

XVII International Congress on Dry Stone

“Dry stone perspectives: challenges after the UNESCO inscription”

Cavtat, Croatia, October 1-2 2021

Filip Šrajer, 4 GRADA DRAGODID, Croatia

srajer@dragodid.org

## **Model for Inventory, Monitoring and Evaluation of Dry-Stone Heritage in Croatia; Case Study Stari Grad Plain on Hvar Island (Doctoral dissertation summary)**

### **Summary:**

*The main goal of the doctoral research was to establish an integral methodological framework for research and management of dry-stone heritage, using the contemporary technologies and applying the contemporary standards for spatial information modelling and cultural heritage data. The applicability of the model was tested by quantitative and qualitative analyses of dry-stone phenomenon in Croatia in general and in the case study area: UNESCO-listed cultural landscape Stari Grad Plain on the island of Hvar.*

**Keywords:** *dry-stone, Adriatic Croatia, heritage data model, GIS, interdisciplinary research*



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### **1.INTRODUCTION**

Dry-stone walls and buildings are the characteristic elements of the Adriatic Croatia's landscape and among the region's most acknowledged cultural symbols. However, due to the lack of the published works, dry-stone works of the Croatian Adriatic are rather unknown on the international level. Another problem is the fragmentation of the phenomenon over different academic fields, which makes it difficult to perceive it integrally. Emerging practical needs to understand the phenomenon better, coming from the sectors of cultural heritage protection, agriculture (because of the EU agri-environmental subsidies), and physical planning, make the practical incentive for the comprehensive qualitative-quantitative research of the dry-stone phenomenon in Croatia.

Despite the dissertations of such a wide scope are not very usual today, the author felt that a synthesis of the phenomenon, combined with the technical expertise and using contemporary tools like GIS and crowdsourced data was most needed at the moment, while the author's engagement in the dry-stone activities during the last fifteen years and the substantial amount of collected data made it easier to achieve. The doctoral research that was undertaken at the University of Zagreb, under the double supervision of experts in vernacular architectural heritage and cultural landscapes (for the other general data, see the last chapter).

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### 2.THE PROBLEM



*Picture 1: Group of corbelled shelters kažuni in Vodnjan, Istria © author*



*Picture 2: Terraced slope near Velo Grablje, Hvar Island © Velimir Bešić*

The usual focus on the extraordinary buildings and sites (pictures 1,2, 7-10, etc.) shifts the attention away from more ordinary scenes (like the one in the picture 3), that make the vast majority of the phenomenon. Those “everyday landscapes”<sup>1</sup> are so common in Adriatic Croatia and saturate the observer’s perception so much, that one doesn’t really see a particular aesthetic or historical value in them.

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However, the aerial photos (especially the older one that show the structures now under vegetation) reveal immense portions of territory covered in those structures, in various of regular and irregular grids (“labyrinths” and “laces”, how are they sometimes depicted in media), in a way that can hardly be found elsewhere in the world.

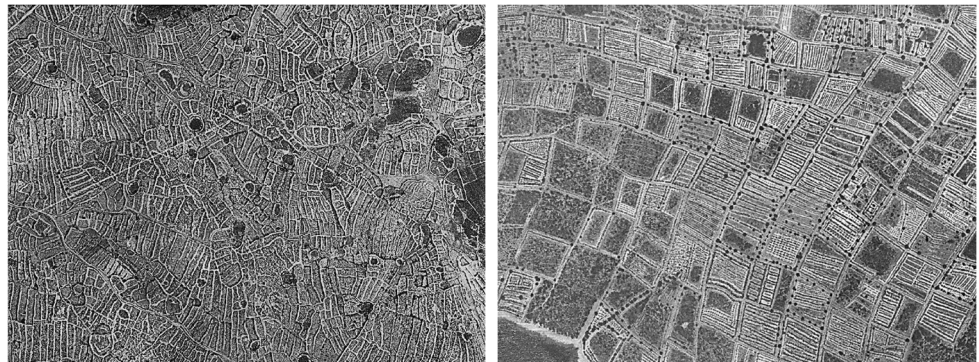


*Picture 3: Dry-stone walls by the road in Dalmatian hinterland © Google*

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*Picture 4 (left): Organic grid of dry-stone enclosures near Punat, Krk island, Kvarner ~1960. © DGU*

*Picture 5 (right): More regular grid of dry-stone enclosures near Vinišće, Dalmatia, ~1960. © DGU*



*Picture 6: A detail of the 18 km<sup>2</sup> dry-stone „labyrinth“ on Srime peninsula near Šibenik, Dalmatia © Google*

A substantial practical problem of research and inventory of dry-stone walls in Croatia is a function of the mentioned immenseness: the usual structural-morphological typology (single wall, double wall, retaining wall etc.) cannot be applied without detailed on-site examination, which is very slow and expensive on wider scope, and often impossible due to the overgrown vegetation and private property constraints.

Therefore, the main problem of the research could be put as: how to make *Immenseness* less immense and more comprehensive?

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### 3.THE OBJECT

The project was realised on three axes:

Dry-stone buildings and structures in Croatia come in various types and forms, mostly along its Mediterranean biogeographical region, i.e., Croatian Adriatic, comprised of three historical-geographical parts: Istria, Primorje (Kvarner) and Dalmatia.



*Picture 7 (left): Kude's bridge, 12-arch tufa bridge on river Krupa, Dalmatia. © Berislav Horvatić*

*Picture 8 (right): Mrgari, multi-cellular sheepfolds near Baška, Krk island, Kvarner © Denis Lešić*

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*Picture 9 (left): Dry-stone walls dividing pastures on Kornat island, Dalmatia. © Velimir Sebesteny*

*Picture 10 (right): Enclosed fields near Draga Bašćanska, Krk island, Kvarner. © Denis Lešić*

Andlar et al., discussing the natural and historical predispositions of the emergence of cultural landscapes of Croatian Adriatic, gave an outline of its main geographical characteristics: complex relief forms, thin soil, sparse natural vegetation, lack of surface water, high and irregular precipitation, high soil erosivity. By emphasising Croatian Adriatic's historical position on the borderline between the Mediterranean, Balkans, and Central Europe, and consequently, the peripheral status within the great European cultures (from ancient Greek world to present day EU), the authors argue that such complex natural and historical background could have resulted in diverse cultural landscapes, most of them characterized by dry-stone works.

Stari Grad Plain on Hvar Island is the largest cultivable field on all the Croatian islands, what is probably the main reason that one of the first two urban settlements on Eastern Adriatic (Φάρος, Pháros) was established on the edge of it in the 4th century BC.

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*Picture 11: A detail of Stari Grad Plain Grid, 1944 © RAF*

Well preserved ancient Greek land division and its continuous use as the cultivated area through the millennia were the main arguments for its inscription on the UNESCO World Heritage list as a cultural landscape in 2006. Despite Stari Grad Plain's prevalent lowland character, the dry-stone structures and buildings are extremely abundant here, especially on the slightly elevated areas: dry-stone walls and shallow terraces on the main and subsequent land divisions, paths, waterways, water cisterns and numerous vernacular buildings, including corbelled stone shelters. It was chosen for the case-study area because of its heritage significance, complexity and the availability of data.



#### **4.METHODOLOGY**

The methodological strategy of the research was mostly deductive one. The topic of **inventory** was focused on the development of multi-level typology of dry-stone buildings and structures, based both on the synthesis of the known examples of their systematisation, and deductive study of general principles of classifying the spatial phenomena. The topic of **monitoring** was referred to by suggesting the way of recording the changes on dry-stone structures according to the topographic and cadastral plans, and analysing the problems of their dating. The topic of **evaluation** was covered by the discussion on the perception and cultural significance of dry-stone heritage in Croatia and systematisation of the possible criteria for their valorisation.

The main research questions and the applied methods were as follows:

**What is the frame of reference – the world’s and Croatia’s most significant dry-stone sites and phenomena in general?** This part of the research included the comparative study of 49 sites/phenomena listed on the UNESCO World Heritage List, UNESCO Intangible Cultural Heritage of Humanity List and FAO Globally Important Agricultural Heritage Systems List, and 29 sites from Croatia’s Register of Cultural Property that were found to be at least partially characterised by dry-stone structures.

**What can one tell about the typology as a method of classification, and how various authors approached to the typology of dry-stone structures?** After the discussion on classification of spatial phenomena in general, this part of research included the comparative study of dry-stone typologies in 16 works from the Croatian and Euro-Mediterranean dry-stone literature. Most attention was paid to the typologies of dry-stone walls because they have been studied less than buildings, while they usually make the most of the quantity of structures.

**What can we tell about the dry-stone structures in Croatian cultural, natural and historical context; what would be their comprehensive typology, and criteria for their evaluation?** The status of dry-stone as the Croatian cultural heritage asset(s), including the general cultural reception and institutional and non-institutional protection is discussed first. The natural and historical context of the dry-stone phenomenon in Croatia is presented next, followed by the discussion on dry-stone

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landscapes as the widest and most comprehensive frame for its interpretation. The proposal typology of dry-stone structures and buildings was the largest part of the work by volume. In order to overcome the problem of today's inaccessibility of the landscape due to wild vegetation and legal property restrains, a new three-level / two-criteria typology was established that allowed to split the research in few phases and draw conclusions from the cartographic data. Every type was presented by its definition, the discussion about the spread of the type, its significance, and examples. Typology is made modular to accommodate further addition of types if necessary.

### **What can we say about dry-stone structures and buildings on Stari Grad Plain and their development in time?**

This part of the research included the synthesis of the natural and historical context of the selected area, discussion on the research and management problems and an overview of the dry-stone buildings and structures in the area. Raw data was mostly drawn from the field research campaign undertaken in 2015 by the team in which author was one of the leaders, funded by the local authorities and resulted in the official conservation document. Other sources of data were several smaller field campaigns funded by the Ministry of Culture. One of the 182 x 900 m Ancient Greek field units was analysed in detail using the structure of the model in GIS environment.

### **How we can design a model for the inventory, monitoring and evaluation of dry-stone works suited to a complexity of phenomenon and the physical/legal constraints and how can we test it?**

The overall framework was designed as a conceptual model of the GIS database, modelled in accordance with MIDAS Heritage standard and CROTIS Croatian Topographic Information System, partially functional through QGIS environment and described by UML diagrams.

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In order to find the optimal methods of recording the dry-stone structures (in particular the geometry that should be used for modelling the dry-stone objects), a cartographic experiment with three landscape architecture students and their teacher was made as well. Analytical potential of the model was tested by GIS operations on different levels: the Adriatic Croatia as a whole, the case study area and several other selected sites.

Inductive method was also present, most notably by establishing and using **Suhozid.hr, a functional open public webGIS database** with about 3000 entries in the time of finishing the dissertation. Wide scope of dissertation and physical/legal constraints of the field research emphasized the **importance of cartographic data**. Maybe the most important was the “discovery” of a layer in the CROTIS Croatian Topographic Information System, in which about 95.000 km of structures are mapped, most of which shown to be to be dry-stone walls. The problem of the lack of exhaustiveness (not every dry-stone wall is mapped) was partially overcome by the estimating the level of its exhaustiveness and with GIS operations such as buffer, which revealed interesting results. Next significant cartographic source is the Austro-Hungarian cadastre from the first half of XIX century, which recorded the state of the landscape at a very important moment for dry-stone heritage and in a very precise and informative way. The last distinctive cartographic source were the historic vertical photographs: orthophoto from 1950s-1960s which covers almost all the Croatian territory, and RAF/SAAF vertical photographs of Stari Grad Plain from 1944.

### **5.RESULTS**

The research resulted in the most detailed and most systematically elaborated synthesis of the physical and cultural features of dry-stone structures in Croatia to date, and the first structured analysis of their distribution

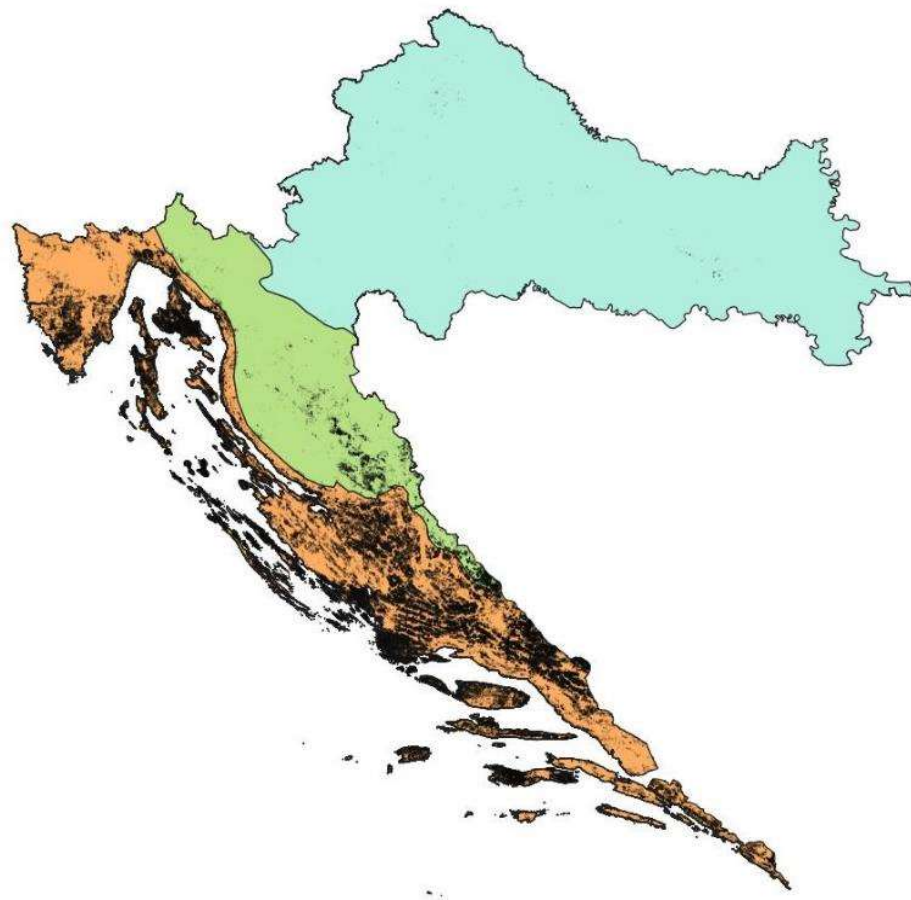
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### 5.1. Dry-stone is confirmed the dominant element of cultural landscape of Adriatic Croatia

By extrapolating of data from CROTIS, it was concluded that the total length of the walls in Croatia can conservatively be estimated to 100.000-300.000 km. Maybe even more descriptive and surprising was the result of the buffer operation on the CROTIS layer that revealed that over 40% of Adriatic Croatia's territory lies within 100 m from the nearest wall (almost 90% in the case of some municipalities).



*Picture 12: Croatian biogeographical regions (Mediterranean-Alpine-Continental) with the spread of dry-stone structures (in black)*

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### 5.2. Evaluation in the international context

Comparative study of most published sites and literature shown that most recognized dry-stone phenomena are terraces, boundary walls and corbelled shelters. All of those phenomena can be found in Croatia as well; taken individually, they may not be the finest examples of their types, but collective presence, diversity and density can be considered extraordinary.



*Picture 13: Baljenac islet near Šibenik, Dalmatia: a reprint from 1970s monograph on Croatia.*

This is especially true in the case of landscapes of stone clearance piles, which occur in number and variety not recorded elsewhere, interwoven with terraces and enclosures' boundary walls. Such landscapes originate mostly from the land reclamation campaigns during the vine-growing boom in the second half of the 19th century, what puts Croatian dry-stone heritage together with many other significant sites in the Mediterranean (like Cinque Terre, for example) in the context of the early modernization of European periphery and the large-scale changes in the landscape caused by the phylloxera event.

### 5.3. Cultural significance in Croatian context

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*Picture 14: painter Oton Gliha standing on the ceremonial curtain of Croatian National Theater in Rijeka (1981)*

The cultural significance has shifted from productive to symbolic one and back to productive in the last 150 years. Mentioned “formative”, or “trans-formative” period during the 19th century boom (caused mostly by phylloxera in France) was followed by a rapid decline in the first half of 20th century (caused again by phylloxera, but now coming to the Adriatic). Economic crisis and exodus could have contributed to the semantic shift of dry-stone wall in the mid-20th century, from productive and almost nameless (infra)structure to the ultimate symbol of work and relationship between human and landscape at the same time when the real work strived away from the land: to factories, cities, tourism.

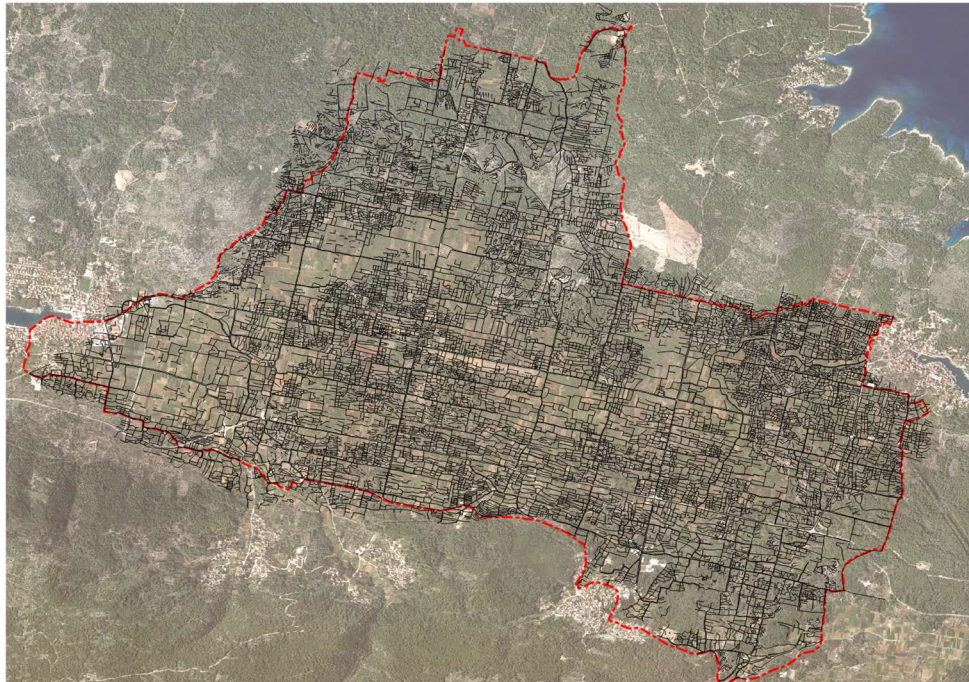
In the 21st century, it seems the trends have been taking turn once again: dry-stone heritage is being partially “rematerialized” through the new trends in heritage protection (like hands-on heritage activism) and agri-environmental policies.

### 5.4. Dry-stone heritage of Stari Grad Plain

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*Picture 15: Mapped dry-stone walls within the UNESCO-listed area of Stari Grad Plain, Hvar island*

Among the dry-stone sites in Croatia, The Stari Grad Plain is proven exquisite by its complexity, both structural and temporal. In comparison to the sites that were made in a relatively short period of time (pictures 4, 5, 6, 9, 13) picture 9 clearly shows more complexity of the landscape that evolved through millennia of agricultural use.

More than 700 km of dry-stone walls are present within the UNESCO-listed area, as well as about 450 small stone buildings, almost 200 of which being corbelled shelters called trimi.

Being one of the oldest Croatian landscapes, it also underwent significant transformation by the end of 19th century (emergence of new water cisterns, trimi and clearance heaps), although the exact time-depth analysis could not be made without some physical dating (C14 and OSL are the most promising methods today).

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*Picture 16: Distinctly elegant example of corbelled dry-stone shelter, trim, Stari Grad Plain. © Berislav Horvatić*

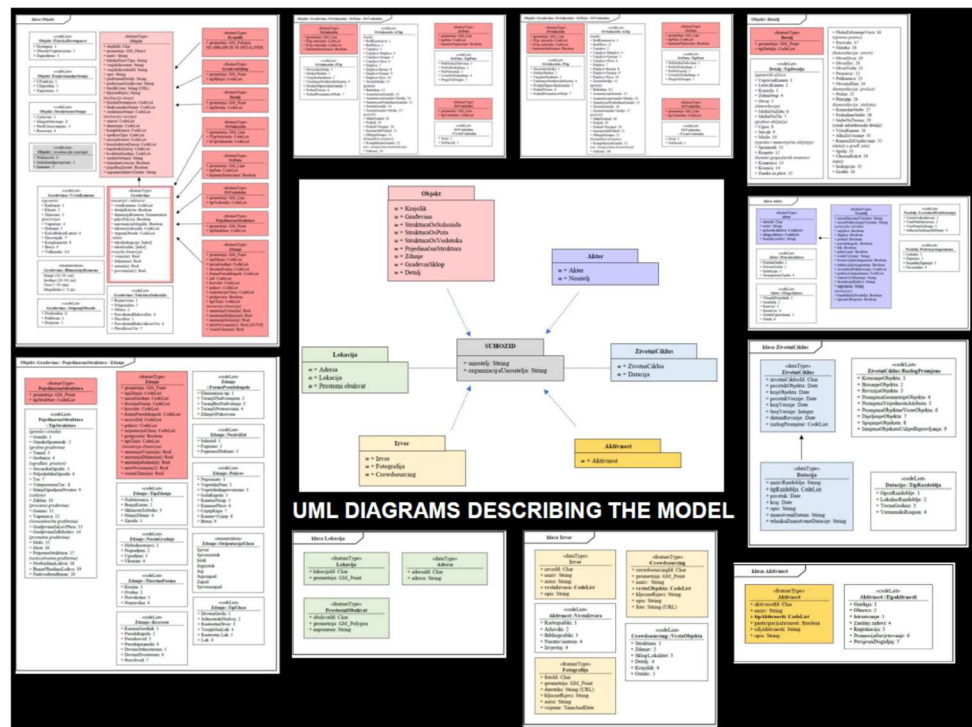


*Picture 17: Examples of various rock types used for constructing trimi on Stari Grad Plain, ~1960. © DGU*

## **5.5. Evaluation of the model itself**



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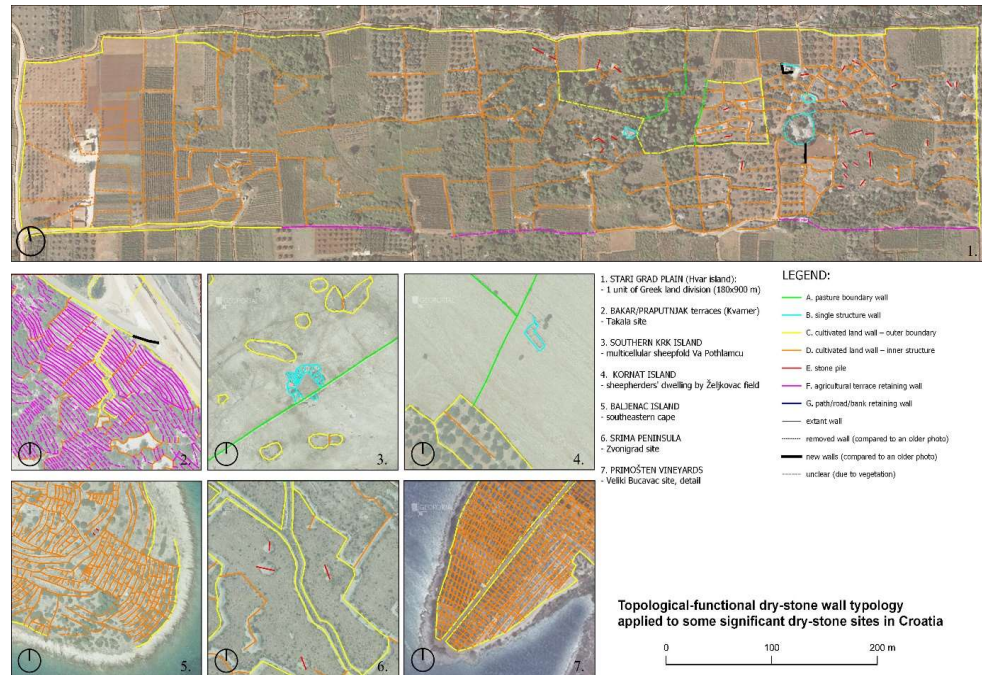
*Picture 18: UML diagrams describing model for inventory, monitoring and evaluation of dry-stone heritage in Croatia*

Multi-level approach which combines cartography and field work is useful, maybe even necessary, to understand the phenomenon integrally and to overcome the restraints of immense field work. Croatia has some cartographic sources of extraordinary quality (for example, maps that show land use and boundaries with such accuracy and exhaustiveness such as Franziscan cadastral maps are extremely rare in 19th century Mediterranean context) whose research potential is more than promising and can partially compensate the impossibility of covering all the area by field work. Regarding the cartography of dry-stone structures, line model that is complemented with additional polygons gives the best results in terms of speed and accuracy of mapping.

In a substantial fundus of research done in the Stari Grad Plain, this is mere one in the row. Its significance is probably greater in the wider context of Croatian dry-stone heritage, which is rather unrecognized at the international level. The author hopes that the research will contribute to better understanding and management of it.

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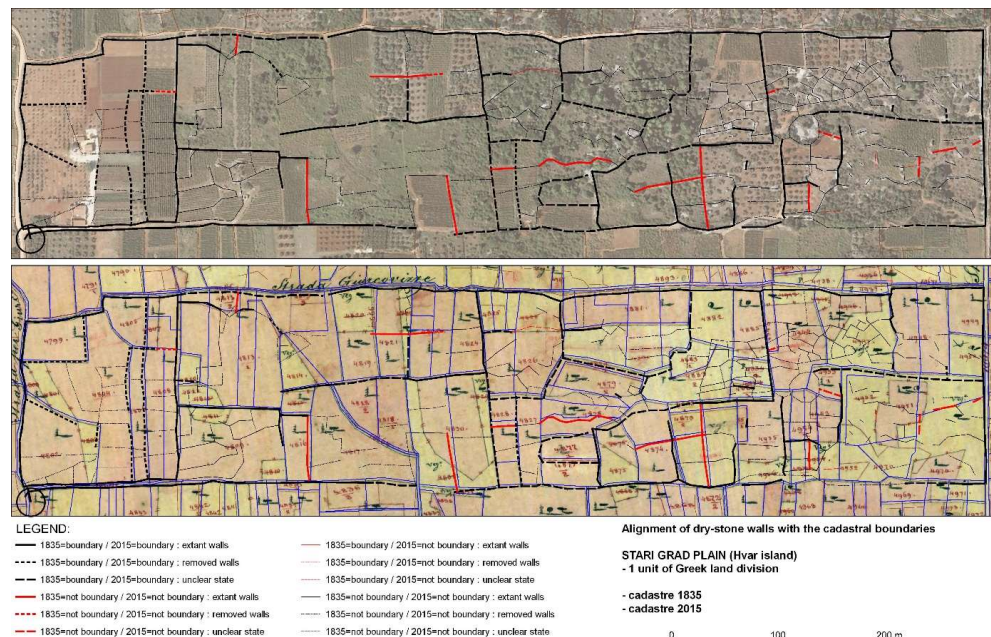
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Picture 19: topological-functional analysis of several significant dry-stone sites in Croatian Adriatic, including 1 unit of the ancient Greek land division in Stari Grad Plain. Opposed to the usual structural-morphological typology (single wall, double wall, retaining wall etc.), topological-functional typology is based on the general function of the wall in the landscape and its topological place (dividing pastures, enclosing agricultural area, excess rock formations etc.) and can be applied by examining the historic maps and aerial photos.

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Picture 20: Historical analysis of dry-stone walls on one unit of the ancient Greek land division in Stari Grad Plain

### 5.6. Guidelines for further research

What could be clearly drawn as the conclusion is that the research potential of Croatian landscapes, cartographic sources and the data collected during the research of Stari Grad Plain in 2015 isn't nearly exhausted by this work. Below is whole list of themes proposed, some scientific, some more of the heritage management:

- interdisciplinary evaluation of the database and interdisciplinary field research (archaeology, ethnology, geoinformatics ...),
- establishment of a physical database, additional analyses,
- more accurate metrics of dry-stone structures,
- use of modern recording technologies (LIDAR, SfM, pattern recognition)
- physical dating methods,
- historical stratigraphy of dry-stone walls in Stari Grad Plain,
- distribution boundaries – dry-stone structures outside the area of Adriatic Croatia,
- distribution of corbelled buildings and their properties (in Croatia and on localities),
- construction standardization of dry-stone structures,

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- questions of roles and models in the protection and preservation of dry-stone heritage,
- new roles of dry-stone heritage.

## **6. GENERAL DATA**

The dissertation was made at the University of Zagreb, Faculty of Architecture, under the double supervision of Zlatko Karač, PhD, full professor at the Faculty of Architecture, an expert in historic and vernacular architecture, and Goran Andlar, PhD, assistant professor at the Faculty of Agronomy, an expert in landscape architecture and landscape history.

It is written in Croatian language and consists of 444 pages, 37 table charts, 11 diagrams, 3 maps, 988 footnotes, 460 bibliographic units, summaries in Croatian and English, keywords, Curricula Vitae of the author and both supervisors.

The thesis was defended on September 24th, 2019, in front of the comity consisting of: Bojana Bojanić Obad Šćitaroci, PhD, full professor at the Faculty of Architecture, Marina Šimunić Buršić, PhD, assistant professor at the Faculty of Architecture and Jasenka Kranjčević, PhD, scientific adviser at Institute for tourism, Zagreb.

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**Short biography of author:**

*Filip Šrajer, PhD, architect, urban planner and heritage expert from Zagreb, Croatia. One of the founders and a member of the board of the 4 GRADA DRAGODID, an internationally awarded heritage NGO. Member of Croatian chamber of architects, licensed for cultural heritage research. His professional and scientific interests are vernacular architecture, cultural landscapes and heritage data models, with two published scholarly papers and many professional and popular papers, handbooks and lectures. One of the founders and coordinators of Suhozid.hr, an open public webGIS database on Croatian dry-stone heritage.*

*Paper: [up to 3.000 words, using chapters and chapter names by personal choice]*



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