 2014). Geographical circumstances have conditioned the choice of settlement, the territorial infrastructure, and the type of economy; in other words, the lives of the people who live in that territory (Dincauze 2006). On the other hand, it is also true that the human presence has affected the evolution of the physical landscape; the massive agricultural use of the land, the strong control of rivers, and dense settlements with a resulting network infrastructure are all elements that have inevitably influenced particular phenomena, or have modified the climate change response (Goudie 2013).

Our study covers the Adriatic coastal sector of northern-central Italy (South Emilia Romagna-North Marche regions) between the seaside towns of Rimini (the Roman *Ariminum*) and Senigallia (*Sena Gallica*) (Fig. 1).

The Roman sites discussed here were towns connected to maritime activities and harbours at, or close to, the mouths of main rivers. Today,

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however, they are enclosed in the coastal plain, some hundreds of metres inland with respect to the modern shoreline, thus accounting for significant post-Roman seashore advances (Calderoni et al. 2010). The urbanized historical sites on the Adriatic coast – Rimini, Pesaro, Fano and Senigallia – are taken into account because of their urban development due to particular geomorphological and environmental conditions that have changed over the centuries from the Roman age to the present day.

The analysis of each site took advantage of a multidisciplinary approach, consisting in an integrated analysis of geological-geomorphological (e.g., maps, characterization of the more recent sediments and information on morpho-sedimentary evolution), archaeological (e.g., monuments, excavations, finds) and historical (e.g., archive information, historical maps) data. Geomorphological and geological data combined with the analysis of recent sediments (both surface probes and subsurface/dig samples and sediment cores) provided an outline of recent modifications framed in the wider context of the Holocene geomorphological evolution of the coastal area (e.g., Coltorti 1997, Calderoni et al. 2010). Archaeological and historical data, also related to evidence from particular toponyms, had the dual function to confirm certain geomorphological evidences and to highlight changes less obvious on the geological-geomorphological basis (Elmi et al. 2001, De Donatis et al. 2012). Specifically, peculiar archeological elements, such as port facilities, specific stems or shrines, bridges, urban walls, etc., were valuable indicators for the physiographic arrangement of the territory during the life stages of settlements (e.g., Luni 1992, Morigi 1999). Finally, geophysical surveys (by means of ground penetrating radar, resistivity meter, seismograph) combined with excavation and survey data revealed of the uttermost importance in Senigallia, where a detailed 3D reconstruction of the Roman buried surface was realized (Silani et al. 2016).

Geological-geomorphological setting

The study covers the Adriatic coastline between the southeastern extremity of the Po Plain (Rimini sector) and the Northern Marche Apennine forehills (Fig. 1). The area sits at the transition from the Emilia Romagna-Marche Apennines, which are part of the northeast-vergent fold-and-thrust belt of the Northern Apennines, and the Adriatic Sea Po Plain, which is the present-day remnant of the foredeep (Coward et al. 1999). The bedrock of the coastal strip consists of marine Plio-Pleistocene arenitic and pelitic deposits overlaying Upper Miocene marly, siliciclastic and evaporitic formations. The Po Plain and the modern coastal plain, in turn, consist of Pleistocene-Holocene alluvial to marine clastic sediments. The central-northern Adriatic Sea, due to its depths, which do not exceed –50/–70 m, experienced repeated emersions driven by glacial stages in the late Quaternary, becoming a wide extension of the alluvial Po Plain (Trincardi et al. 1994). The eventual Holocene sea-level rise caused the shoreline to break into the Apennine foothills of the Marche region (Lambeck et al. 2004) and the Romagna Po Plain to contract to roughly to its modern extension.

Severe anthropogenic subsidence (2–15 mm a^{-1}, mainly due to groundwater withdrawal and gas extraction) has affected the Romagna coastal plain for many decades (Bitelli et al. 2010). Conversely, the natural subsidence (chiefly tectonic and sediment compaction) that occurs in the Po Plain Adriatic basin decreases towards the Apennine foothills, reducing to zero close to the present-day coastline of the Rimini sector (Elmi et al. 2003). In turn, a long-term tectonic uplift of only 0.15 mm a^{-1} can be extrapolated for the Marche-Romagna forehills (Antonioli et al. 2009).

With the only exception being the cliff of Mount San Bartolo (Fig. 1), which has retreated by 300 to 1000 m in the last 6000 years (Colantoni et al. 2004), the modern coast is accreted by an up to 1.2 km-wide depositional plain joining sand-gravel beaches seawards. The major South Emilia Romagna-Northern Marche rivers (i.e., from the NW, the Marecchia, Conca, Foglia, Metauro, Cesano and Misa rivers, Fig. 1) cross-cut the coastal plain, directly flowing into the Adriatic Sea. The plain underwent a rather complex suite of both local and generalized advancement and retreat episodes starting in the mid-Pleistocene. Nevertheless, the plain formed for the most part after the Holocene maximum flooding, with the very latest modifications largely dismantling and/or concealing the previous

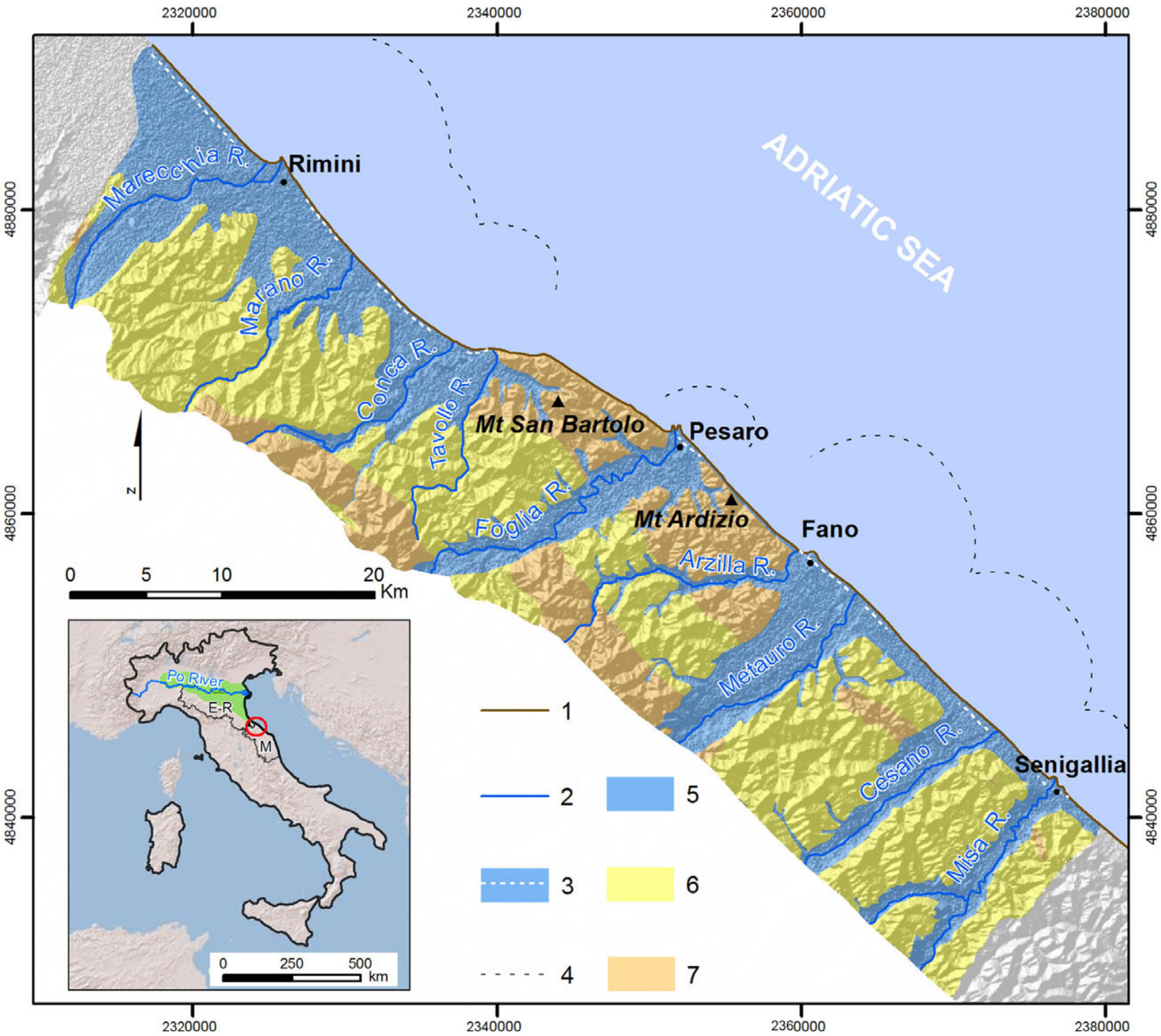

Fig. 1. Location map and geological sketch of the Southern Emilia Romagna-Northern Marche coastal area. Main frame: 1 – coastline; 2 – river; 3 – Holocene wave-cut scarp; 4 – early-Holocene fan assumed extension; 5 – Pleistocene-Holocene fluvial and coastal deposit; 6 – Plio-Pleistocene pelitic and arenitic marine deposit; 7 – Miocene marly-calcareous, evaporitic and terrigenous unit. Lower-left frame: E–R – Emilia Romagna region; M – Marche region; in green, Po-Plain extension.

ones (Nesci et al. 2012). The complex evolution of the plain is stressed by series of small scarps, flexures and gravel ridges. Notably, wave-cut scarps that are 1–8 m in height strike parallel to the modern coastline at the seawards end of the river valleys, where the Roman seaside towns described here are also found. In the Marecchia, Foglia and Misa plains, the scarps are smoothed and partly concealed by urbanization, while they are sharp and well developed close to the Metauro and Cesano outlets. According to Nesci et al. (2012), these scarps were carved out by the wave erosion of alluvial fans that originally extended for more than 5 km off the modern shoreline (Fig. 1), which formed in the uppermost Pleistocene-early Holocene in conditions of still rather low sea levels. These fans, which stack unconformably on older, larger and thicker fans formed by the same rivers in full glacial conditions, presumably depend on the sedimentary overburden caused by the extensive upstream incision of alluvial-fills (i.e., terrace formation in the onshore sectors of the valleys). The scarps carved out of fans as the early Holocene shoreline was shifting landwards became higher when the previous fan-height/degree of convexity was greater, which was in turn a function of gravel supply to the fan. As a result, low-relief scarps formed at the mouths of the Foglia and Misa rivers, while relatively high relief forms are found in the Marecchia, Metauro and Cesano valleys.

About the mid-Holocene, the scarps presumably achieved a position which, apart from fewer shoreline fluctuations, was maintained up to Roman times. Such an appraisal, which was substantiated by archaeological evidence of fluvial harbours and other remains, is why these scarps are often referred to as the best evidence of the shoreline in Roman times (Elmi et al. 2001). After the Roman times-Early Middle Ages, the coastal plain advanced, shifting by about 300–500 m seawards to roughly its modern position. Contrasting episodes of seawards shifting and recession to the "Roman position" of the shoreline took place, until an ultimate sedimentary regressive tendency was established from the 15th–16th century up to the end of the 19th century, roughly coinciding with the Little Ice Age (L.I.A. 1450–1850). This latter advance resulted in the construction of the entire sector of the plain facing the fan-truncating scarps, thus producing the modern coastal plain-beach system.

Historical sites

Four urbanized historical sites on the Adriatic coast are described: Rimini, Pesaro, Fano and Senigallia.

Rimini (*Ariminum*)

The town of Rimini is located at the southernmost end of the Po Plain, where it narrows before terminating against Mount San Bartolo (Fig. 1).

The geomorphology of the site mainly depends on the action of the Marecchia River, coupled with marine processes in Holocene times. In fact, Rimini rests above the Marecchia alluvial fan that extends 94 km^2 (40% below the modern Adriatic Sea). The alluvial fan experienced multiple growth stages, spanning several glacial-interglacial cycles in mid-late Quaternary times. Moreover, given the long-term subsidence affecting the modern offshore, it developed a comprehensive alluvial sediment thickness of about 300 m. With the Holocene maximum flooding, the sea level rise brought the coastline about 0.5–1.5 km inland (Fig. 2), effectively reworking the alluvial fan surface and shaping a wave-cut scarp that is partially recognizable today. Through complex sequences of advances and retreats, the subsequent sedimentary regression drove the coastline to shift northeastwards to its modern position. Within this framework, geomorphological and anthropic factors have interacted for more than two millennia in shaping the urban areas of Rimini, with acmes in natural changes probably matching periods of climate deterioration.

Although the inland areas have been populated since early Paleolithic times, it was in the Iron Age (IX–VI century BC) that the Villanovian culture thrived in the territory of Rimini (Antoniazzi 1996). Later, the plain of Rimini has been inhabited continuously from the VI century onwards (Fontemaggi, Piolanti 2010).

It was in 268 BC that Rimini became a Roman colony (*Ariminum*). Indeed, between the I and III centuries AD, *Ariminum* was located amid the Marecchia and Ausa rivers, in proximity to the shoreline which, at that time, ran close to the city walls following the so called "Roman" wave-cut scarp (Elmi et al. 2001). The location of the major Roman monuments reflects this geomorphological arrangement as follows: the Tiberium Bridge (I century AD) has been enabling the Marecchia River to be crossed for two millennia. A Roman bridge of the same age, which was destroyed in 1944 (Cesaretti 2004), crossed the Ausa stream in front of the Augustus Arch (I century BC). The Surgeon's House and the Roman amphitheatre, both dating back to the II century AD, attest that the urban extent reached areas close to the seaside at that time.

Many clues suggest that during the climate deterioration of the Early Middle Ages, the Marecchia and Ausa river patterns changed frequently and drastically. The toponym San Martino in Riparotta (from the Latin *ripa rupta* = broken riverbank or broken levee) appeared around the XI century as evidence of a fluvial diversion that occurred about that time. This diversion caused the mouth of the Marecchia River to shift 2 km northwest with respect to its Roman position (i.e., slightly downstream from the Tiberium Bridge). Such modifications have also been reported in later historic testimonies. It was in this period that the river name changed from Ariminus to Maricula, meaning little sea,

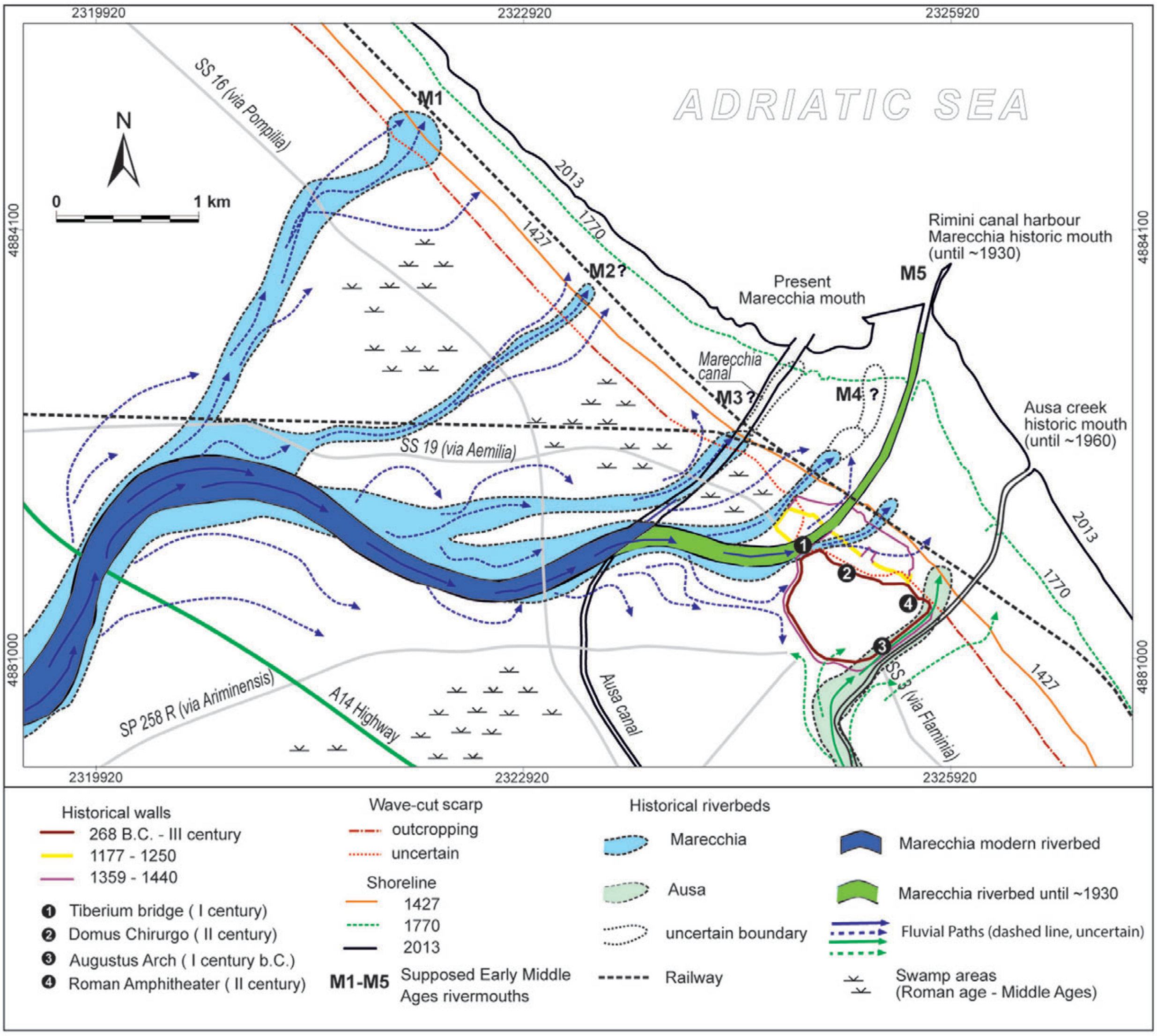

Fig. 2. Morpho-evolutive reconstruction of the Rimini (*Ariminum*) site.

as a description of the hydrological instability in the river mouth area: from the Riparotta to the Roman mouth, the land was swampy and the river channels filled up and frequently changed their path.

In the early 1400s, canalization supported by the Malatesta family forced the terminal reach of the Marecchia River within an artificial riverbed, exploiting it as the city harbour, which is a position and function that were maintained until 1938 (Fig. 2).

A continuous sedimentary advancement of the shoreline can be reconstructed starting around the XV century until today. South of the harbour, the coastline advanced more than 1400 m, as testified by the ceaseless work to lengthen the port sides (Fig. 3).

From the XV to the XIX century, the Marecchia River frequently aggraded and overflowed, flooding the town centre. This tendency can be associated with the climate deterioration of the L.I.A.

Seemingly, in Rimini, the coastline maintained roughly the same position as in the Roman age until the year 1000. This is an anomaly that is currently difficult to explain, because: the shoreline subdued some perceptible advancement in the northernmost areas during the Early Middle Ages (Amorosi 1999); and the centurial net around Rimini was partly concealed by alluvium in the same period (Veggiani 1988).

In summary, based on stratigraphic, geomorphological and historical records (e.g., Veggiani 1983, Morigi 1999, Delucca 2000), an evolution

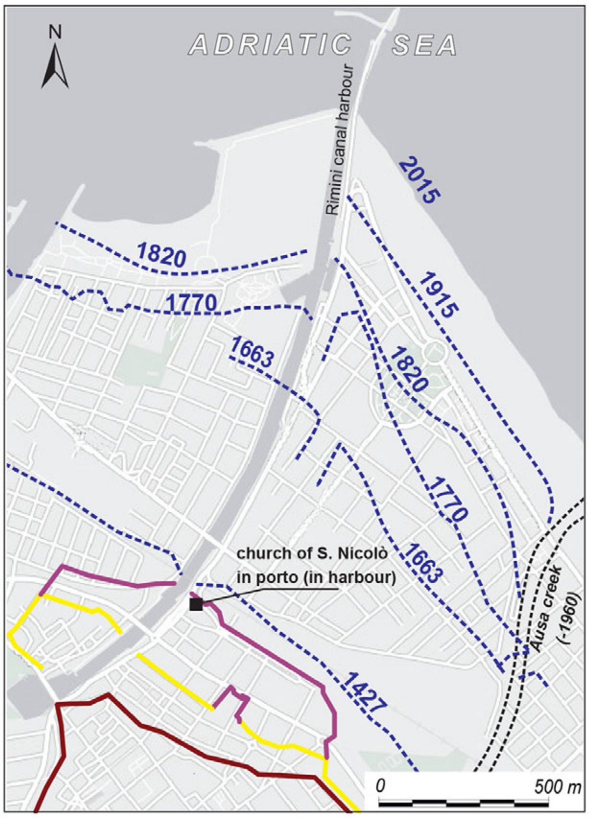

Fig. 3. Coastal advance since the XV century in the harbour sector of the Rimini site.
Solid colour lines: historical town walls, symbols on Fig. 2.

frame is proposed here in which the Marecchia River developed at least five different mouths in the Early Middle Ages, shifting over a short time span (a few centuries, Fig. 2). This shift would preclude the formation of a stable delta during the climate deterioration of the Early Middle Ages. It is, however, difficult to establish a straightforward time sequence. Indeed, the riverbeds may have been active for short periods, or could have been revisited more than once. The existence of other riverbeds cannot be excluded, given the lack of a regular stratigraphic drilling grid. Different behaviour can be assessed for the L.I.A. when the river, confined between artificial banks, experienced repeated overflows and produced a delta-like accumulation lobe (Fig. 2), also causing the sedimentary drowning of Tiberium Bridge under several metres of gravel.

Pesaro (*Pisaurum*)

Pesaro (*Pisaurum* in Latin) was founded near the mouth of the Foglia River, in the uppermost part of the Northern Marche region (Fig. 1) and in a very favourable position that determined its urban development. The morphology of the area of the Pesaro coastal plain appears to be noticeably different from the other neighbouring rivers, Marecchia and Metauro. Such conformation is mainly due to the tectonic structure, to which should also be traced the configuration of the lower plain of the Foglia upstream of Pesaro, which is characterized by an extremely low slope. The relief anticline, which partially "closes" the river mouth, has partially hindered the outflow of the Foglia River towards the sea, favouring the formation of large fluvial bends and the accumulation of predominantly silty-sandy alluvial sediment, which also comes from the secondary streams (Genica creek). *Pisaurum* rose on an area of terraced alluvial fan shaped by the Foglia River and the Genica creek. The terraced surface, where the Roman town stood, presents a straight scarp towards the sea that connects the two cliffs of San Bartolo and Ardizio mounts (Fig. 4). This scarp represents the morphological evidence of marine advancement on the Pesaro plain, and thus constitutes the shoreline that existed at the time of Roman settlement. In 184 BC, the first colony named *Pisaurum* stood over an old Roman settlement, which was probably erected in 232 BC (Dall'Aglio, Nesci 2013). The recall element consisted of the possibility of exploiting the mouth of the Foglia River as a port. In fact, the location of the Roman city was close to the mouth of the river, and the Roman walls towards the sea were positioned just above the escarpment, which limited the Roman shoreline. As mentioned above, the Foglia is a particularly unstable river due to the reduced slope of the valley plain. This instability was well-known to the Romans; in two land survey treatises, *Pisaurus* is used as an example of the need to adopt special arrangements in the organization of the territory in order to minimize the disputes that were related to variations in the course of the river (Dall'Aglio, Nesci 2013). To avoid the dangers of the river, the Roman city, as well as the pre-Roman village, stood on a plain that is elevated about 5 metres higher than the area where the Foglia River flowed (Fig. 4). On the other side, another more modest sloping slope protects this area of the city from the action of Genica creek. The study of the evolution of the coastline and river network near the town, put in relation to historical and archaeological sources,

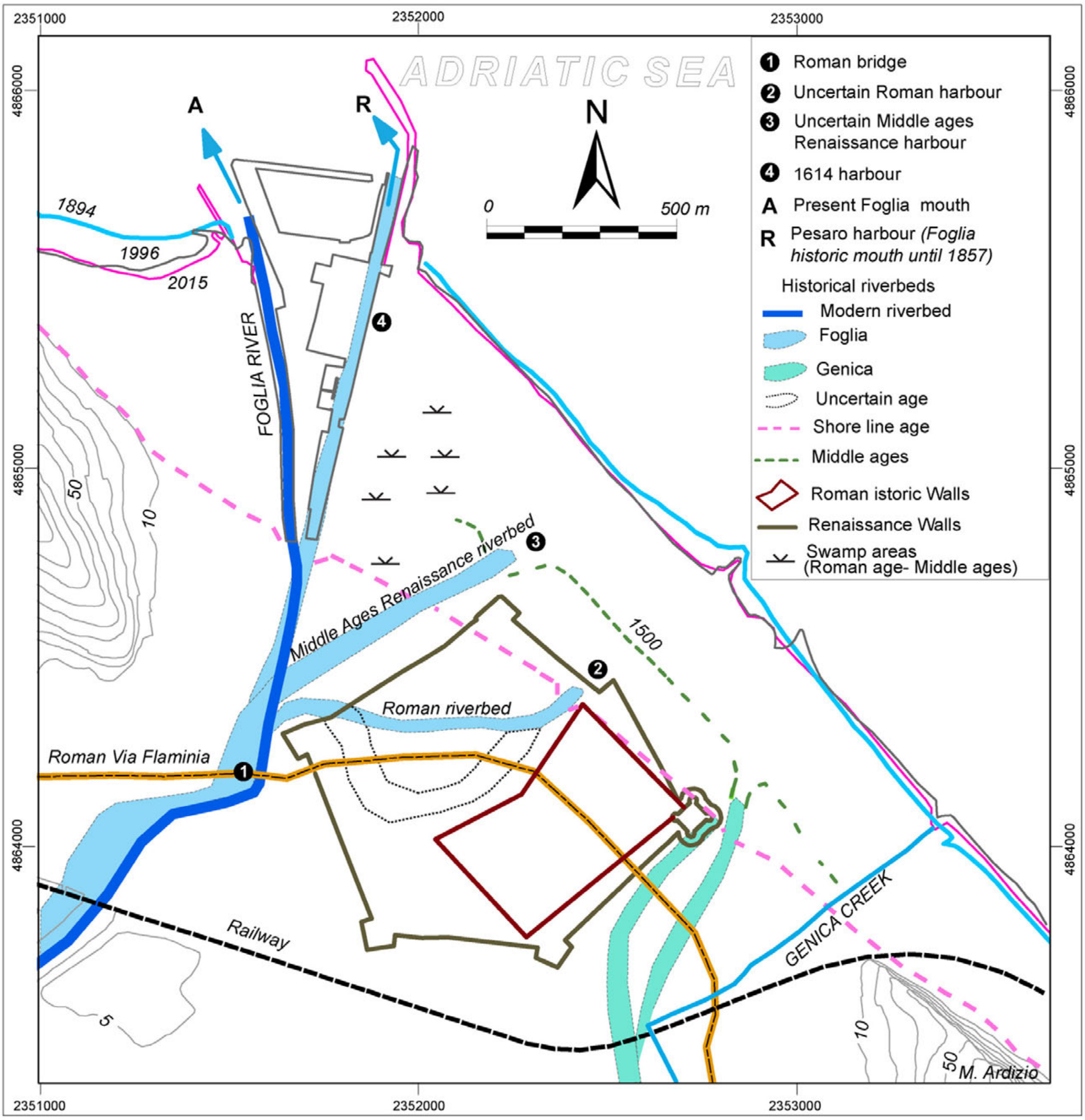

Fig. 4. Morpho-evolutive reconstruction of the Pesaro (*Pisaurum*) site.

made it possible to recognize the migrations of the mouth of the Foglia River and, therefore, speculate on the shift of the harbour during various epochs. Different assumptions have been made (Fig. 4), but there are still no reliable data on the location of the Roman port (Campagnoli et al. 2005).

In the Middle Ages, the instability of the Foglia River increased due to both climate changes and the fall in the territory's population which meant that less ongoing maintenance work on the rivers was required. The increased rainfall and the greater strength and frequency of storms caused by the general climatic deterioration accentuated the difficulties of the outflow, thus favouring floods and water-logging. In the Medieval/Renaissance period, the city increased in size and the Foglia River was relocated further north, under the Renaissance walls. The coastal aggradation increased after the Renaissance, and the harbour was filled with sediment and abandoned. Subsequently, we have news of the river mouth roughly where it is now. The mouth was separated from the port after the unification of Italy (1861).

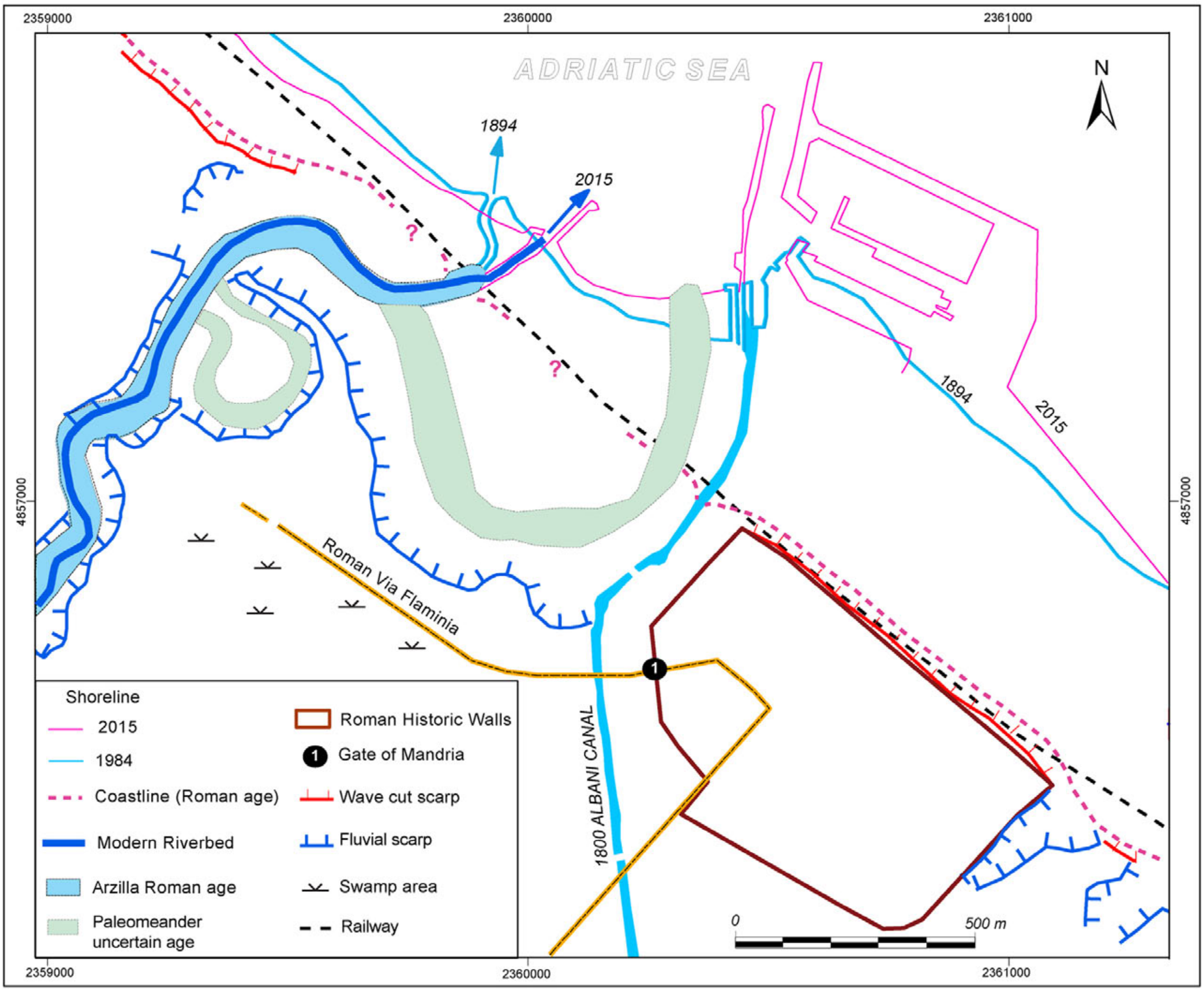

Fig. 5. Morpho-evolutive reconstruction of the Fano (*Fanum Fortunae*) site.

Fano *(Fanum Fortunae)*

Fano is located on the sea and, unlike the other three towns surveyed, the mouth of the main river was not a factor in the location of the city centre. In fact, *Fanum Fortunae* is not located near the mouth of the Metauro, which runs about 3 km further south of the city (Fig. 1). The ending of the main *Via Flaminia* towards the sea is instead what affected the construction of the Roman city. In fact, *Fanum Fortunae* is located where the road reaches the coast, and then continues along the coast north towards Pesaro and Rimini (Fig. 5). *Via Flaminia*, contrary to what we expected, did not come from the northern side of the walls, because the Roman walls have a curtain here that is not interrupted by doors. The only gate from which the Consular Road could exit is *Porta della Mandria*, which opens in the northwestern section of the walls and is characterized by an oblique course with respect to the interior design (Fig. 5). This is an obvious anomaly, the explanation for which is to be found in the morphology of the coastal plain. Northwest of Fano town is a lowered area bounded upstream by a semicircular scarp (Fig. 5). This scarp is the result of an old fluvial engraving and corresponds to a large paleomeander of the Arzilla River. Currently, Arzilla is a small river, although it has a fairly wide basin and its sediment has helped to build the coastal plain, together with the sediment from the Metauro River. The amplitude of the paleomeander is not attributable to the current dynamics of the Arzilla River. Its radius of curvature is not, in fact, consistent with the amplitude of the current meanders, which have considerably smaller dimensions (Fig. 5). It is, however, more easily attributable to a much larger river that spread over the alluvial plain when the shoreline was very backwards. Such a condition occurred about 11,000 years ago when the Adriatic Sea was considerably more backwards than it is now (Nesci et al. 2012). The subsequent rise of the sea changed the dynamics of the rivers considerably up to Roman times, with the shoreline being more backwards than it is today, corresponding to the scarp that runs parallel to the present shore line, roughly where the railway line is now set. This feature is known as the Roman wave-cut scarp (Fig. 5). *Fanum Fortunae*, unlike today, was very close to the sea, not only to the east, but to a certain extent to the north, where the depression opened up from the ancient scarp engraved by Arzilla. At this point, it is clear that the trend of *Via Flaminia* within the city is only apparently anomalous, as its exit to the Gate of Mandria is due to the need to avoid the lowlands and valleys at the mouth of Arzilla River (Fig. 5). The paleomeander thus laid close to the sea and constituted a kind of protected gulf. The presence north of Fano of a low area near the sea once again raises the problem of the position of the port of *Fanum Fortunae*. The city in the first Imperial Age was equipped with a landing place (Dall'Aglio, Nesci 2013), which could not have been located at the mouth of the Metauro, given the distance separating the city from the river. On the basis of the paleogeographic reconstruction, therefore, it should not be overlooked that, at least in the first Imperial Age, the depression delineated by the ancient riverside of Arzilla would be exploited. The paleomeander was an excellent morphology for a canal harbour. Subsequently, due to the Arzilla solid load, the depression of the Augustan ages filled and the sediment, along with that discharged by the Metauro coastline, contributed to a shift of the shore northeast. The expansion of the beach at the eastern walls of the city and the disposal of the old harbour thus led to the emergence of a new landing. The work for the construction of the *Portus Borghesius*, which was in the Arzilla depression too, began in 1612. Moreover, at the start of the following century, the artificial channel "Liscia of Vallato Albani" was created in order to increase stream power, thus preventing the silting of the channel.

Senigallia *(Sena Gallica)*

Senigallia is a seaside town located on the mouth of the Misa River, in the Northern Marche region (Fig. 1). *Civium Romanorum* of *Sena Gallica* was the first Roman colony in this sector of the Adriatic coast (Bandelli 2002, Lepore 2013). It developed in a place already settled by an earlier population (V–IV centuries BC), as the discovery of a pre-Roman domestic building (*Via Cavallotti*) attests (Lepore et al. 2012). The date of its foundation is controversial, as literary sources provide contradictory information. According to Ortolani and Alfieri (1953), the foundation of the colony dates to 284 BC, after the definitive defeat of the *Senones*, a Celtic Gallic population who at that time hold the Adriatic coast of central Italy (Grassi 1991), handed over the entire *ager Gallicus* to the Romans. However, an older, pre-colony Roman settlement must be assumed based on the discovery of a shrine (*Via Baroccio*, Lepore 2012) with two phases of use, the first dating to the early 3rd century BC and the second to the end of the same century. The first settlement probably had the aim of controlling (even militarily) the connection between commercial maritime routes and land paths towards the Apennines within land which, at that time, formally still belonged to the *Senones* (Frey 1992). *Sena Gallica* was actually the natural arrival point for the connection between Rome and the Adriatic coast north of Ancona before the opening of *Via Flaminia* in 220 BC. This is because the Misa valley allowed *Sentinum* (the modern Sassoferrato) to be reached easily and, from there, the Apennines could be crossed towards Rome. This was an ideal place to develop a colony that was able to profit from the commercial benefits arising from its seaside location.

The settlement took advantage of the geomorphology of the site (Silani et al. 2016). It exploited the Misa River fan, truncated seawards by a rather low wave-erosion scarp today concealed by recent sediment and buildings. The relict fan apex was dissected by minor streams, to such an extent that some slight topographic mounds were the only remains of the primitive depositional surface.

These mounds close to the river mouth, enclosed by the meandering course of the Misa River, the Sant'Angelo/Penna stream, marshy depressions and the sea, formed the most favourable site to establish a protected settlement. Indeed, the fair elevation above the surrounding land prevented *Sena Gallica* from flooding and, at

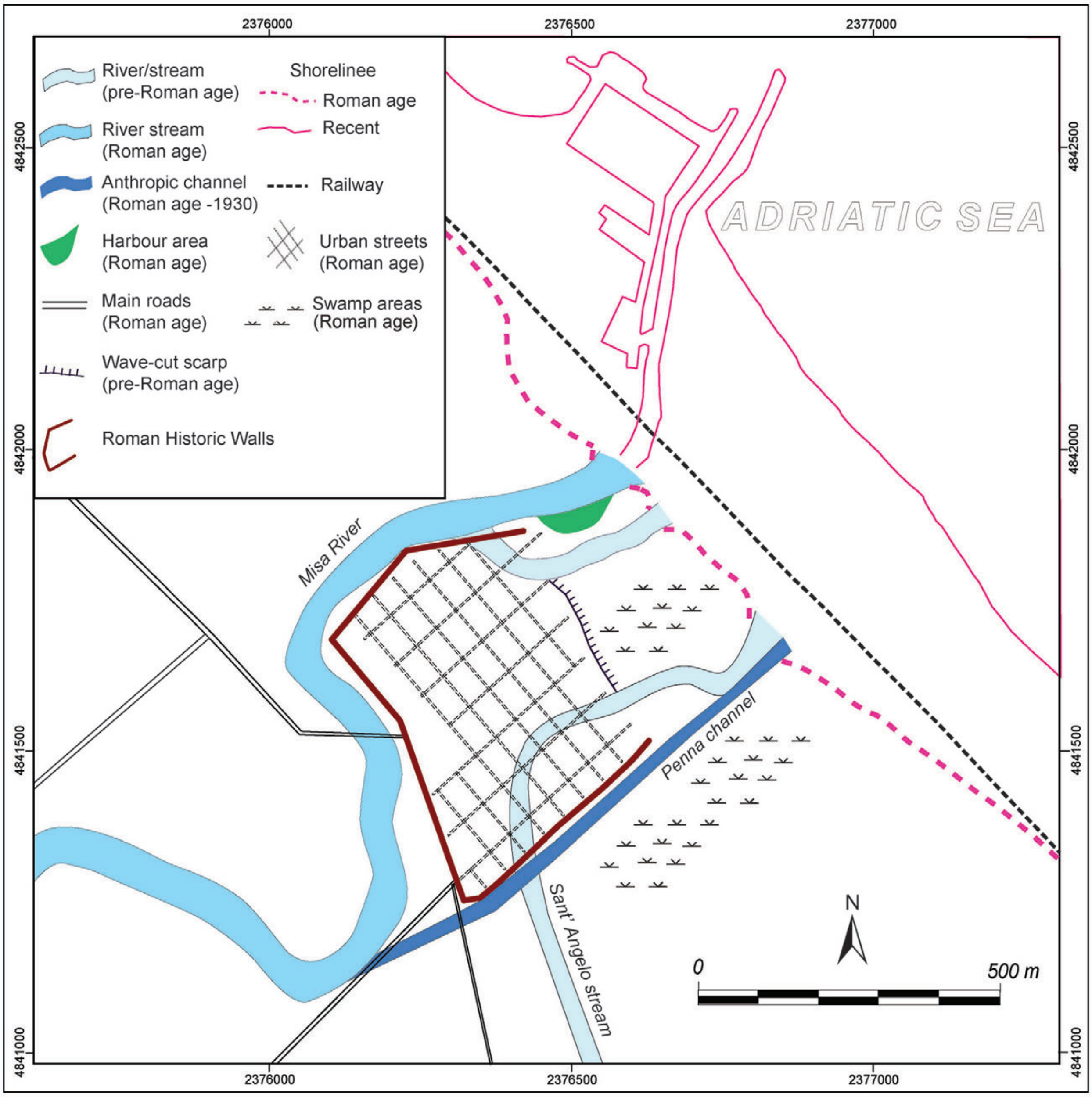

Fig. 6. Morpho-evolutive reconstruction of the Senigallia (*Sena Gallica*) site.

the same time, coastal swamps and ponds preserved it from storm waves.

The configuration of the Roman buried paleosurface of *Sena Gallica* has been attested by the identification, characterization (archaeological excavations) and reconstruction (historical sources, geophysical prospection and probings) of a buried stratigraphic level consisting of dark brown clay (paleosoil) lying above late Pleistocene-early Holocene alluvial sediment (Silani et al. 2016). *Sena Gallica,* which covers the entire surface between the Misa and the S. Angelo/Penna streams (Fig. 6), is a much larger town than the other colonies of this period, and this is an anomaly that currently cannot be properly explained. The urban tissue of *Sena Gallica* (Fig. 6) highlights close relationships and mutual influence between landforms and human activity. Some of the paleomorphological elements were exploited by the Romans without significant modifications, while others were substantially modified and adapted for specific needs. The reconstruction of the buried soil attests that, during the pre-colony phase, the surface morphology beneath the town was still rather irregular; it was with the colony foundation that the surface was gradually flattened and adapted to the needs of urban planning. The Roman coastline is attested with good confidence. The seawards margin of the urban area roughly matches the edge of a pre-roman wave-cut scarp. These features limit the maximum expansion of the inhabited area when the colony was founded and stress that the northeastern side of the town was naturally fortified by coastal swamps and the sea. An urban wall was built as the colony was founded (284 BC). Along the Misa River (northwestern and southwestern sides of the town), the wall exploited the fluvial channel as a defensive element. At that time, this was still characterized by a slight bend (Fig. 6), which was artificially straightened (De Donatis et al. 2012) only much later (1757–1760). Conversely, on the southeast side of the town, a significant modification of the natural hydrographic pattern accompanied the building of the urban walls. Here, an abandoned channel bend of the S. Angelo/Penna stream is clearly detectable beneath the Roman urban net (Fig. 6), demonstrating that this brook was diverted and straightened as early as Roman times and aligned with the eastern wall to improve the defensive system of the urban area.

The Roman hydraulic work, besides its defensive value, also prevented the town from flooding. In fact, the dismantling of the Roman walls in the Middle Ages left a large part of the town exposed to floods, and repeated post-Roman episodes of overflow occurred, as attested in the urban area by archaeological digs exposing Roman artefacts buried beneath the alluvium.

Concluding remarks

Taking as example four urbanized town on the Adriatic coast, this paper highlights as historical and present human urbanization are conditioned and, at the same time, blended with geomorphological factors, which influence both the original structure and the future development of several towns. In particular, the study focuses on the evolution of the shoreline and changes in the position of streambeds and river mouths, which are fundamental factors for determining the development of a town, both as basic boundary elements of defence and protection and as preferred communication path. The integrated analysis of these sites is certainly an important tool for urban planning, not to mention a primary data source for historical urban planning. In fact, a deeper understanding of the rates of geomorphological change in a historical time-frame can lead to better plans that do not assume the fixed, unchanging nature of the physical elements upon which older plans depended.

The wide range of information provided by this kind of study can be useful also as reference for further archaeological studies (i.e. digs; environmental/paleotopographical reconstruction), detailed geological-geomorphological targeted investigations (i.e. detailed reconstruction of the Roman paleosoil for seismic microzoning, flooding hazard assessment), land-use planning (i.e. development and evaluation of proper management and intervention strategies in the territory).

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