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## Roman Empire. An Investigation on the Effectiveness of Flood Risk Prevention Systems in the Roman Period. Research Carried Out between August and October 2022

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## ROMAN EMPIRE

# An Investigation on the Effectiveness of Flood Risk Prevention Systems in the Roman Period



Research Carried Out between August and October 2022

**Head Office of the German Archaeological Institute**

by Ilaria Trivelloni



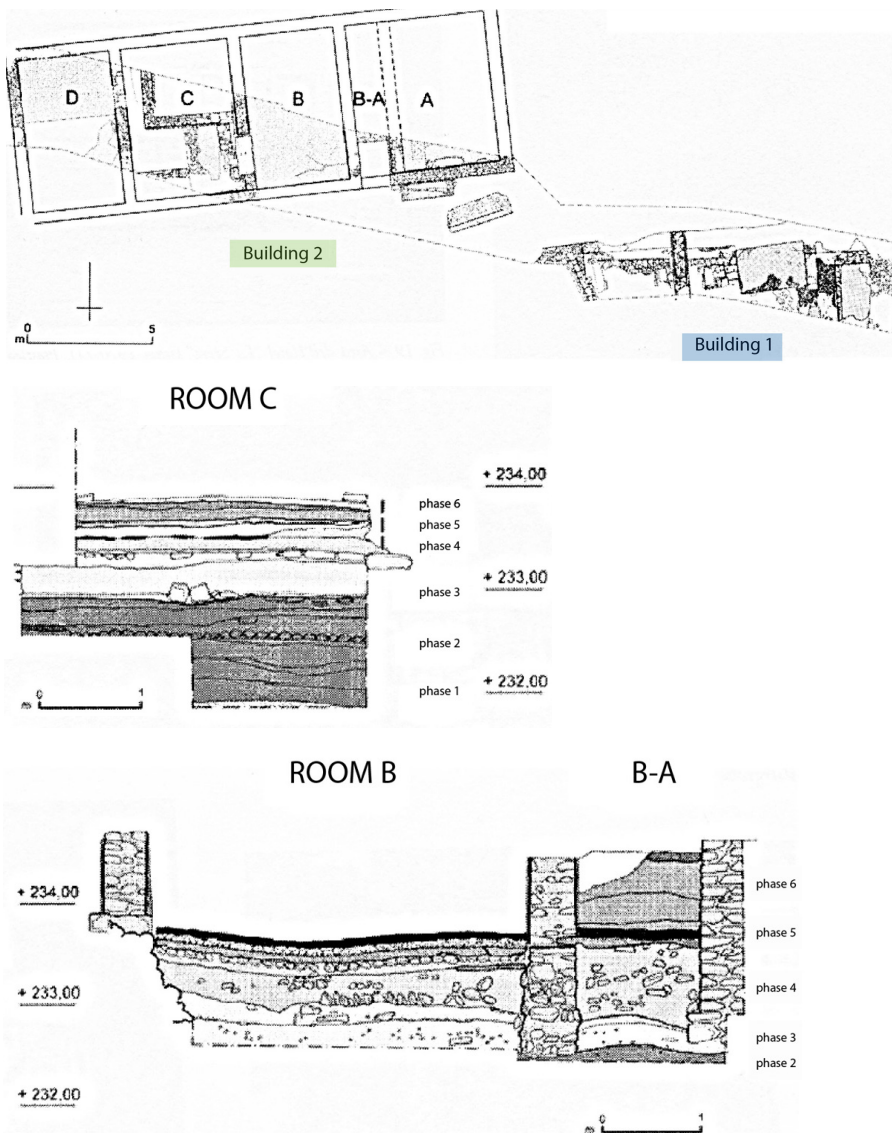
e-FORSCHUNGSBERICHTE DES DAI 2023 · Faszikel 2

*Ziel dieser Studie ist die Untersuchung von Präventionssystemen zur Vermeidung der Auswirkungen von Katastrophenereignissen und der anschließenden Wiederaufbaumethoden von städtischen und vorstädtischen Räumen nach Katastrophenereignissen wie Überschwemmungen. Archäologische Funde und Textquellen zeigen, dass die römische Gesellschaft diesen unvorhersehbaren Ereignissen große Aufmerksamkeit schenkte und sich ihrer bewusst war. Zu diesem Zweck werden einige Städte, deren Planung durch das Vorhandensein von besonders überlaufenden Wasserläufen stark beeinträchtigt wurde, als Fallstudien herangezogen. Sie sollen dazu anregen, sich mit der Wirksamkeit oder Unwirksamkeit dieser Systeme auseinanderzusetzen und eine Diskussion darüber anzuregen, was heute noch geschieht.*

*The present paper aims to investigate prevention systems to avoid the effects of disastrous events and subsequent reconstruction methods of urban and suburban spaces following catastrophic events such as flooding. Archaeological evidence and textual sources reveal the attention and awareness in*

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**Head of project:** I. Trivelloni.



1 Ivrea, Italy. An example of flooding and reconstructions. Two buildings, 1 and 2, were found in the area of the »Giardini Pubblici«. Their occupation phases (1–7) show a sequence of flooding and reconstructions (between phases 2 and 5), with rising of the ground level. (Plan and Sections: after Brecciaroli Taborelli 2007, elaborated by Ilaria Trivelloni)

ancient Roman society for these unpredictable events. For this purpose, some cities, whose planning has been greatly affected by the presence of particularly overflowing watercourses, are taken as case studies. The idea is to promote an investigation into the efficacy or ineffectiveness of those systems, encouraging a discussion of what is still happening today.

#### Roman Society and Nature: (Un)Sustainable Relationship

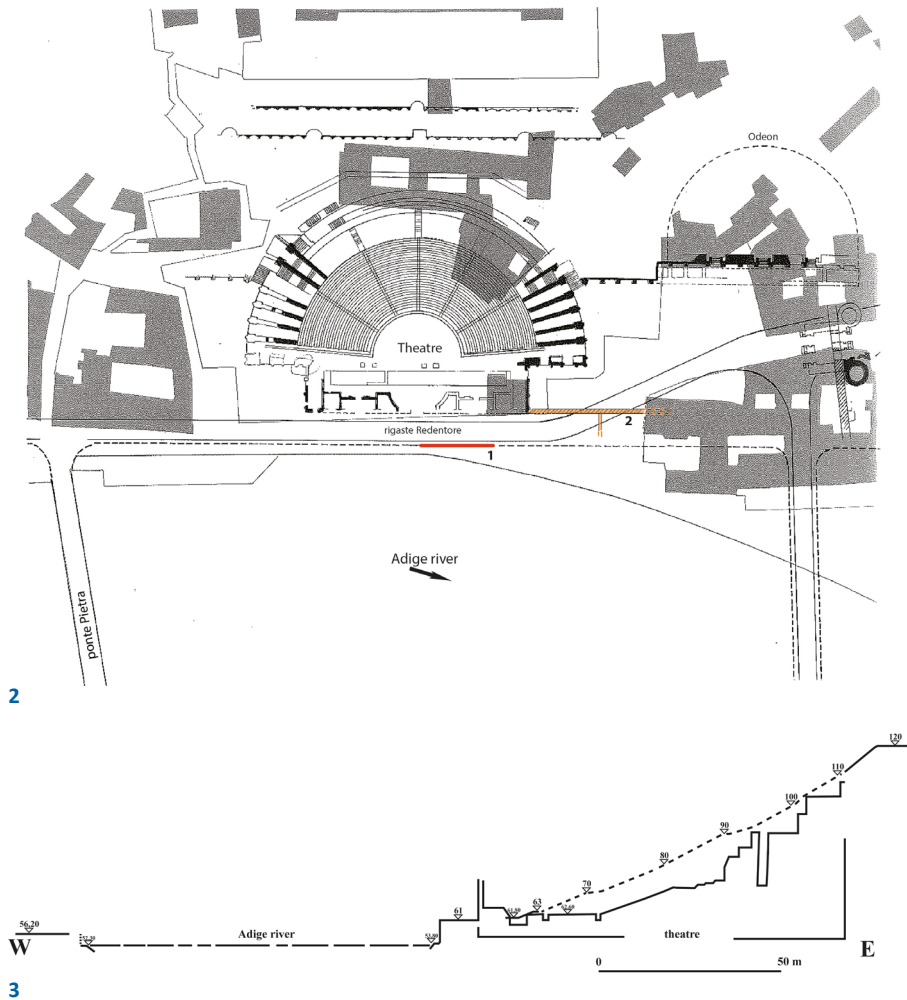
- 1 An interesting definition of the concept of sustainability as applied to the ancient world has recently been proposed by Erika Guttman-Bond: among the various meanings is that sustainability is understood as defining the relationship that ancient people had with the surrounding landscape and how they were able to derive the right benefits for their subsistence and existence [1].
- 2 If we apply this concept to complex societies, such as the Roman one, the issue appears very articulated. Literary sources express the relationship between humankind and nature, which is often marked by negative terms. They represent situations of exploitation of the landscape with consequences that are anything but positive. As evidence, it is sufficient to quote Pliny the Elder (Plin. nat. 33, 1, 1), who reminds us how the intensive and deep excavations conducted, for example, for metal mining, could affect the stability of the ground. In another passage, he argues that the practice of deforestation could cause considerable damage and encourage flooding, destroying the surrounding landscape (Plin. nat. 31, 30, 53).
- 3 In general, textual sources and archaeological remains reveal the tendency of the landscape to »rebel«, causing considerable problems that humankind is completely unable to cope with. Among catastrophic events, it is sufficient to think about floods, earthquakes or fires, all unpredictable events that were almost the order of the day.
- 4 Discussing (un)sustainability, it is worth trying to examine the prevention systems that were used in the past, how the damaged structures were maintained and repaired, and how effective were the adopted solutions. A special focus will be given to floods (Fig. 1), a phenomenon that still affects cities even today, although it appears to occur less frequently [2].

|                              | "GIARDINI PUBBLICI"                    |   |
|------------------------------|--|---|
| Phase                        | Building 1                             | Building 2                                  |
| 1<br>(100-50 BC)             |  | occupation                                  |
| 2<br>(50-25 BC)              | first construction<br>flooding         |   |
| 3<br>(25 BC-15 AD)           | reconstruction                         |   |
| 4<br>(15-70 AD)              | flooding                               |   |
|                              | destruction                            | restoration and<br>renovation               |
| 5<br>(from 70 AD)            | rebuilding                             | renovation and<br>functional<br>adaptations |
| 6<br>(end of III-IV century) | partial<br>reconstruction              | adaptations                                 |
| 7<br>(V-VI century AD)       | abandonment<br>spoliation<br>levelling |   |

**Tab. 1** Ivrea, Italy. The Table shows the sequence of floodings and reconstructions of the two buildings, 1 and 2, found in the area of the »Giardini Pubblici« (see Fig. 1). (Table: after Brecciaroli Taborelli 2007)

### *Risk Awareness and Prevention Systems*

- 5 Speaking of damage and prevention, an analysis of the textual sources immediately reveals the ancients' awareness of the risk and their attempt to contain it as much as possible: laws for the protection of buildings and building regulations are explicit in this sense. Significant is a passage from Strabo (Strab. 12, 8, 18), who, speaking of the city of [Philadelphia](#)<sup>↗</sup> (present-day Turkey), specifies how the inhabitants were conscious of the seismicity of those areas to the extent that they tried to build appropriately to avoid collapses or disruptions [3].
- 6 Evidence of damage prevention and mitigation can often be recognised archaeologically. In the case of river flooding, for example, one of the most immediate systems was certainly the raising of ground levels. An example is the case of [Arles](#)<sup>↗</sup> (France), where backfills were found in different areas in order to elevate the ground level so that the built-up areas would not be affected by the flooding of the Rhone River [4].
- 7 The same caution has been verified in the city of [Vienne](#)<sup>↗</sup>, in France, another centre affected by the flooding of the Rhone river, where there is evidence of reconstructions of numerous city buildings, which foundations are often built on backfills of alluvial soil combined with quarry waste [5]. Also, at [Ivrea](#)<sup>↗</sup> (Italy), following the great flood of 30 to 40 AD, in the area of the river port (see Fig. 1 and Tab. 1), there is evidence of elevations of the floor level above the alluvium of the Dora Baltea. What emerges from the examples mentioned above is the intention to ensure the continuous use of flood-prone areas and to attempt to rehabilitate them.
- 8 Among the first measures against flooding phenomena was certainly the construction of more or less complex embankment systems. It is sufficient to recall the case of [Verona](#)<sup>↗</sup> (Italy): the archaeological remains on both the right and left banks of the Adige River show particular attention to the definition of its riverbed, which caused damage to people and property of a considerable extent [6], as recalled in a description on 6<sup>th</sup> century AD (Hist. Langobardorum 3, 23). The stretch of embankment intercepted in front of the theatre shows the complexity of the system, which included parallel walls placed at different distances that gradually approached the riverbed



2 Verona, Italy. The slope of the S. Peter Hill. Area of the Roman theatre; n°1 embankment, n°2 retaining wall. (Plan: after Cavalieri Manasse 1998, elaboration by Ilaria Trivelloni)

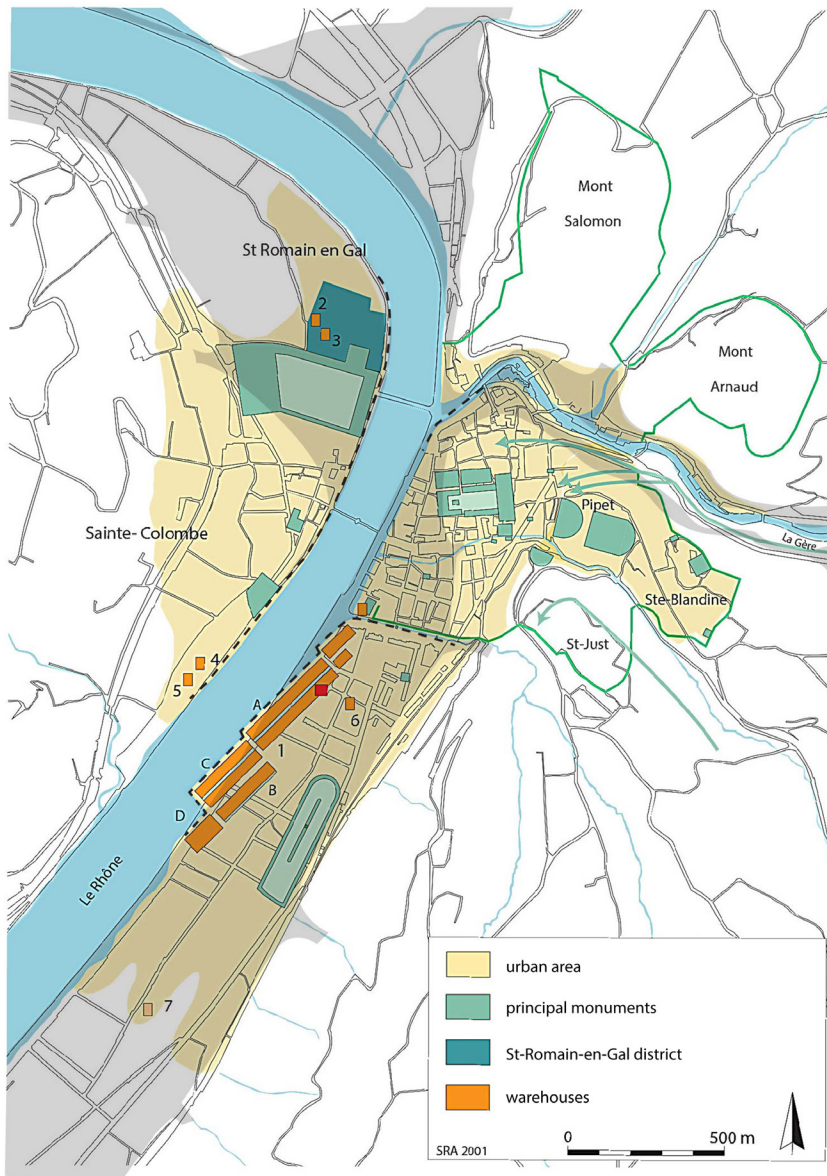
3 Verona, Italy. East-West Section of the S. Peter Hill, highlighting the relationship between the theatre, the embankment and the Adige River. (Plan: after Bolla 2010, elaboration by Ilaria Trivelloni)

(Fig. 2). The system thus articulated also contained the backfill that was necessary to drain the lake/swamp, which was at the foot of the hill (Catull. 17, 1–11), where the theatre was erected at the end of the 1<sup>st</sup> century BC (Fig. 3).

- 9 Besides Verona, archaeological data often show the presence of earthen embankments as well as the use of amphorae arranged in rows and separated by earthen piles, as identified, e. g. in Arles [7].
- 10 Floods were so frequent that the municipalities were possibly obliged to provide for the construction of embankments. This is clearly pointed out in two inscriptions found in [Koroneia](#) (Greece) whose texts recall Hadrian's order to build dykes along the banks of the Kephisos and Herkyna river [8].
- 11 In addition to the embankments, there are indications of other prevention measures noted by literary sources, e. g. the channelling and drainage of water and leaving areas unbuilt close to the river course in order to allow water to drain away without causing damage to people or property in the event of a flood [9].
- 12 There were also ordinary and extraordinary maintenance processes, such as the cleaning of watercourses and the cutting of trees that obstructed the course of the river and prevented proper water flow [10]. For maintenance, even private owners of riparian land were obliged to tolerate their neighbours or the competent authorities building embankment systems and passing through their property for maintenance [11].

#### *Restoration after Damage*

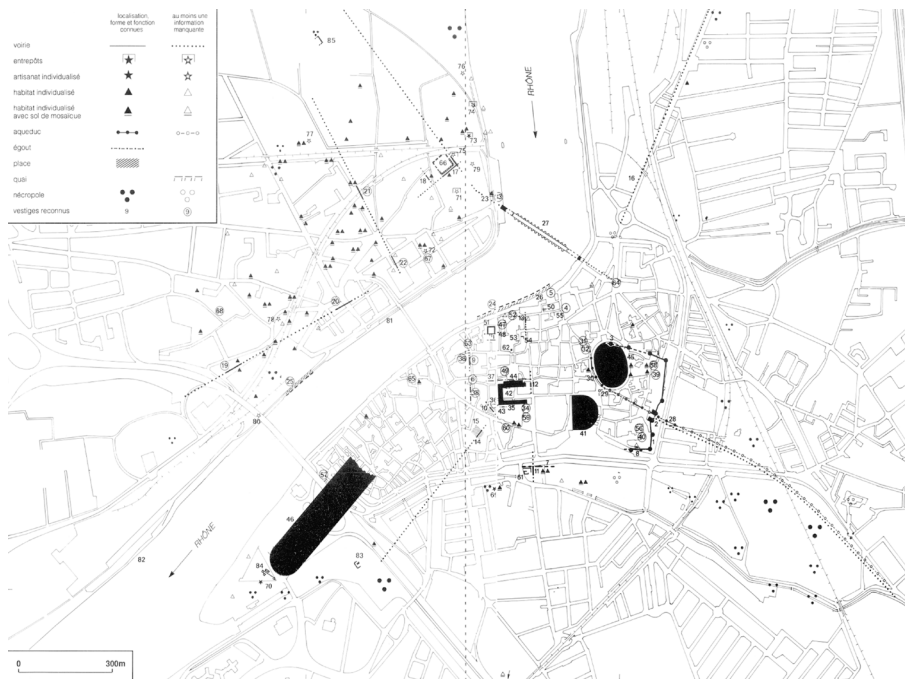
- 13 One of the major problems is related to restoration after damage. Textual sources are clear in specifying that private individuals were unprotected in the event of major damage or collapse (Dig. 19, 2, 59). Even in the event of a flood, the responsibility for repairs lies with the owners, not with the usufructuaries or tenants. The only protection concerns the recovery of movable property displaced by the force of the water [12].
- 14 Due to the unsustainability of citizens in bearing the costs of repairing, there is evidence of donations, gifts, by emperors or notables, and in some particular circumstances also the suspension of tax payments for communities affected by natural disasters [13].



4 Vienne, France. In grey, the flood areas along the course of the Rhône and Gere rivers. (Map: after Le Bot-Helly – Helly 1999 and Helly 2014, elaborated by Ilaria Trivelloni)

15 The attempt to restore areas after a catastrophic event might be the interpretation of the construction of some public buildings. Even if we are dealing specifically with the case of floods, it is worth recalling the case of the great *horrea* in Vienne, where appears a construction sequence that originates after an earthquake and is momentarily interrupted by a flood. The project of the great *horrea* seems to have followed a significant seismic event that must have caused considerable damage in some areas of the city. The *horrea* were built on top of one million cubic meters of backfill [14], consisting, among other things, of the rubble of buildings demolished after the earthquake [15]. Furthermore, the public building has been erected along the banks of the Rhône (Fig. 4). The location appears, in fact, rather vulnerable, being located along the bank of the river in a highly alluvial area. It cannot be ruled out that also flooding may have interfered with the construction, at least in the northern sector, as revealed by the alluvial deposits that emerged during the excavations [16].

16 Problems related to the Rhone River emerged from the analysis of the circus of Arles. As mentioned above, the city was prone to flooding, and the same was true for this suburban area where the circus was erected. The circus is the last spectacle building constructed outside the city in the 2<sup>nd</sup> century AD (Fig. 5), and it was built along the riverbed, in an area characterised by sporadic occupation since the 5<sup>th</sup> to 4<sup>th</sup> centuries BC [17]. From a geological point of view, the site is characterised by an alternation of loam, silt and clay. Due to the composition of the soil, it was necessary to consolidate the ground through wooden piles inserted in the sub-foundation levels of the cirque, according to a common practice in the case of construction in wetland or alluvial terrain (Vitr. 3, 4, 2). Hypothetically, it may be assumed that the construction of the circus and the juxtaposition of the rectilinear part of the structure, which in the case of Arles follows the riverbed, could be a further attempt to reinforce the riverbank. In fact, given the type of structure, its shape, the construction method, the geological conformation of the soil, the proximity to the river, and the fragility of the site, it is possible to suggest that the construction of a structure such as the circus may also have had a function in relation



5 Arles, France. Archaeological map of the city between the 2<sup>nd</sup> and the 3<sup>rd</sup> century AD. (Map: Heijmans – Sintès 1994)

to the flooding of the river, perhaps as a sort of retarding basin in case of flood.

### *Effectiveness or Not?*

- 17 The final question to be addressed is whether or not these systems were effective. The archaeological remains, combined with textual sources, reveal mostly the inefficacy of the prevention systems. The centres investigated, in fact, continued to be subject to flooding. In Arles, the area of the circus was affected by flooding already in the 2<sup>nd</sup> century AD to the extent that the *pista* had to be rebuilt.
- 18 In Verona, the effective solution was only reached at the end of the 19<sup>th</sup> century with the construction of walls to dam the river within very high embankments, causing indelible alterations to the urban and suburban landscape. A similar solution has been reached in [Rome](#) <sup>↗</sup>, where the Tiber River caused damages along its banks since the beginning of the settlement. Only the construction of the so-called *muraglioni*, built at the end of the 19<sup>th</sup> century, solved a millennia-old problem.
- 19 In general, we are facing a history of attempts that nonetheless makes the natural element destructive but evidently a vital source for centres that continue to build despite the fragility of the areas.

### *Future Perspectives*

- 20 Considering the topical issue, as flood phenomena are occurring with increasing frequency even today, it is intended to deepen and broaden the case studies to other urban contexts. A large-scale survey will be carried out, investigating archaeological evidence that may be indicators of systems used to prevent flood damages. It would be appropriate to verify whether the measures taken in Roman times led to greater problems encountered in later periods and whether the risk has increased over the centuries.
- 21 Special emphasis will be given to investigating the theme of public buildings, e. g. circuses, erected along riverbanks, which might have had a specific function even in case of flooding. This proposed interpretation would indeed

contribute to a better comprehension of their placement in a context that was far from suitable for building but which evidently could have provided more advantages than disadvantages.

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#### *Endnotes*

[1] Guttmann-Bond 2019, 1666.

[2] The paper was completed at the same time as the disastrous floods in the Emilia-Romagna region in Italy, occurred on the 20<sup>th</sup> May 2023.

[3] On anti-seismic systems in antiquity, see Giuliani 2011.

[4] Leveau 2014, 15.

[5] Le Bot-Helly – Helly 1999, 77.

[6] Bruno – Cavalieri Manasse 2019.

[7] Arcelin et al. 1999, 125.

[8] Fossey 1981–1982, 54.

[9] Maganzani 2012.

[10] Maganzani 2012.

[11] See Maganzani 2023.

[12] Maganzani 2012, 70.

[13] See the work of Conti 2008 and Storchi Marino 2009.

[14] Le Bot-Helly – Helly 1999.

[15] Helly 2014, 119–120.

[16] Helly 2014, 121.

[17] Rothé – Heijmans 2008, 415–416.

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