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University of Padova
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Supervisors:

Mauro Varotto, PhD, associate professor
Goran Andlar, PhD, assistant professor

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Università di Padova
Dipartimento di Studi Storici,
Geografici e dell'Antichità



Sveučilište u Zagrebu
Agronomski fakultet

Tanja Kremenčić

VALORIZACIJA SUHOZIDNE BAŠTINE CRESKO-LOŠINJSKOGA OTOČJA

MEĐUNARODNI DVOJNI DOKTORAT ZNANOSTI

Mentori:

izv. prof. dr. sc. Mauro Varotto
doc. dr. sc. Goran Andlar

Padova, 2022.

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SUPERVISOR'S CURRICULUM VITAE (1)

MAURO VAROTTO (Padua, 1970) is an associate professor of geography at the University of Padua. He graduated with a degree in arts in 1996 and completed his PhD on 'Man and Environment' in 2000 at the Department of Geography, University of Padua, where he has carried out research since 2002.

He has taught theory and methods of geography, cultural geography, human geography and the geography of food at the Universities of Padua and Venice Ca' Foscari. He is currently a professor of geography and history and enhancement of rural landscapes at the University of Padua. He is a member of the scientific Committee of the Doctoral School in Historical, Geographical and Anthropological Studies. Since 2008, he has been the national coordinator of the Terre Alte research group of the CAI Central Scientific Committee. He promoted and coordinated the European project Interreg IIIB ALPTER 'Terraced landscapes of the Alps' (2005-2008) of the III World Meeting for Terraced Landscapes (2016), as well as the manifesto for a 'public geography' (2018).

From 2015 to 2019, he was elected a member of the Academic Senate of the University of Padua. From 2012 to 2021, he was the scientific coordinator of the Museum of Geography of Padua (the first such museum in Italy). Since 2017 he has been the scientific coordinator of the national research group 'Museums of geography: organization of knowledge, enhancement and dissemination of the academic geographic heritage' (GEOMUSE). Since 2021 he has been the rector's delegate for the museums and collections of the University of Padua.

He wrote over 150 national and international publications on topics concerning contemporary mountain territories, terraced landscapes, historical rural landscapes and the history of geography. He is a referee for the main Italian geographic journals and several international journals. He won the prize for best Italian documentary at the 2012 Cinemambiente Festival in Turin for the documentary *Piccola terra*. His book *Altopiano dei Sette Comuni* ranked first for the 2010 Leggimontagna Award. Furthermore, he won the Manfrini prize in 2012 for *Marmolada* and the Dolomiti Unesco award (2021) for *Montagne di mezzo* (Einaudi, 2020).

SUPERVISOR'S CURRICULUM VITAE (2)

GORAN ANDLAR (Sisak, 1981) is an assistant professor at the University of Zagreb, Faculty of Agriculture, Department of Ornamental Plants, Landscape Architecture and Garden Art. He graduated with a degree in landscape architecture in 2006 and received his PhD in 2012.

Since 2006, he has been employed at the aforementioned faculty and department, where he now serves as head of the undergraduate (BA) course and as a lecturer and assistant in five graduate and undergraduate landscape architecture courses. He initiated seminars for landscape typology and rural landscape planning. He is also a member of the Faculty of Agriculture Selection Committee.

His research interests are cultural landscape, green infrastructure, national landscape legislation, landscape character assessment and GIS analysis and databases topics. His research work primarily focuses on Adriatic karst agricultural landscapes. He runs a Croatian rural landscapes geo-photo archive based on many years of field research and aerial flights. He is the initiator of the interdisciplinary platform Banija Landscape Observatory and a member of the dry stone wall web platform Suhozid.hr, EUCALAND, ITLA and CALA – Croatian Association of Landscape Architects. For his PhD, he was given special recognition at the 47th Zagreb Architecture Salon. Meanwhile, as project leader of the Town of Sisak Green Infrastructure Development Study and Strategy, he was awarded a prize in the category of project of the year for green building and sustainable development.

INCENTIVES

For us, dry stone walls are something completely natural and common, something we don't even think about... often we don't even notice them. Very few people might ask themselves what our landscape would look like without them. And yet, they have always been here, just like the sea surrounding us, and like the air we breathe, without our immediate awareness of it.

LJ.G., an archipelago inhabitant, in: Puntarski fuoj (2017, 16)

The statement that 'it wasn't fish who discovered water', attributed to Pierce Butler in 1954, combined with the quote cited above, exemplifies that sometimes an individual or a community, embedded in a particular culture or environment, can become less observant of the prevailing particularity within their domain. Accordingly, being born and raised on the island of Cres did not predetermine my full insight into its territory or its preindustrial, 'traditional' customs, nor did it predetermine my understanding of the ubiquitous both natural and cultural artefact of the dry stone walls and the landscape they form. Life and study outside of the island caused a certain detachment from it, transposing me out of the 'water'. This aloofness, in my judgement, was exactly what prompted my amplified curiosity and appreciation towards the landscape of my home island and archipelago. The incentive was not to share my vast knowledge but to redeem myself for the superficial one I had. The incentive was also to bring to light what I noticed was lacking, and to complete the study of this part of the archipelago's heritage in light of the new scientific and institutional recognition.

On a personal note, and, based on the premise that bonds are maintained through study and knowledge, one particular dedication of this study goes to my grandfather, Frane Kremenić, who lived the agricultural landscapes studied here, who left before this work has started, and who would have likely appreciated the effort.

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Throughout the course of this thesis, encounters with experts and enthusiasts who shared my passion for research and the topics here studied made the experience worthwhile and stimulated the enthusiasm needed for the meticulous cabinet work afterwards. My sincere thanks go to the inhabitants of the Cres and Lošinj archipelago who agreed to be interviewed and take part in hours-long field visits. They introduced me to the richness not only of the archipelago's dry stone heritage but also of the archipelago's people. Furthermore, I greatly benefited from the perpetual correspondence and support from the Croatian 'dry stone trio' of Berislav Horvatić, Jadran Kale and Filip Šrajer, as well as Sergio Gnesda, who regularly brought new materials and discussions to my attention. Furthermore, I am grateful that I have become

part of the intelligent group of people gathered in the Croatian dry stone walling '4 grada Dragodid' association, in whose activities I became involved in the 'hands-on' part of this research.

Finally, I offer my biggest thanks to my family and friends, who provided support throughout the study period, whether the challenges at hand were related to dry stone walls or not. I thank them for giving me the space and encouragement I needed to complete this work.

ABSTRACT

Current scientific considerations still fail to capture the prevalence and significance of the Croatian dry stone heritage despite their increasing relevance in the framework of research, institutional environmental and cultural protection, as well as in the activities of the non-governmental organisations. The aim of this research was to capture its extensiveness, diversity, historical circumstances, and values of an important component of the Croatian Adriatic landscape. In this thesis, term *valorisation* comprised a multi-method approach, and was applied to the geographical area of the Cres-Lošinj archipelago in Croatia. By combining a GIS-based cartographic production and analysis with the *in-situ* recording of the dry stone structures, accompanied by literature-based or ethnography-based descriptions, the objective was to lay a foundation in understanding their distribution and characteristics. This task was followed by drawing correlations between the dry stone wall landscape-scale patterns to local historical socioeconomic circumstances to address the queries of time-depth data of their structures. Finally, the benefits arising from the dry stone walls were reviewed, especially those appurtenant to the ecosystem services framework, to assist future monetary valuation approaches and management discussions. The research results include the establishment of a GIS database and full quantification of the dry stone walls of the Cres-Lošinj archipelago, a review and assessment of the heritage diversity, use, and its distinctiveness in the context of the Croatian Adriatic and within the case study area. A scientific value of the dry stone wall patterns as indicators of historical events is demonstrated. With the example of the Cres olive grove, another lens of valorisation was discussed – namely, recognition under the cultural landscape category. Finally, initial steps for the conceptualisation of a valuation model were provided.

Keywords: dry stone structures, landscape patterns, GIS vectorisation, ecosystem services, Croatian Adriatic

SAŽETAK

Valorizacija suhozidne baštine cresko-lošinjskoga otočja

Suhozidna baština čini jednu od važnijih sastavnica hrvatskoga jadranskoga kulturnoga poljoprivrednog krajobraza. Suhozidi postaju dio domene politika ruralnoga razvoja, vrednovanja krajobraza, a zbog usluga ekosustavima, priznaju se i kao važan element u očuvanju okoliša. Umijeće suhozidne gradnje priznato je kao nematerijalna kulturna baština na državnoj i međunarodnoj razini. Unatoč povećanju aktualnosti tema suhozidnih struktura, i unatoč ugrožavajućim tendencijama deagrarizacije, sukcesije vegetacije te nove izgradnje, hrvatske suhozidne strukture u znanstvenoj su literaturi i dalje nedovoljno zastupljene. Kako bi se smanjila parcijalnost dosadašnjih istraživanja te odgovorilo na određena istraživačka pitanja, suhozidnoj baštini u ovom se radu pristupa uzimajući prostor cresko-lošinjskoga otočja kao studiju slučaja. Smatra se da je spomenuti prostor nedovoljno istražen, međutim dovoljno reprezentativan za kontekst jadranske Hrvatske i Sredozemlja, područja koja karakteriziraju slični geomorfološki, klimatsko-vegetacijski i društveni utjecaji.

Na primjeru predmetnoga područja, ciljevi su ovoga doktorskog rada ustanoviti rasprostranjenost, raznolikost i stanje suhozida, pojasniti genezu suhozidnih krajobraznih uzoraka te postaviti osnovu za daljnja istraživanja gospodarske isplativosti obnove suhozida izrađujući replikabilni model valorizacije suhozida. Suhozidne strukture sagledavaju se u trima geometrijskim oblicima: kao linije (suhozidi), kao točke (pojedinačna struktura) te kao poligoni (suhozidni krajobrazni uzorak), a primjenjuju kombinirani kabinetski i terenski postupci rada, koji uključuju pregled literature, razgovore s lokalnim stanovništvom, analize u GIS-u te fotografsko bilježenje.

Aktualnost i problemi objekta istraživanja kratko su predstavljene u prvom („Uvod“), a metodologija u drugom poglavlju rada („Materijali i metode: pristupanje suhozidnoj baštini cresko-lošinjskoga otočja“). Terminom „valorizacija“ obuhvaća se nekoliko pristupa kojima se adresira fenomen suhozidne baštine, zbog čega su objekti istraživanja, metode i pregledi literature dodatno elaborirani kroz središnja četiri poglavlja (3-6).

Treće poglavlje rada („Otkrivanje suhozidne baštine cresko-lošinjskog otočja“) predstavlja pregled rezultata terenske *in-situ* inventarizacije suhozidnih struktura cresko-lošinjskoga otočja. Ovaj dio istraživanja provodi se s ciljem identificiranja

prostorno specifičnih i/ili prethodno nezabilježenih otočnih suhozidnih struktura te njihovo stavljanje u kontekst dosad poznatih struktura na području jadranske Hrvatske. Svaka je suhozidna struktura prikazana geolociranim terenskim i/ili zračnim fotografijama te njihovim opisima. Suhozidne višeprostrorne ovčare dodatno su provedene kroz kratki model vrednovanja. Opisi i vrednovanja temeljena su na terenskim zabilješkama, kazivanjima lokalnoga stanovništva te podacima dostupnima iz literature te digitalnih ortofoto karata.

Navedeni kvalitativni podaci u poglavlju četiri („Kartiranje suhozida cresko-lošinjskoga otočja“) upotpunjeni su njihovom kvantifikacijom te njihovim smještanjem na karte na temelju vektoriziranja rasterskih snimaka u geografskim informacijskim sustavima. Cilj ovoga dijela istraživanja jest dopuniti parcijalnost dosadašnjih prostornih podataka suhozida i ustanoviti njihovu duljinu. Suhozidi cresko-lošinjskoga otočja digitalizirani su uglavnom na temelju ortofoto snimaka iz 1953. godine. Trećim i četvrtim poglavljem kumulativno je postavljena temeljna baza podataka o rasprostranjenosti i karakteristikama suhozidne baštine cresko-lošinjskoga otočja.

U petom poglavlju („Suhozidni krajobrazni uzorci i povijesni procesi koji ih određuju“) ispituje se hipoteza vrijednosti suhozida za potrebe znanstvenih istraživanja. Konkretno, na primjeru pet unutar-otočnih studija slučaja ispituje se korelacija između krajobraznih suhozidnih uzoraka tih područja i poznatih povijesnih okolnosti. Na taj se način posredno adresira problem često nepoznate geneze suhozidnih područja. U ovom poglavlju djelomično se potvrđuje hipoteza da se kartiranjem i detaljnom analizom suhozida i njihovih uzoraka stvaraju nova saznanja o njihovoj genezi i funkciji.

U poglavlju šest („Prema valorizaciji suhozidne baštine“) daje se pregled funkcija suhozida unutar usluga ekosustava u kontekstu cresko-lošinjskoga otočja. Adresira se uloga suhozida u poljoprivredi, u krajobraznoj estetici, njihova vrijednost za bioraznolikost, za „osjećaj mjesta“ i „osjećaj identiteta“. Ustanovljeni su indikatori u korist hipoteze da suhozidi predstavljaju važan gospodarski resurs, međutim, izračun omjera troškova i koristi ulaganja u obnovu suhozida i suhozidnih krajobraza zahtjeva zasebna dodatna istraživanja.

Sedmo poglavlje rada („Zaključci“) kumulativno obuhvaća prijedloge za daljnja istraživanja te zaključke rada.

Rezultati ovoga rada obuhvaćaju GIS bazu vektoriziranih suhozida, izračunatu ukupnost svih suhozida cresko-lošinjskoga otočja izgrađenih do 1953. godine, kao i njihovu gustoću unutar zasebnih otočnih regija. Nadalje, utvrđena je korelacija između suhozidnih krajobraznih uzoraka i povijesnih okolnosti. Izrađen je katalog i tipologija suhozidnih struktura te su iznesena zapažanja i zaključci o posebnostima cresko-

lošinjskih suhozidnih struktura u odnosu na ostale strukture jadranske Hrvatske. Dan je pregled aktualnih funkcija suhozida s konkretnim prijedlozima za daljnja istraživanja, dok su modelom vrednovanja izdvojene vrijedne višeprostrorne suhozidne ovčare. Na primjeru maslinika grada Cresa predložen je aspekt valorizacije suhozidnoga krajobraza kroz designaciju toga prostora kao zaštićenoga kulturnog krajobraza.

Znanstveni doprinos ovoga rada ogleda se u detaljnom prikazu ukupnosti, kompleksnosti, rasprostranjenosti i vrijednosti suhozidne baštine predmetnoga područja. Predočavaju se različite dimenzije istoga fenomena - povijesna, arhitektonska, kartografska, društvena i baštinska. Predložene su metode vektorizacije i valorizacije replikabilne za istraživanja suhozidnih krajobraza na drugim područjima jadranske Hrvatske. U praktičnom smislu, vektoriziranom bazom prostornih podataka suhozida stvoren je alat za njihovo upravljanje te su dobiveni temeljni podaci potrebni za daljnja istraživanja ove važne komponente jadranskoga poljoprivrednoga kulturnog krajobraza.

Ključne riječi: suhozidi, suhozidne strukture, suhozidni krajobrazni uzorci, kulturni krajobrazi, vektorizacija, GIS, usluge ekosustava, cresko-lošinjsko otočje, jadranska Hrvatska

RIASSUNTO

Valorizzazione del patrimonio dei muri in pietra a secco dell'arcipelago di Cherso e Lussino

Il patrimonio dei muri in pietra a secco è una delle componenti più significative del paesaggio rurale adriatico della Croazia. L'arte della costruzione delle strutture in pietra a secco è stata riconosciuta come patrimonio culturale immateriale a livello nazionale e internazionale. Come componente paesaggistica, i muri in pietra a secco sono diventati importanti nelle politiche rurali, nelle valutazioni dei paesaggi e nella salvaguardia dell'ambiente in virtù dei loro servizi ecosistemici. Nonostante l'aumento della loro rilevanza nel dibattito pubblico, e nonostante siano diventati un patrimonio a rischio a causa dell'abbandono e della successione vegetazionale spontanea, il patrimonio di manufatti in pietra a secco non è finora stato sufficientemente considerato nella letteratura scientifica croata.

In questa tesi, il patrimonio dei muri in pietra a secco viene preso in considerazione a partire dall'arcipelago di Cherso e Lussino come caso di studio. Quest'area è scarsamente considerata in termini scientifici, ma è in ogni caso rappresentativa del contesto della Croazia adriatica e dell'area mediterranea per gli aspetti geomorfologici, climatici e territoriali che la caratterizzano.

A partire dall'area d'indagine, gli obiettivi di questa tesi sono l'analisi della consistenza e varietà dei muri in pietra a secco, chiarirne la genesi storica e creare una base di dati che faciliti la stima dell'efficacia economica del loro mantenimento e recupero, creando un modello replicabile di valorizzazione del patrimonio in pietra a secco nelle aree rurali.

L'attualità del tema e i problemi metodologici connessi all'oggetto di ricerca sono brevemente presentati nei primi due capitoli ("Introduzione" e "Materiali e metodi: un approccio al patrimonio in pietra a secco dell'arcipelago di Cherso e Lussino"). Le strutture in pietra a secco sono considerate secondo tre forme geometriche: linea (muro), punto (struttura a secco puntuale) e poligono (strutture complesse in pietra a secco). Dato che il termine "valorizzazione" è utilizzato in riferimento ad approcci diversi al patrimonio della pietra a secco, l'oggetto di ricerca, i metodi e la revisione della letteratura sono ulteriormente elaborati all'interno dei quattro capitoli centrali (3-6).

Il terzo capitolo ("Rilievo del patrimonio dei muri in pietra a secco dell'arcipelago di Cherso e Lussino") presenta i risultati dell'indagine sul campo sulle strutture in pietra a secco dell'arcipelago. La ricerca è stata realizzata con l'obiettivo di identificare le strutture in pietra a secco specifiche dell'isola e di metterle a confronto con il contesto di strutture già conosciute nell'area della Croazia adriatica. Ogni struttura a secco è presentata con descrizioni e ampio apparato fotografico (foto aeree e/o da terra) che illustra gli elementi architettonici e paesaggistici indagati. I recinti pastorali pluricellulari sono stati ulteriormente analizzati attraverso un breve modello di valutazione. Le descrizioni e le valutazioni si basano su osservazioni sul campo, sulle testimonianze della popolazione locale e sui dati disponibili da letteratura e ortofoto digitali.

I dati qualitativi così ricavati sono stati completati attraverso una loro quantificazione. Precisamente, nel capitolo quattro ("Mappare il patrimonio dell'arcipelago di Cherso e Lussino"), sono stati presentati i dati dell'estensione spaziale dei muri a secco sulla base della loro vettorializzazione da ortofoto digitali in un sistema informativo geografico (GIS). Lo scopo di questa parte della ricerca era completare la parzialità o carenza di dati spaziali esistenti e calcolare la loro reale estensione. I capitoli 3 e 4 insieme formano un database fondamentale e tuttora mancante relativo alla distribuzione e alle caratteristiche del patrimonio dei muri a secco dell'arcipelago di Cherso e Lussino.

Nel quinto capitolo ("Modelli paesaggistici di muri in pietra secco e processi storici che li determinano") si sperimenta l'ipotesi del valore della distribuzione del muro a secco per l'indagine scientifica sulla loro genesi. In particolare, con cinque aree campione identificate all'interno dell'arcipelago, si esamina la correlazione tra disposizione spaziale dei muri in pietra a secco e le circostanze storiche della loro realizzazione. In questo modo, il problema della genesi delle diverse aree di muri a secco viene indirettamente affrontato. Si conferma, almeno in parte, l'ipotesi che mediante una dettagliata analisi cartografica si possa ottenere una nuova conoscenza della loro genesi e funzione.

Nel sesto capitolo ("Verso una valorizzazione del patrimonio dei muri in pietra a secco") viene presentata una panoramica dei benefici che il patrimonio dei muri in pietra a secco può assolvere all'interno dei servizi ecosistemici e nel contesto del caso di studio. Tali benefici comprendono il ruolo dei muri in agricoltura, come componente estetica del paesaggio, il loro valore per la biodiversità, il valore identitario e la loro rilevanza da parte degli abitanti. Una volta presi in considerazione in maniera combinata gli aspetti sopra menzionati, un'area dell'arcipelago è stata ulteriormente elaborata per una potenziale designazione come "paesaggio culturale" da tutelare. Viene infine presa in considerazione la possibilità di calcolare il loro valore monetario potenziale: esistono numerosi indicatori a favore dell'ipotesi che il muro a secco rappresenti un'importante

risorsa economica; tuttavia, a causa dell'insufficienza dei dati di partenza, calcolare il rapporto costi-benefici nell'investimento relativo alla ristrutturazione di un muro a secco e dei paesaggi in pietra a secco richiede una ricerca supplementare. Il capitolo sette ("Conclusioni") riassume le proposte per ulteriori ricerche e le conclusioni del lavoro.

I risultati ottenuti dal lavoro di tesi comprendono la base GIS di muri in pietra a secco in formato vettoriale e le mappe tematiche, la quantificazione dei muri in pietra a secco delle isole di Cherso e Lussino costruiti fino al 1953, nonché la loro densità all'interno delle varie regioni dell'isola. Un catalogo e una classificazione tipologica delle strutture dei muri a secco vengono proposti e alcune riflessioni conclusive sulle peculiarità delle strutture dei muri a secco dell'arcipelago di Cherso e Lussino in relazione ad analoghe strutture in pietra della Croazia adriatica. Inoltre, è stata determinata una ipotesi di correlazione tra modelli di paesaggio in pietra a secco e circostanze storiche di realizzazione. Nell'esempio dell'uliveto della città di Cherso, l'aspetto della valorizzazione del paesaggio del muro a secco è stato proposto attraverso la progettazione di un'area come paesaggio culturale protetto.

Il contributo scientifico di questo lavoro di ricerca si riflette in una rappresentazione dettagliata della totalità, della complessità, della distribuzione e del valore del patrimonio dei muri in pietra a secco nell'area in questione. Sono stati proposti metodi per la vettorializzazione e valutazione dei paesaggi in pietra a secco replicabili in altre aree della Croazia adriatica. In senso applicativo, la base vettoriale di dati spaziali relativi ai muri a secco è uno strumento utile per la loro gestione e costituisce una base di dati necessaria per ulteriori ricerche di questa importante componente del paesaggio culturale adriatico.

Parole chiave: muri in pietra a secco, paesaggi culturali, GIS, servizi ecosistemici, arcipelago di Cherso e Lussino, Croazia adriatica

ABBREVIATIONS

ACM - Austrian Cadastral Maps - the first cadastral survey of the research area, marked with the year of origin (ACM1821) or its rectifications (e.g. ACM1837)

APPRRR – Paying Agency for Agriculture, Fisheries and Rural Development of the Republic of Croatia (Croatian: *Agencija za plaćanja u poljoprivredi, ribarstvu i ruralnom razvoju*)

CAP - EU's Common Agricultural Policy

CoE – Council of Europe

DGU – Croatian State Geodetic Administration (Croatian: *Državna geodetska uprava*)

DIM – diminutive of a word

DEM – digital elevation model

DOF – digital orthophotographs (Croatian: *Digitalni ortofoto*), with the year of origin (e.g. DOF53, DOF11)

DSW – dry stone walls, dry stonework, dry stone walling

DSWPs – dry stone wall patterns

DZS – State Bureau of Statistics of the Republic of Croatia (Croatian: *Državni zavod za statistiku*)

EC – Ecosystem services

ELC – European Landscape Convention

EU – European Union

FAO - Food and Agriculture Organization of the United Nations

GIAHS - Globally Important Agricultural Heritage Systems

GIS - Geographic Information System

HLC – Historic landscape characterisation

HOK - Croatian base map (Croatian: *Hrvatska osnovna karta*), with the year of origin – (e.g. HOK79)

LCA - Landscape character assessment

NGO - Non-governmental organisation

TK25 – Topographic map of the Republic of Croatia, of scale 1:25000 (Croatian: *Topografska karta*)

UNESCO - United Nations Educational, Scientific and Cultural Organization

WMS, WFS - Open Geospatial Consortium's Web Map Service and Web Feature Service

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CHAPTER 1

INTRODUCTION

1.1. Introduction

Historical continuity and prolonged human adaptation to natural and socioeconomic conditions have resulted in the high complexity of Croatian Adriatic landscapes spatially manifested by various land uses, as characterised by enclosures and terraces, patchwork fields, pasture lands, managed woods and historical settlements that still reflect the landscape's character (Aničić and Andlar 2018, 90). Dry stone walls, structures, shelters, and enclosures are features which bind these landscapes. They are a striking symbol and a basic feature of economic activities in this area (Kulušić 2004b, 64), an embodiment of the strenuous cultivation of soil underlain by limestone and dolomites. Although dry stone wall structures have suffered exposure to various forms of deterioration and serve their original economic function to a noticeably lesser degree, they still strongly testify to the scope of historical human intervention in this area. They are, moreover, considered as one of its dominant anthropogenic components (Šrajter 2019, 1, 392).

The current period is witnessing perhaps the greatest historical retreat from our traditional landscapes with the consequent neglect of the dry stone walls (Frangješ et al. 2015b, 4). By their transposition to the past, the dry stone walls are redefined from a daily, utilitarian and economic category of the widest extension (Kale 2021, 140) to the category of heritage. As such, they are considered an object of aesthetic admiration and artistic inspiration; therefore, they were a part of various exhibitions (*Exhibition Oton Gliha - Gromače* 2014; Trinajstić 2013), the art of walling part of the activities of international associations ('Dry Stone Walling Across Canada' 2021; 'The Dry Stone Walls Association of Australia' 2022; 'The Dry Stone Walling Association of Great Britain' 2021; 'Dry Stone Wall Association of Ireland' 2021; 'S.P.S. – Société scientifique internationale Pour l'étude pluridisciplinaire de la Pierre Sèche' n.d.; 'The Stone Trust USA' 2013) and contemporary art (Paterson 2015, 260), and the subject of many new re-examinations, such as their mechanical properties, stability and soil erosivity (Mundell 2009; Colas, Morel, and Garnier 2010; Le et al. 2020; Camera et al. 2018). The

perseverance of dry stone walls over time is conceived as one of the last links to our predecessors and to the preindustrial character of these landscapes, evoking romanticised notions of their genesis and their aesthetics, symbolising harmony with nature, the old way of life and the skills and characteristics of their builders (Kale 2016, 164).

These observations and conclusions about dry stone walls and their place in the Croatian Adriatic can be downscaled to the Cres-Lošinj archipelago. This area is representative not only of their extension and diversity, underlying instigating socioeconomic and cultural processes, but also of the current spatial and economic trends of abandonment and neglect. Except for the island of Susak, dry stone structures of various shapes and forms are distributed across this entire archipelago. Scholars and enthusiasts who examined these structures consistently described them as 'a symbol of endurance and survival on the island' (*Puntarski fuoj* 2017, 16), the work of 'Promethean persistence' (Muraj 1999, 189) and a 'project of pharaonic dimensions' (Bommarco 2019). The whole island has been described as 'a story of the effort and work of generations of islanders' (Jurkota Rebrović 2009, 8:25). Even though the technique of dry stone wall construction has been known since ancient times, it is difficult to fully comprehend this strenuous work from today's perspective.

This study was motivated by the author's observation of repetitive bypassing of a more systematic study of this increasingly relevant subject, as well as its position in the Croatian and Mediterranean context and in the context of current scientific and public discourse. It aimed to quantify the work of the insular ancestors, to reveal and explain its nature and diversity, to understand its potential use in current scientific research and to explain its value within contemporary modern needs. The dry stone wall heritage is here considered an underexplored but important layer in the stratification of this territory, and this thesis is thus an attempt to respond to such knowledge and conceptual gaps.

1.2. The topicality of dry stone wall heritage

The current relevance and contemporaneity of dry stone wall heritage can be understood through a combination of different factors: its increasing presence in scholarly publications of various scientific disciplines, its increasing recognition within the activities of various associations, institutional recognitions, and its vast presence now threatened by the synchronous tendencies of abandonment and neglect, reforestation, being overridden with other construction materials and touristic needs for the same spaces. Nevertheless, it has not yet been completely captured and understood in scientific work.

Dry stone walls have been used around the world where the underlying lithology made suitable stones available—throughout the Mediterranean and in the Alps and Apennines regions, where they are densely distributed, often used as retaining walls for terracing (Agnoletti et al. 2015; Barbera and Cullotta 2012; Makhzoumi 2000; ‘Project ALPTER’ 2008); throughout central and northern Europe, where they are mostly used as field boundaries (Collier 2013; Marshall and Moonen 2002; McAfee 2011; Müller 2013a; 2013b); in North America (‘Dry Stone Conservancy’ n.d.; ‘The Stone Trust’ n.d.; K. M. Johnson and Ouimet 2016; ‘Dry Stone Walling Across Canada’ 2021); Australia and New Zealand (Corangamite Arts Council 1995; ‘The Dry Stone Walls Association of Australia’ 2022); Africa (Chirikure and Pikirayi 2008) and Asia (Šrajter 2019, 37, 42). They are an extensive and densely distributed element, which partially explains the lack of systematic inventories.

This ubiquity is now diminishing under the following spatial tendencies: 1) visible deterioration under strong processes of (agricultural) abandonment and reforestation (Figure 1), 2) the increasing expansion of tourist infrastructure (Figure 2), and 3) declining numbers of dry stone walling practitioners. The grapevine diseases of the late 19th century, the socio-economic-political turbulences of the first half of the 20th century (WWI and WWII), and especially the post-World War II focus on the industrialisation of the Yugoslavian country mark a time of rapid deruralisation and migration to factories and the tertiary sector (Defilippis 2006, 1049–50). Dry stone walls became, for many, a symbol of the backwardness of rural life. The agrarian landscapes of life and work became landscapes of abandonment, leaving the dry stone walls as a testimony and monument to which the eyes of the public and scientific community are slowly returning, re-evaluating their purpose at the end of the 20th and beginning of the 21st centuries.



Figure 1. Accelerated re-conquest of the plant communities, after the abandonment of the preindustrial agriculture and the dry stone walls on the example of Lovreški area. A comparison between 1953 and 2014 (DGU, 2019)



Figure 2. A comparison between the land use and vegetation cover of the town of Cres environs between 1953 and 2014 (DGU, 2019)

Neglecting the traditional dry stone walls represents neglect of the arduous human efforts of the past, loss of anthropogenically formed fertile soil, loss of local knowledge, cultural heritage, (agro) biodiversity, and, for many communities, it equals cutting ties with what they perceive as their identity. It merits a wider scientific reaction, which has already been gaining momentum in recent decades. One of the important categories through which the dry stone heritage was observed is ‘terraced landscapes’. Their value is recognised and discussed at international conferences, and a group of networks and communities—the global International Terraced Landscapes Alliance (ITLA)—was founded in 2010, ‘committed to recovering the memory of terraces and reinventing them as active resources that can be used to meet new social demands for food and agriculture, leisure, education, social interaction and quality of life’.¹ The major impetus comes from the activities of volunteer associations dedicated to promoting the knowledge and understanding of dry stone walling techniques by organising training events and demonstrations. They are now established in all countries where dry stone walling is present. Their work comprehends gathering and producing publicly available corresponding literature, which, along with networking, has shaped conservation debates and institutional responses.

The institutional recognition of dry stone walls and their adjacent landscapes as an important part of the cultural heritage came about for the protection of their immateriality, its all-binding component – the technique or art of dry stone walling. As such, dry stone walls have been protected at the national level since the Croatian Ministry of Culture inscribed the technique in the Register of Cultural Goods in 2016, based on the nomination documentation obtained from the Croatian association ‘4 grada Dragodid’ (*Rješenje o zaštiti umijeća suhozidne gradnje* 2016). A joint nomination of eight countries (Croatia, Cyprus, France, Greece, Italy, Slovenia, Spain, and Switzerland) followed, and global recognition was confirmed by inscribing ‘Art of dry stone walling, knowledge and techniques’ on the United Nations Educational, Scientific and Cultural Organization’s (UNESCO) Representative List of the Intangible Cultural Heritage of Humanity on 28 November 2018.² Naturally, questions of management and preservation ensued. The Council of Europe (CoE) published guidelines for the conservation of dry stone walls (Cornu 2019) as part of the implementation of the European Landscape Convention (ELC). Subsequently, many landowners started seeking cheaper and less

¹ Global International Terraced Landscapes Alliance (ITLA). 2020. *FAO*. Last modified: 09/20/2020. Accessed: June 13, 2021. <https://www.fao.org/mountain-partnership/members/members-detail/en/c/166764/>.

² Art of dry stone walling, knowledge and techniques. 2018. *UNESCO*. Accessed: July 14, 2021. <https://ich.unesco.org/en/RL/art-of-dry-stone-walling-knowledge-and-techniques-01393>.

strenuous fencing alternatives. This led to the commencement of agricultural policies at the European Union level that recognised dry stone walls as objects of environmental value and the provision of financial aid for their reconstruction and maintenance (Croatian Ministry of Agriculture, 2021; Rural Payments Agency, Natural England, n.d.; GLAS, n.d.).

Dry stone walls are characterised by certain dichotomies: They rely on a simple construction technique of stacking stones upon stones but emerge in complex typologies, functions, and patterns. Their extensiveness, combined with the lack of cartographic study, make them as ubiquitous as cartographically invisible (Varotto and Ferrarese 2008, 38; Scaramellini 2008, 10). In this sense, dry stone wall enclosures and terraces today have become important items of consideration in the present day, especially after the recognition of their multifunctional role and importance in the postmodern age, having an important place within the concept of ecosystem services (Assandri et al. 2018; Fusco Girard, Gravagnuolo, and De Rosa 2019; Powell et al. 2018). They continue to provide the basis for agricultural production in many Mediterranean regions. Therefore, their inventory and the protection of their tangible and intangible aspects should be an important part of sustainable land policies. Building upon these notions, and in conjunction with the dynamics of public interest and civic activism, the (growing) tourist popularity of the Croatian and Mediterranean coast and increased institutional recognition, it can be concluded that the dry stone wall landscapes have become a part of a 'sought after commodity that occurs in a national store of uninventoried items' (Kale 2010, 464).

1.3. Research questions, hypotheses, and objectives

The Cres-Lošinj archipelago was chosen as a geographical area for the elaboration of the research questions. In line with the conceptual and knowledge gaps stated above, the following research questions emerged:

RQ1: What is the actual extent of the dry stone walls, and how can it be quantified?

RQ2: Are there unique features of the dry stone heritage of the Cres-Lošinj archipelago that differentiate it from the Croatian Adriatic context?

RQ3: What is the time-depth of the dry stone walls, and how can it be determined?

RQ4: If the initial agricultural function is mostly abandoned, are there other values and functions of the dry stone wall heritage that are relevant in the modern era?

To further direct the research, the following hypotheses have been developed:

H1: It is possible to develop a model that captures the value of dry stone walls in the Adriatic Croatia region

H2: Mapping and interpreting of dry stone wall landscape patterns can generate new knowledge about the historical formation and function of dry stone walls

H3: Dry stone walls of the Cres-Lošinj archipelago are an important economic resource; investing in various aspects of dry stone wall landscape has a long-term positive cost-benefit ratio

Accordingly, the objectives of the thesis were the following:

O1 Design, validate and apply a replicable valuation model of the dry stone walls on the Cres-Lošinj archipelago

O2 Clarify the historical-geographical formation and assess the capital stock of the dry stone walls of the case study area

O3 Establish the economic cost-effectiveness of dry stone wall restoration

1.4. Research area and research subject

The broad area of reference of this research is the Croatian Adriatic, a western geographic area of the Republic of Croatia, which comprises 50% of its area, its coast and islands (Magaš 2013, 102–3). The main area of research is the Cres-Lošinj archipelago, which is its geomorphological, climatological, and cultural part. The area of the Cres-Lošinj archipelago is approximately 500 km², and it comprises the largest Croatian island – the island of Cres (Duplančić Leder, Ujević, and Čala 2004, 12, 41). Within this area, the island of Susak (3.77 km²)³ was left out due to its peculiar lithology and thick sand deposits (Bognar 1983), which did not allow for dry stone wall enclosing. Certain areas, like smaller islands or islets – for example, Čutin (0.08 km²), Trstenik (0.33 km²) and Veli and Mali Osir (0.07 km²) – that have been used as un-enclosed off-shore pastures were not considered as much as some of the representative or peculiar localities.

The distribution of the dry stone walls spans the majority of the archipelago territory, but the archipelago is formed of many other sub-realities and micro-regional differences. Therefore, such a research object might seem ambitiously set, especially when time constraints are applied and detailed measurements and analyses are required. In the cases of GIS mapping and field mapping, the whole area was considered. However, in the case of the correlation between the dry stone wall patterns and history, the territory was divided further into case studies and localities, which were estimated to be representative examples of either a DSW structure, building, pattern, landscape, or the socioeconomic and cultural customs behind them.

One of the focal points of this thesis are the dry stone linear structures – the enclosing walls, clearance walls and terraces dominant in the agrarian landscapes of the Cres-Lošinj archipelago, excluding the rare ones still distributed in the settlements. A dry stone wall as an object of research is more layered and meaningful than one might anticipate. As expressed in the words of Sedej, in which he regarded the topic of ethnological research, ‘it is an important understanding that a particular object or cultural monument is interesting as much as it possibly illuminates the way of life or habitation of a particular social layer, and not because of its shape or artistic value’ (Sedej 1080, 26-38; in Stepinac-Fabijanić 1985, 201). In the analysis of the dry stone walls, especially for the completion of the ‘valorisation’ task, a researcher enters disciplines that consider the following matters:

³ All the islands’ surfaces are taken from the official measurements from the work of Duplančić Leder et al. (2004) and are accepted as official measurements in the Islands Act (Ministarstvo regionalnog razvoja i EU fondova 2018).

- geology (lithology), for its effect on the construction forms and occurrence,
- ethnography or cultural anthropology, for the intertwining with the lives of individuals and communities and elements of intangible character – for example, customs, toponymy, and speech (dialect),
- architecture and civil engineering, when concerned with modes, techniques and, recently, the legitimacy of their construction,
- agronomy, to understand the impact of dry stone wall terraces on agricultural production,
- environmental sciences and ecology, for their importance as habitats for plants and animals,
- socio-political-economic history, for their genesis and evolution,
- environmental economics, for the techniques of monetary valuation,
- landscape architecture and geography, which bind the above listed, through the integration of their spatial distribution and causal relations.⁴

⁴ This list of binding elements in the relation 'dry stone structures – scientific discipline' is not exhaustive.

1.5. Discussion of key terms: a dry stone wall, heritage, valorisation

1.5.1. A dry stone wall

In dictionaries and in the literature of English speaking countries, various forms of the term 'dry stone wall' are used:

- with a hyphen: a 'dry-stone wall' (Fitzgerald 2019)
- without the hyphen: a 'dry stone wall' (Müller 2013a, 1:32)⁵
- with no spacing: a 'drystone wall' (Mundell 2009)
- a 'dry-stane dyke' in Scotland⁶ (Paterson 2015, 16)
- and a simple 'stone wall' in Ireland and the USA (Collier 2013; K. M. Johnson and Ouimet 2016; Allport 2012)^{7 8}

The use of 'dry-stone' seems the most appropriate since these two words together form a compound modifier for which a hyphen is needed⁹ and would fit better as an adjective in phrases such as 'dry-stone walling', 'dry-stone structures' and 'dry-stone huts'. However, for this thesis, 'dry stone wall' was chosen because only 'dry' is considered as an adjective preceding the noun 'stone walls' or 'stone structures' (as opposed to 'dry-stone' being considered a compound adjective). Furthermore, most relevant sources do not hyphenate the term, e.g. English studies for Historic England (Powell et al. 2018), Countryside Surveys of the UK Centre for Ecology & Hydrology (Carey et al. 2008), English heritage conservation handbooks ('Dry Stone Walling Glossary - TCV Practical Conservation Handbooks' n.d.), the main dry stone walling association of Great Britain and Ireland ('Dry Stone Wall Association of Ireland' 2021; 'The Dry Stone Walling

⁵ Further referenced in the text below.

⁶ There are only two entries in the Dictionary of the Older Scottish Tongue (DOST), prior to 1700: one is of a 'stane dyk(e)', which is referred to as the 'dry stone wall' ('DOST: Stane Dyke' 1700), and one is of 'cowan', which is referred to as '[o]ne who builds dry stone walls or dykes' ('DOST: Cowane' 1700). Therefore, the word is used without a hyphen. After 1700, in the Scottish National Dictionary (from 1700 onwards), there are 12 results of the 'dry-stone wall' entry, and three without a hyphen ('Dry Stone Wall Search Results' 1700).

⁷ The use of the 'drywall' by non-native English speakers has also been noticed, but this form has a completely different meaning and is not a matter of variety.

⁸ These references are not exhaustive. A search of the Scopus database with a 'dry stone wall' entry returned 311 results; however, the search mechanism does not differentiate 'dry-stone' from 'dry stone', and therefore, it was not possible to calculate the percentages of their usage.

⁹ A compound modifier is made up of two words that work together to function like one adjective.

Association of Great Britain' 2021; Griffiths 2002), Council of Europe Reference Report 'Dry stone in the landscape, ancestral and innovative for sustainable territories' (Cornu 2019) and UNESCO documentation).

Within the UNESCO's decision, the art of the dry stone walling has been defined as 'the knowhow related to making stone constructions by stacking stones upon each other, without using any other materials except sometimes dry soil' (UNESCO 2018). Therefore, a dry stone wall is a wall built out of stones without any binding materials, such as mortar or concrete.

Another slightly different definition is as follows: 'a dry stone structure, because of the special way in which the stones are arranged and the friction between them, does not require any binding to make it stable' (Cornu 2019, 11). This definition, used by the professor of civil engineering Éric Vincens, may better illustrate the essence. The fact that binding material is not needed to make the wall functional is an important criterion. It is one of the features that made the technique worthy of protection and study, especially during times when the use of cement and mortar was prevalent and considered more appropriate or legitimate. Consequently, gabion walls are excluded from this work despite some apparent advantages (fast construction – or, rather, fast placement – and the ability to retain slope to some degree). Although they are composed of stones stacked up without binding material, they are stabilised by outer metal bars (hence the name 'rock cage' [Ramli et al., 2013, pp. 706, 709]) and are not the result of a historical craft.

The term 'dry stone wall' has many similarities between its *definiendum* and *definiens*, and its explanation may seem self-evident. However, in the Croatian language, the standardised term for a dry stone wall is *sùhozīd*, composed of words *suh(o)* (dry) and *zid* (wall), without the inclusion of its constituent material (stone). The same occurs in neighbouring Slavic-speaking countries.¹⁰ Furthermore, for this reason, it is not a complete equivalent to its use in Romance languages (e.g. *muro in pietra a secco* [Italian], *mur en pierre/sèche/s* [French], *muro de piedra seca* [Spanish], *alvenaria* [or *muro*] *de pedra seca* [Portuguese],¹¹ *mur de pedra seca* [Catalan] [Observatori del Paisatge de Catalunya 2007]), where the constituent material is used.

The term *suhozid* was not used by the Croatian rural inhabitants of the preindustrial era. As Kale writes, it is an 'academism which in the industrial times was adopted from the

¹⁰ In this way, it is used in the neighbouring countries as well: *suhi zid* in Slovenian, *suvozid* in Serbia and Montenegro, *suvomeđa* in Bosnia & Herzegovina.

¹¹ This list has been taken and adapted from the Croatian dry stone walling Protection Decision (Ministry of Culture of the Republic of Croatia 2016, 2).

literary standard into an ordinary speech' (Kale 2016, 163–64), maintaining its 'local feel' by maintaining its shorter plural form (*suhozidi* instead of *suhozidovi*) (Kale 2021, 140). Previously, along the Croatian coast and among the inhabitants, *suhozid* was called exclusively by its local or region-specific vernacular synonyms: *gromače*, *gomile*, *barbakani*, *međe*, *ograde*, *zidi*, *podzidi*, *mocire*. Considering the use of a unified term for dry stone walls in the Mediterranean countries mentioned above, Šrajer assumed the possibility that the local terminology of the dry stone wall experienced a similar linguistic standardisation path in those countries as well (2019, 4). The dry stone walls of the Cres-Lošinj archipelago bear the local names of *gromače*, *gromace*, *masiere* or *mocire* (Šimunović 2011, 214).

Within this thesis, the research object was largely oriented to 'walls' (i.e. linear structures constructed using the dry stone technique). They are the main features of GIS mapping and the main components of the dry stone wall landscape patterns and valuation. However, other dry stone categories are reviewed in chapter 3 - Revealing the dry stone wall heritage of the Cres-Lošinj archipelago.

1.5.2. Heritage

Since the initial economic and agricultural functions of dry stone walls have largely been abandoned, over time, the dry stone walls and structures became part of the vernacular architectural cultural heritage. They matured into an object of research increasingly approached from a cultural, anthropological-ethnographic standpoint. This transition, which primarily happened after the 1960s, is what brought this subject back into scientific writings.

There are several reasons for joining the term 'heritage' with the syntagma 'dry stone wall' in the thesis title. Their all-binding component, the art and technique of dry stone walling, has been recognised as a heritage, both nationally (by the Croatian Ministry of Culture in 2016) and internationally (by UNESCO in 2018). Its material manifestation, usually on the scale of a landscape and less often as an individual structure, has been protected and registered on the World Heritage List¹² and the Food and Agriculture

¹² World Heritage List of the UNESCO World Heritage Centre. n.d. UNESCO. Accessed: December 10, 2021. <https://whc.unesco.org/en/list/>.

Organisation's (henceforth FAO) Globally Important Agricultural Heritage Systems¹³ (henceforth GIAHS) (See the full list in: Šrajcar 2019, 36–43).

Definitions of the term 'heritage' differ slightly, which is in line with changing attitudes toward heritage. Still, most of them refer to some aspect of the dry stone wall(ing). The International Encyclopedia of Human Geography defines 'cultural heritage' as 'an expression of the ways of living developed by a community and passed on from generation to generation, including customs, practices, places, objects, artistic expressions, and values' (Hartmann 2020). Here, the emphasis on the intangible component is observable. Intangible heritage comprehends 'holders' of the craft; in the case of dry stone walling, individual practitioners who know how to construct a stable and functional dry stone wall are currently the most important component of passing knowledge on to younger generations.

International Encyclopedia of the Social & Behavioral Sciences makes another remark: 'Cultural heritage includes the sites, things, and practices a society regards as old, important, and worthy of conservation' (Brumann 2015). Volunteer associations and their activities reflect their recognition of dry stone walling's worthiness; later, due to their efforts, it took on an official (state-validated) form.

The term 'heritage' involves certain issues, all of which can be connected to the analysis of dry stone walls: memory, identity, conflicting narratives, censorship, multiculturalism, national and local identity, commodification, authenticity, and critical thinking applied to cultural heritage. Furthermore, fitting the dry stonework into the category of heritage may enable a better understanding of its relations with the economy, tourism, management, and politics (Hartmann 2020; R. Jones 2009; Kelly 2009). Finally, emphasising the term 'heritage' anticipates the placement of the heritage value of dry stone walls within the cultural ecosystem services.

1.5.3. Valorisation

'Valorisation' is a not a very straightforward term and it may include different meanings. Some of the dictionary entries¹⁴ are presented as follows (from the Cambridge dictionary):¹⁵

¹³ GIAHS - Globally Important Agricultural Heritage Systems. n.d. FAO. Accessed January 13, 2021. <https://www.fao.org/giahs/en/>.

- 'the act of thinking or stating that something has value or is valuable'
- 'the act of making something valuable or useful from an existing substance'
- '(finance & economics) the process of deciding or increasing the price or value of goods, services, etc., for example by government action'

Oxford Reference:¹⁶

- 'The attempt to give an arbitrary market value to an asset, commodity, or currency usually through government intervention.'

An amalgamation of the above-stated key phrases can be applied to the methods used in this thesis, where the process of valorisation primarily refers to current functions and benefits and discusses its potential and monetary value.

To valorise something commonly means to express its use-meaning or use-value by transforming an asset from a passive into a functional structure. This process relies on defining practical benefits that justify and legitimate something's preservation. Valorisation, in terms of cultural heritage, often means the 'recycling' of heritage. In this way, valorisation is done through touristic commodification and folklorism or by emphasising the quality of an agricultural product to give value to a historical agricultural terraced system (Terkenli, Castiglioni, and Cisani 2019) while rarely fully resurrecting its initial function in the full sense or extent. Therefore, it is beneficial that the international discussion started to guide the examination of ecosystem services of cultural heritage assets and not just of natural ones (Navrud and Ready 2002). The inherent understanding is that services derived from object value or function and expressed in monetary language are a viable way to legitimise and justify the non-abandonment and non-neglect of 'useless' historical assets.

In this work, the valorisation of the dry stone wall heritage is conceived as follows: Chapters 2 and 3 reveal the hidden, unknown, or less-known dry stone wall heritage by explaining their extent, diversity, and the underlying traditional activities. In this way, the latent value and potential were made explicit. Chapter 4 demonstrates their scientific

¹⁴ Interestingly, the term *valorization*, even though it is widely used within text of various authors, was not part of the International Encyclopedia of Human Geography entries.

¹⁵ Valorization - dictionary entry. n.d. *Cambridge University Press*. Accessed February 01, 2021. <https://dictionary.cambridge.org/dictionary/english/valorization>

¹⁶ Valorization – quick review. n.d. *Oxford Reference*. Accessed May 13, 2021. <https://www.oxfordreference.com/view/10.1093/oi/authority.20110803115118584>. This reference has been taken from *The Handbook of International Financial Terms* (Moles and Terry 1997).

value (i.e. how they promote an understanding of the landscape's historical character). Chapter 5 assembles and discusses their currently known multifunctionality through their functions within the ecosystem services.

CHAPTER 2

MATERIALS AND METHODS: APPROACHING THE DRY STONE HERITAGE OF THE CRES-LOŠINJ ARCHIPELAGO

2.1. Materials and methods

The results of this thesis are based on a combination of deskwork and fieldwork. The deskwork included consulting written archival sources, cartographic material, and heterogenous literature sources. Data were analysed using Geographic Information Systems software (GIS analysis). The fieldwork consisted of collecting empirical data from field visits and free and semi-structured interviews.

2.1.1. Deskwork

The first step of the deskwork was to collect the data and create a bibliographic and cartographic database, as described below.

2.1.1.a Bibliographic database

The topic of dry stone walls calls for a review of a wide range of literature, archival sources, and cartographic data. Given the interdisciplinarity of the topic, the desk work included the collection and review of local and regional resources from the fields of history, geography, archaeology, cultural anthropology and ethnology, linguistics, architecture and engineering, landscape architecture, agronomy, and environmental economics. Given the relative paucity of the systematic research data, the consulted sources also varied in their form, from books and scientific articles to professional documents, spatial planning documentation, manuals created by professionals and

enthusiasts, local and regional historical journals, unpublished manuscripts from local inhabitants, blog posts and posts on social networks. More than 400 bibliographic units have been collected and partially processed using Zotero bibliographic software. The reviewed literature can be grouped into three broad categories: 1) dry stone wall heritage in Croatia, in the local context of the Cres-Lošinj archipelago and in the Mediterranean region; the place of dry stone walls in local, national and European development policies; 2) methodologies for mapping and classifying dry stone walls and landscapes; 3) the ecosystem services concept and the protection of the dry stone walls landscapes as part of the cultural landscapes.

2.1.1.b Cartographic material and spatial data

Cartographic and spatial data that were obtained and used, are approximately classified by their relevance to this investigation, as follows:

Raster layers and base maps:

- Digital Orthophotos (in Croatian: *Digitalni ortofoto*) from 1953, from the Croatian State Geodetic Administration (Croatian: *Državna Geodetska Uprava*). Its common name ('DOF68', as used in the state Geoportal)¹⁷ is based on its last year of the aerofotogrammetric survey – 1968. The survey started in 1950 (DGU 2019). Aerophotogrammetry above the Cres-Lošinj archipelago was done in 1953; therefore, in this text, this source will be abbreviated as 'DOF53'. Despite its low resolution, lack of a greater zoom-in capacity, sporadic damage to certain photographs, and the black and white format, this source has been the most useful in detecting the full extent of the dry stone wall heritage before the vegetation succession.
- Digital orthophotos from 2011, 2014/2016, 2018 and 2020 from the Croatian State Geodetic Administration – National Spatial Data Infrastructure ('Geoportal NIPP-a' n.d.), at a 1:5000 scale are abbreviated as 'DOF11' or 'DOF14/16'. The latter can be retrieved from the Web Map Service (WMS)¹⁸ and, therefore, were mostly used for mapping the recent dry stone wall landscape changes.

¹⁷ Croatian Geoportal. n.d. *Državna geodetska uprava*. Access September 07, 2022. <https://geoportal.dgu.hr/>

¹⁸ Mrežne usluge prostornih podataka Državne geodetske uprave. 2019. *Državna geodetska uprava*. Last modified: February 28. Accessed December 01, 2022. <https://dgu.gov.hr/vijesti/mrezne-usluge-prostornih-podataka-drzavne-geodetske-uprave/5015>.

- Croatian Base Map (in Croatian: *Hrvatska Osnovna Karta*) from the State Geodetic Administration, at a scale of 1:5000, retrievable as WMS.¹⁸ It is the official state map that presents in detail many of the topographic encoded images, including a variety of dry stone wall structures. For the area of the Cres-Lošinj archipelago, these maps were created in 1979, 1986 and 1988. In the text, these maps will be abbreviated as 'HOK79', 'HOK86' and 'HOK88'.
- Topographic map at a scale of 1:25000 from the State Geodetic Administration, available on DGU Geoportal and retrievable as WMS.¹⁸ In the text, this map will be abbreviated as 'TK25'.
- Austrian Cadastral survey from 1821 and its rectifications from 1837 and 1847. This is the first systematic cadastral measurement of the research area and one of the most important historical sources for the study of landscape genesis and evolution. The Cres-Lošinj archipelago and Istria are among the rare Croatian regions not available for consultation on the Mapire web portal,¹⁹ but on the digital repository of the Italian State Archive of Trieste.²⁰ Unlike the common interface of Mapire, which uses the latest GIS features (Majić 2015, 136) and significantly facilitates faster geohistorical comparisons by using current and historical maps. State Archive of Trieste offers consultation in a less user-friendly manner (i.e. it allows the consultation of each map separately without offering overlaps with other base layers). Austrian Cadastral Maps can also be consulted in the Croatian State Archives in Split and Pazin.

Vector layers:

- 'Built barriers' (*Izgrađene barijere*) type 'Freestanding wall' (*Slobodnostojeći zidovi*). This vector layer was part of the Croatian Topographic Information System project version 2.0 (henceforth CROTIS 2.0; in Croatian: *Topografsko informacijski sustav Republike Hrvatske*), released in 2014. Its aim is to establish a unique topographic-cartographic database. Most of the data are retrievable from the DGU website.¹⁷

¹⁹ Arcanum Historical Maps. n.d. *Arcanum Maps*. Accessed: January 12, 2022. <https://maps.arcanum.com/en/>.

²⁰ Sistema informativo dell'Archivio di Stato. Patrimonio archivistico. n.d. *Archivio di Stato di Trieste*. Accessed: July 05, 2021. <http://ariannaweb.archiviodistatotrieste.it/AriannaWeb/main.htm;jsessionid=3E39306993A76C014E26B3CE33992CAF#archivio>.

- Digital cadastral plan from SGA, which has been retrievable from WMS and WFS since 2019 (for registered users).²¹ This includes the graphical display of cadastral particles and boundaries and documentation on its use and ownership.
- Layer of dry stone walls registered for aid, 2015, Agency for Payments in Agriculture, Fisheries and Rural Development,²² visible under the category of 'Landscape features' (*Obilježja krajobraza*).
- Spatial planning maps and documentation for the two administrative units of the archipelago: Town of Cres (Zavod za prostorno uređenje Rijeka 2018) and Town of Mali Lošinj (URBING d.o.o. ZAGREB 2016).
- CORINE Land Cover 2018, from the COPERNICUS programme.²³
- Map of the terrestrial non-forest habitats of the Republic of Croatia, on the Bioportal of the Croatian Environment and Nature Agency,²⁴ released in 2015, a database of biodiversity and nature protection in Croatia.
- Base geological map (*Osnovna geološka karta*) from the Croatian Geological Institute, updated and made available for public use in November 2020.²⁵ In addition to the already active WMS for the maps at a scale of 1:300,000, geological maps of Croatia at a scale of 1:100,000 (which covers the entire area of the Cres-Lošinj archipelago) and 1:50,000 (available only for the area south of Vodice) can be retrieved. Henceforth:
 - 'OGK300' is used for the entire territory.
 - 'OGK50 2012' is used for the area of the island of Cres south of Vodice.
 - 'OGK50 2014' is used for the southern part of the island of Cres, the Lošinj archipelago.
 - 'OGK50 2018' is used for the southern part of the island of Lošinj (the islands of Ilovik and Sveti Petar).

²¹ Katastarske čestice i katastarske općine - WMS/WFS. n.d. *Ministarstvo pravosuđa i Uprave. Državna geodetska uprava*. Accessed: January 05, 2021. https://oss.uredjenazemlja.hr/public/inspire_dkp.jsp.

²² ARKOD preglednik. n.d. *Agencija za plaćanja u poljoprivredi, ribarstvu i ruralnom razvoju*. Accessed: December 16, 2021. <http://preglednik.arkod.hr/ARKOD-Web/>.

²³ Copernicus Land Cover. 2018. *Copernicus Programme*. Last modified: March 29, 2022. Accessed July 08, 2021. <https://land.copernicus.eu/pan-european/corine-land-cover/clc2018>.

²⁴ Bioportal. 2019. *Ministarstvo gospodarstva i održivog razvoja. Državni zavod za zaštitu okoliša i prirode*. Accessed: April 26, 2021. <https://www.bioportal.hr/gis/>.

²⁵ Geološke karte. n.d. *Hrvatski geološki institut*. Accessed: November 15, 2020. <https://www.hgi-cgs.hr/geoloske-karte/>.

- Digital elevation model (henceforth DEM) (Croatian: *Digitalni model reljefa*) from the SGA, with the scale of precision of 25 × 25 m.

2.1.2. Fieldwork

Free and semi-structured interviews with the local population of the island of Cres and joint field visits contributed the most to the research of the various localities of the archipelago. Interlocutors are predominantly middle-aged (very few were younger than 40) and elderly (either retired or still active). They are all tied to traditional agricultural activities (i.e. occupied in the areas of olive growing, sheep husbandry and/or the cultivation of crops). Unless otherwise stated, all photographs are from the author of the thesis with the permission of the rightful owners or occupants.

Participation within the contemporary wall culture was also included as part of the research process to develop a full understanding of the dry stone structures and their current place in the Croatian Adriatic domain. Since the dry stone walling craft in Croatia is based less on professional work and more on hobbyist and voluntary participation, the author engaged directly with this kind of dry stone walling practice in local and regional workshops as part of the '4 grada Dragodid' association,²⁶ for the development of 'haptic knowledge' (Crang 2003, 499) and better understanding of the effort invested in the building of these structures.

2.2. Workflow and methods by chapters

Within this thesis, different arguments were addressed (always under the umbrella term of 'dry stone wall heritage'), which necessitated fairly separate methodological approaches. Chapters 1 and 2 introduce the relevance of the topic and the methodological approach followed to explore it. Chapters 3–6 present the results of this study, while Chapter 7 presents the final reflections on the results of the study and suggestions for further research. Below, the methods and procedures are listed by their use in the chapters.

²⁶ Workshops on dry stonemasonry in Konavle (September 2021), Lubenice and Vinkuran (October 2021), Petrebišća (July 2021), Srma (September 2020).

2.2.1. Methods used: Chapter 3 'Revealing'

Apart from descriptive geography, this part of the work concerns salvage ethnography – a common race against time in the recording of objects and customs characterised as redundant or at risk of becoming so and starting from the premise of the intrinsic value of the vernacular heritage. Therefore, the scope of this chapter was to survey, review and assess (both visually and theoretically) the diversity, use and occurrence of the various dry stone and semi-dry stone structures of the Cres-Lošinj archipelago, as well as to place them in a broader regional context (Croatian Adriatic and Mediterranean). This part of the research results presents a list and description of the recognised structures. Each of them is categorised under the national typology of dry stone structures proposed by Šrajer (2018, 143-184).

This initial part of the work was based more on fieldwork and conversations with the local community than the work described in any other chapter. Field visits were directed by the examination of the local literature, cartographic and satellite imagery data, and even social network pages (e.g. a Facebook group dedicated to the island of Cres), and others were guided or indicated by the interlocutors. Some dry stone structures were found by chance during individual field explorations.

The dry stone structures were recorded via geotagged terrestrial and aerial photographs taken from 2018–2022. Due to the observed 'dronogenicity'²⁷ of the structures, more emphasis was placed on aerial photographs.

The main research obstacle was the advanced abandonment of some of the structures. This made it impossible to fully capture them through photographs due to vegetation coverage and caused the availability of information and descriptions to vary. For example, multicellular sheepfolds were the only dry stone structures that went through a brief evaluation model, resulting in a selection of those most apt for potential renewal and public presentation. The evaluation model considered ease of access, level of preservation, aesthetic value, and the willingness of owners or users to support presentation or renewal. The latter criterion was included since a conservation model, if such would be deemed apt to implement, should be tailored together with the local community. Aesthetic value in this context is guided by the following elements: size, recognisability, complexity of form, associative shape, construction quality, and a prominent or distinguishing setting. The aesthetic value should be considered from a pedestrian perspective as well, but the bird's-eye view more successfully conveys the

²⁷ The use of the term 'dronogenic' was inspired by correspondence with Filip Šrajer, who used the term in the context of multicellular sheepfolds.

entirety of these structures, most of which are not noticeable from the ground. Scores have been given with the Cres-Lošinj archipelago serving as the geographical context of comparison. This unexpected study spin-off resulted from the synchronous combination of plentiful recollections of the informants and their paucity in literature sources.²⁸

The literature consulted for this chapter implied reliance on non-academic works: local monographs, historical works, dictionaries of local dialects, daily journal entries, magazines written by local associations and publications by knowledgeable (often new) inhabitants of the archipelago (Nikolić 2000; Pavoković 2016; Jurkota Rebrović 2009; Imamović 1979). The attribution of the names of localities was based on the toponyms from the official Croatian Base Maps 1:5,000 and Topographic maps 1:25,000. These names do not always correspond to the names used by the local community. Cases in which the actual names of localities were revealed during conversations with local inhabitants will be stated in the notes.

The names of the structures are explained etymologically wherever possible to facilitate an international understanding of the dialect words. Local pronunciations were added to words from the archipelago which are relevant for the dry stonework and dry stone walling. The attribution of local²⁹ pronunciation was based on the dictionaries of local dialects (Houtzagers 1985; Tentor [1907] 2020; Velčić 2003; Nikolić 2000; Chalvien Saganić 2014) or magazines written in the local dialect (*Puntarski fuoj* 1-20, 2005-2019) and advised by Bernard Balon.³⁰ The three main types of standard vowel accents of the Chakavian dialect are short (ä), long (â) and čakavian acute (ã). The 'ǰ' sound signifies a vocal between 'a' and 'o', as if one is trying to say 'a' but ends up saying 'o'. This pronunciation is typical for Tramuntana and Unije. The 'ś' sound is a sound between 's' (pronounced as 'c' as in 'certainly') and 'š' (pronounced as 'sh' as in 'shop'). For the use of diphthongs, which are common in Punta Križa and Nerezine environs, as well as the island of Unije, a long descending accent is put above both vocals: 'ûâ'.

²⁸ Accordingly published as a preliminary findings (T. Kremenčić, Varotto, and Andlar 2021).

²⁹ 'Local' does not imply that the entirety of the archipelago speaks the same dialect. Due to its long history within a marginal region between Slavic/Croatian and Roman/Latin/Italian language realms, the inhabitants of the archipelago speak mostly in the dialect of Italian language (of the Veneto region, 'istoveneto' dialect) and northern-Čakavian dialect, with its sub-varieties between regions of *Tramuntana*, *Gerbin*, *Punta Križa* and *Nerezine*, etc.

³⁰ Bernard Balon (born 1946), despite being an economist by profession, gained an expertise in Glagolitic letter, diacritic signs and local pronunciation due to his absolute hearing. He was the first editor-in-chief of *Otočki vjesnik* (1979-1986), one of the founders of the *Katedra čakavskog sabora Cres-Lošinj*, and other activities in the realm of creation, collection and safeguarding of the local heritage and topics. He is currently writing the dictionary for the village of Valun.

2.2.2. Methods used: Chapter 4 'Mapping'

While Chapter 3 can be considered as mapping of the point features, Chapter 4 proceeds by mapping the linear features covering the whole research area of the Cres-Lošinj archipelago. In this chapter, the mapping implies the manual vectorisation or digitisation of the dry stone walls based on the digital orthophotos (DOF 1953, DOF after 2011) and Croatian base maps (HOK 1979–86–88). It includes the drawing of the vector lines in Geographic Information System software (ArcGIS by ESRI and QGIS), thus transferring the walls from raster to vector data. Vectorising necessitated a view of the data at scales of 1:600–1:1000. The first vector layer production was employed by Michela Trevisan³¹ and was subsequently revised and analysed by the author.

Older cartographic data were used to determine the full historical extent of the dry stone walls built until 1953. DOFs after 2011 were used to quantify of the current stock of the walls, subtracting those which were recently overridden by new construction and those built after 1953. Verification of the existence of certain walls also included the use of Google Street View.

Initially, it was expected that new features would be merged or added to the existent national vector layer's 'built barriers' from the CROTIS 2.0 database (2014). However, the differences of the two methodologies caused the layers to be incompatible – the CROTIS layer was based on aerophotogrammetry from the 1980s (therefore, it was based on lesser visibility of the structures), and the polylines did not overlap with those on the orthophotos.

The whole archipelago was mapped regarding all the structures as linear features (polylines). Such a geometric generalisation had to be made to facilitate comparisons between quantifications, especially with the official CROTIS layer, although some of the structures would require their mapping as polygons as well due to their large width (such as the dry stone clearance walls). The mapping methodology corresponds to the 2nd-level model of inventory of dry stone walls proposed by Šrajcar (2019, 305), which implies attributing geometrical data and other attributes to these features, which are available from the interpretation of cartographic data (e.g. topographic symbology from HOK 1979, HOK1986, HOK1988 [*Zbirka kartografskih znakova mjerila od 1:500 do 1:25 000* 2020]) and orthophotography.

³¹ Extensive vectorisation and other quantitative analyses of the raw data were done by archaeologist Michela Trevisan as part of her master's thesis 'Mappatura del patrimonio in pietra a secco nei territori di Cherso e Lussinpiccolo', supervised by professors Silvia Piovan and Mauro Varotto (Geography department of the University of Padova). The thesis was published in spring 2021.

2.2.3. Methods used: Chapter 5 'Dry stone wall patterns'

In the present work, a dry stone wall landscape pattern (DSWP) is considered the smallest area discernible and occurring in repetition, identifiable by the spatial arrangement, design and relationship of its corresponding parts (i.e. dry stone walls and structures) in a floor plan view. The case studies were chosen based on the extrapolation of the representative examples, which could explain the dependency between the processes associated with it. All patterns were, to some extent, verifiable in local and international literature. As such, they could assist in deciphering the other Croatian Adriatic or Mediterranean landscapes and their historical formation. In this sense, a larger picture is induced from a detailed level.

The method of DSWP differentiation and characterisation can be understood as a form of the historic landscape characterisation (HLC) method. This method, developed largely in England, is concerned with recognising how the present countryside reflects how people have adapted to, changed and exploited their physical environment through history (Fairclough, Lambrick, and Hopkins 2002, 69; S. Turner 2006). Revealing the DSWPs and their characterisation and interpretation is based on a combination of deskwork and fieldwork. They are primarily the result of topological explorations (using DOF 1953 and DOF after 2011), followed by an assessment of their underlying topography and constructive form (Figure 3). The investigation of the DSWPs involves significant fieldwork, but the cartographic analysis focuses on a particular point of interest – namely, the dry stone structures and the patterns they form.

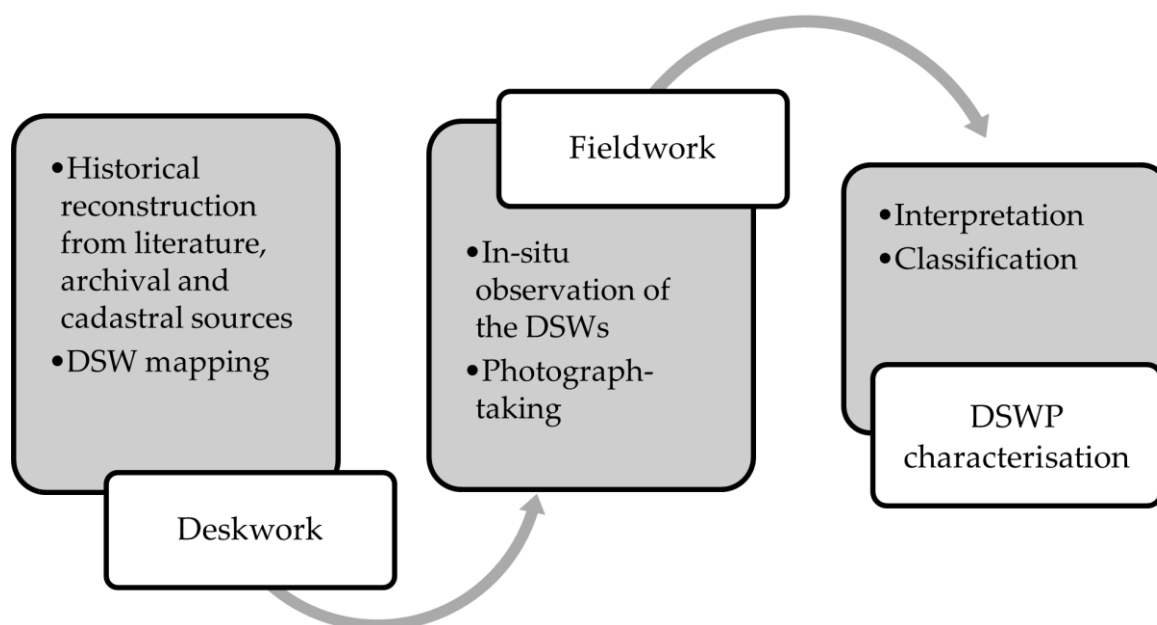


Figure 3. The dry stone wall landscape pattern characterisation

The analysis and distinction of DSWPs was based on research on its natural and cultural aspects: geomorphology, local crops, local dry stone wall typology, historical circumstances, and cartographic interpretation. Discerned DSWPs were then compared with the existing work relevant to the Croatian Adriatic – the landscape pattern categories, enclosures and terraces (Andlar, Šrajer, and Trojanović 2017; 2018). These authors divided the Croatian Adriatic area into two classes of terraced landscapes (terraced field landscapes and hillside terraced landscapes); these were further divided into nine sub-classes and six general classes of enclosures (micro-clusters, individual enclosures, managed woodlands, pastures, fields, and karst clearings for crops). These, in turn, were further divided into 14 sub-classes. Within the following case studies, the objective was to assign these categories to the Cres-Lošinj area.

Furthermore, the discerned DSWPs have been confronted with previous knowledge and observed regularities on the relation DSWP – historical events and circumstances (Bonardi 2019; Kale 2006; Kulušić 1999; 2004b; 2004a; Stražičić 1981; Klimm 1935).

The process of pattern recognition sometimes commenced from the socioeconomic event, followed by the search for patterns in the field. Understanding the historical landscape circumstances, the traditional economy and the utility of these structures is also important in their identification, as it enhances the perceptual abilities of various gradients of patterns. The identification of the essence of patterns often requires the juxtaposition of at least two images. An example of this is the similarity in land use of the case studies of Cres and *Lovreški*.

Patterns sought should be objectively measured or described in some way (Bell 2012, 17). As dry stone wall patterns often depend on topography, they do not occur in an identical geometric disposition, but they will follow a discernible and describable arrangement of features. The dimensions of the patterns were measured and described based on cartographic (digital orthophotos from 1953 and 2011–2020) and field observations. Comparisons with the Croatian base map (1979–1986–1988) and the Austrian Empire cadastral maps (1821) have been used for historical reconstruction. The landscape patterns are represented by the following:

- A block diagram – a 3D model of the pattern based on DEM (25 × 25 m) and a digital orthophoto from 1953 or 2014
- A dry stone wall vector layer
- Aerial and terrestrial photographs
- Austrian Cadastral Map

They have been ordered by size, from smaller to bigger scales. Although it was sought to equalise the graphics for each case study, there are deviations due to the availability of graphic material (for example, it was not possible to find an older photo for each of the case studies) or the fact that some patterns are better recognised with a 1953 DOF while others are better recognised with a more recent one.

2.2.4. Methods used: Chapter 6 'Towards valorisation'

This chapter focuses on the value of dry stone walls and dry stone wall landscapes, which have been considered within the framework of ecosystem services. The scope of the chapter was to review the valuation approaches which regard the benefits provided by the dry stone walls as applied in the Peak District of the United Kingdom and to evaluate and discuss its applicability and validity in the case of the Cres-Lošinj archipelago, assuming this research area to be sufficiently representative for the Croatian Adriatic.

A critical review of the theoretical concept of values, their substantiation in literature and the potential arbitrariness of the monetary attributes comprise a large part of the chapter. Conclusions are drawn regarding the value of dry stone walls and the applicability and validity of this model, as well as proposals for further research, its improvement, and guidelines for its implementation elsewhere, primarily in Adriatic Croatia.

The current and potential benefits arising from the dry stone walls (such as habitat provision, soil retention, livestock management, sense of place and identity) are tabulated and discussed. Functions and benefits are further allocated to four major ecosystem service categories (supporting, provisioning, regulating, and cultural). The benefits of the dry stone walls are extracted not only from the walls but also from the landscape of which they are an integral part. The conceptual model and methods used in dry stone wall pastoral settings by Powell et al. (2018) were discussed. The purpose of this chapter is to review the benefits to which financial approximations should be attributed and proposed the obtaining of the necessary data for the application of the valuation model.

CHAPTER 3

REVEALING THE DRY STONE HERITAGE OF THE CRES-LOŠINJ ARCHIPELAGO

3.1. Natural and social circumstances underlying the dry stone walling of the Cres-Lošinj archipelago

Thirty-two islands, islets, and rocks make up the Cres-Lošinj archipelago. The largest ones are the island of Cres (405.7 km², which is also the largest island in the Adriatic Sea) and the island of Lošinj (74.37 km²).³² The total area of the archipelago is about 515 km², and it comprises about 16% of the total area of all the Adriatic islands (Duplančić Leder, Ujević, and Čala 2004).

The islands of Cres and Lošinj, as well as other smaller islands in the environment, are built predominantly of carbonate deposits – limestone (calcium carbonate, CaCO₃) or dolomitic limestone (calcium magnesium carbonate, CaCO₃ + MgCO₃) of the Cretaceous and Paleogene Period (40–140 million years ago [Mya]). These layers form a karst environment which is characterised by high erosivity, the complexity of landforms, scarce soil (limited mainly to the karst valleys and dolines) and lack of surface water (Stražičić 1981, 4:102–3). Only a smaller part of the archipelago is made of clastic deposits – Paleogene marl and loess (Fuček et al. 2015). Besides the island of Susak, layers of loess are found on the islands of Unije,³³ Vele, and Male Srakane, as well as parts of the island

³² These islands have been divided only by a narrow, artificial canal in front of the ancient town (and now a small village) of Osor. After the excavation of the canal on Privlaka in 1936, the island of Lošinj physically became two islands but is always understood as one island for functional and historical reasons (Stražičić 1997, 63).

³³ It is assumed that the island of Unije derived its name from the Greek word *ἡνεϊός* (*heneios*), meaning 'field' (Skok 1950), based on the toponym Nia, which was used on old nautical charts. The

Lošinj (Kurile). These notions can be read from the dry stonework. It introduces to the local lithology and reflect the bedrock which lies beneath them as most stone was quarried very close to the lines of the walls.³⁴ The indications go vice-versa – geological maps have been proven as an indicator of the location of certain dry stone structures, such as lime kilns and their types (Faričić and Juran 2021, 7).

According to Köppen, climate classification is defined by the mean annual temperatures and precipitation amounts. Based on the previous climatological normal (1981–2010), the Cres-Lošinj archipelago falls under the ‘sub-humid and warm temperate climate with hot summers’ (Cfa, sometimes referred to as sub-Mediterranean climate) and the ‘Mediterranean climate’ (Csa). The latter is ascribed to the Town of Mali Lošinj area and the former to the Town of Cres (Magaš 2013, 60).³⁵

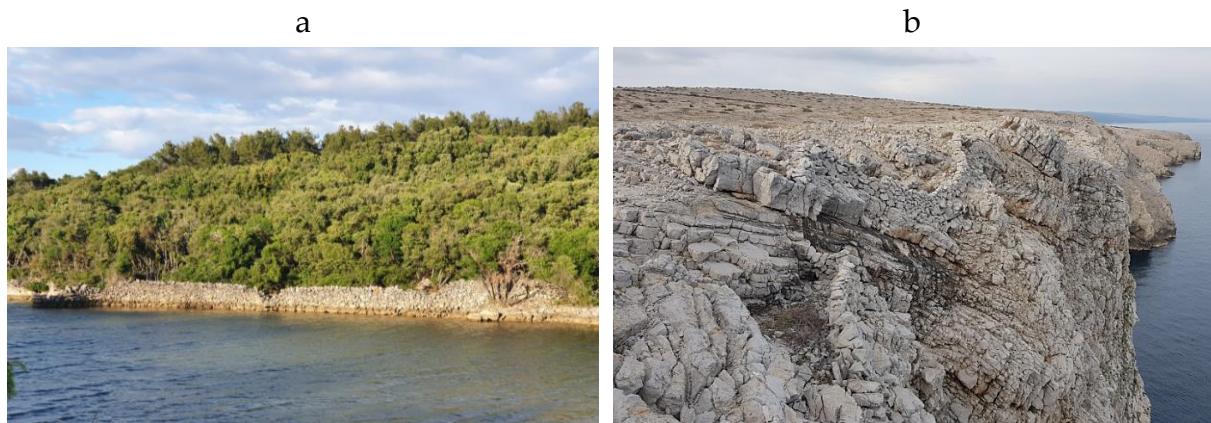


Figure 4. Dry stone walls built all the way to the sea a) on the lower shores of the bay Ul of Punta Križa (2021) and b) on the higher and steep cliff of the eastern shore of the island of Cres (2020)

Certain factors of these climates, like erratic rainfall and summer droughts, along with the island’s location in the karst environment, have caused human agricultural interventions to be strenuous and well thought-out.

Besides resulting from the archipelago’s natural circumstances (bedrock, soils, climate, insularity), the dry stone walls and enclosures reflect strenuous human activities and anthropopressure on the previous ecosystem. They are currently a main component of an (agri)cultural landscape – a landscape largely modelled by the people. Due to land abandonment and vegetation succession, this fact is often overlooked, and these islands

field in question is on the western part of the island, one of the largest areas suitable for agriculture – Polje. It was formed by the Quaternary loess sediments (Magaš, Faričić, and Lončarić 2006, 179).

³⁴ Stones were carried to the work site in *kopānce* – small troughs with handles.

³⁵ Meteorological station Mali Lošinj experienced a change from fully humid Cfa to dry summer precipitation regime, Csa only in the period 1981–2010 (Nimac and Perčec Tadić 2016).

are highly regarded as having an ‘intact natural beauty’.³⁶ Considering the current trends of reforestation, this observation, motivated by commercial means and advertisement, is not fully erroneous. However, it neglects the layers of historical reality below the overgrowing canopy of the entire area of these islands (Figure 5) - dry stone walling has been immediately following most of the historical land use and other historical events.³⁷ Even where it has not been marked by dry stone walls, the historical land use is known. For instance, the islet of Palacol had around 100 olive trees, which, in their best years had a 3-ton yield (approximately 3000 L of oil),³⁸ while the island of Zeča was used by multiple users for sheep breeding (Stražičić 1981, 4:211).

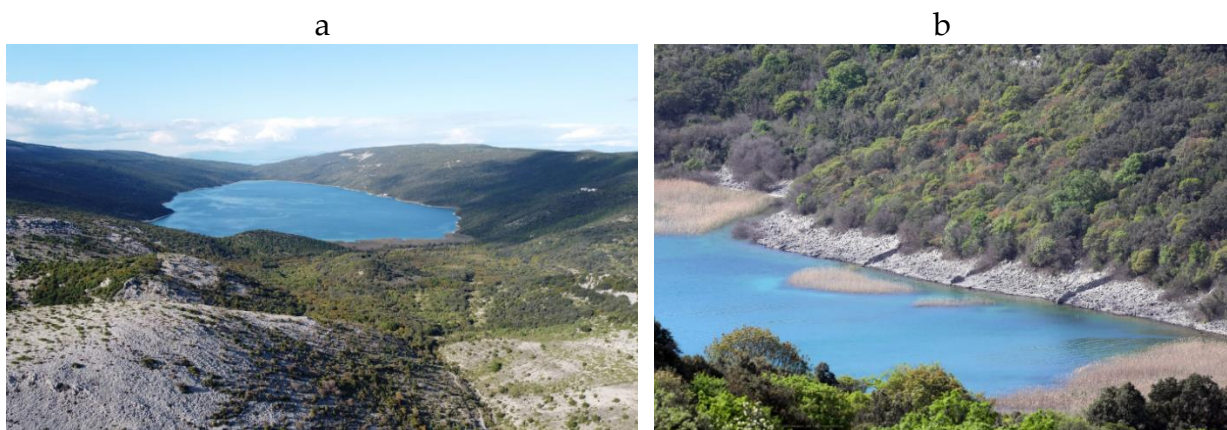


Figure 5. Regarding current considerations of the landscape of Vrana Lake as a ‘fully natural landscape’: a) The full overgrowth with plant communities is a result of strategic attempts to safeguard the lake (the archipelago’s only source of fresh water), and b) its previous use as private pastures is noticeable in the visible dry stone walls which remain visible at the lake water level (© Vladimir Tkalčić, 2019).

The agriculture and sheep husbandry have historically been the main economic activities of the archipelago. Agriculture relied on Mediterranean cultures of grapevines and olives. The porosity of the karst and skeletal soils did not facilitate the cultivation of crops to a larger extent (Stražičić 1997, 74–77). The island of Cres and Lošinj had different developmental trajectories. While the town of Cres was inhabited since the ancient times, the island of Lošinj had not been inhabited by a sedentary rural population in Roman times (as was the island of Cres) and remained uninhabited until the early Middle Ages (Crnković 2001, 14:24). In 1910, 11.2% of the total area of the island of Cres was arable land. The largest part of arable land contained vineyards (40.8%), while somewhat less was occupied by gardens and orchards (34.2%) – which refers to olive groves – and the

³⁶ A few of the magazine articles which promote the ‘intact natural beauty’ in (Salković 2021; Beničić 2020; Putni kofer 2020, and many others).

³⁷ Discussed in chapter 5 – Dry stone wall patterns and the underlying historical processes.

³⁸ Recollection of Ivica Badurina – Tango. Conversation was published in *Puntarski fuoj*, vol 19 (2019; 17).

smallest part was arable land (25%). More than half of the total island area was covered by ‘pastures’ (54.1%), which refers to bare areas that vary from shrubs to rocks. Another 31.8% is under forest, mainly in the northern and southern parts of the island. The remaining 1.4% include the Vrana Lake and unproductive soil. The great increase in arable land occurred from 1818 to 1900, when the population of Cres increased by 62%, which is primarily true of municipalities in which agriculture was of great importance, such as the cadastral municipality of Cres (Stražičić 1981, 4:200). The island of Lošinj on cadastral maps from 1821 shows significant land reclamation, mostly manifested in dense terraced olive groves and vineyards.³⁹



Figure 6. Different forms of dry stone walling reflect dry stone artisans’ craftsmanship, the micro-climate, and the local lithology a) along the pathway between Cres and Loznati (2021), b) on the pathway close to Dragozetići, c) Along the pathway below Ustrine (2019).

³⁹ Patrimonio archivistico online. Distretto di Lussinpiccolo. n.d. *Archivio di Stato di Trieste*. Accessed February 06, 2021.

http://ariannaweb.archiviodistatotrieste.it/AriannaWeb/main.htm;jsessionid=512C054F6605AE0B265A0A1FCE35F99D#20412_archivio.

The lithology can only partially explain the diversity in the form of the dry stone walls in different areas (Figure 6); the rest is attributed to the craftsmanship of the unknown names of the many vernacular architects of the archipelago. On one of the educational tables in the town of Cres olive grove, it is written that ‘the effort that the islanders put into the gradual transformation of the landscape has certainly influenced their relationship with the newly created living space. By careful observation of this cultural landscape, it is not difficult to notice that its resourceful builders have been paying close attention to the aesthetic dimension, although their primary goal was to create new arable land’. J. Kremenčić wrote in a similar manner that the ‘dry stone wall beside the road had to be constructed as an exemplary wall. Such a wall had to be built masterfully, had to reflect strength and beauty, especially at the outer side, because that was the one often judged’ (Kremenčić & Kremenčić, 2019, n.a.). The dry stone walls are commonly built of unhewn stone,⁴⁰ and currently, due to the neglect, it is difficult to discern regularities in the potential consideration of the aesthetics of the outer walls. However, two distinctive dry stone terraces of hewn stones and of great dimensions have been registered (Figure 7) and presumably reflect the artisans’ aspirations towards durability and aesthetics.

⁴⁰ ‘Every stone is suitable for a dry stone wall. You just need to know how to place it’ was a rehearsed vernacular in many of the conversations with the Cres and Lošinj interlocutors.



Figure 7. Rare examples of hewn dry stone structures on the Cres and Lošinj islands. These outer walls represent the lower retaining walls a-b) along the pathway from Veli Lošinj to Sveti Ivan (2020) and c-d) Along the gravel road from Cres to Valun (2020)

3.2. The dry stonework of the Cres-Lošinj archipelago

Within this chapter, the dry stonework of the Cres-Lošinj archipelago will be categorised based on constructive-morphological features, while the typological-functional aspects will be addressed in chapter 4. The dry stonework of the Croatian Adriatic has been categorised by Šrajer (2019, 376) based on criteria such as geometry, topology, function, construction, form, detail, texture and material, into:

1. Dry stone wall landscapes
2. Dry stone buildings
 - a. Linear structures
 - i. Dry stone walls (walls and mounds)
 - ii. Pathways
 - iii. Watercourses
 - b. Individual buildings
 - i. Individual structures
 - ii. Individual buildings
3. Constructed complexes
4. Details of structures/buildings and in the landscape

Other than 'constructed complexes', all categories are addressed in this chapter.

3.2.1. Dry stone wall landscapes

The dry stone wall landscapes are large areas which have been predominantly characterised by dry stone walls. The typology of the dry stone wall landscapes can be considered based on the work by Andlar et al. (2015) for the island of Cres and on the work by Frangeš et al. (2015a, 37–46) for the Town of Mali Lošinj. The latter group of authors divided the landscapes into 10 categories based on their function and spatial arrangement as follows:

1. Free pasture (commons)
2. Landscape of rotational pastures
3. Landscape of forest rotational pastures
4. Mosaic (agrarian and pastoral) landscape
5. Agrarian landscapes of the karst valleys
6. Agrarian landscapes of the settlement immediate surroundings
7. Landscapes of intense land reclamation
8. Terraced landscapes
9. Unenclosed agrarian landscape

10. Predominantly undeveloped landscape⁴¹

Landscapes are complex, and their categories classifications normally indicate the predominance of a certain character of a landscape. This is one of the reasons for their further classification based on the dry stone wall patterns, as done by Andlar, Šrajer, and Trojanović (2017; 2018). Nonetheless, for the purposes of this study, the typology of dry stone wall landscapes was divided into three major categories (agricultural, pastoral and mosaic) while introducing some of the components that give a landscape its character. Besides differing in their function (cultivation of crops or sheep husbandry), these landscapes differ in the density of the dry stone wall enclosures, with the agricultural landscapes being naturally denser than the pastoral landscapes.

3.2.1.1. Agrarian landscapes

Agrarian landscapes are typically composed of field enclosures (Figure 8) and/or terraced patterns (Figure 9). Due to the archipelago's topography, terracing, however mild, is the most common method of agricultural enclosing. It is intended to turn slopes into horizontal fields of a convenient width (Sereni 1961) and add adequate stability for agrarian land by dry stonework. Usually, hillsides were transformed to meet the needs of extensive farming in the vicinity of the settlement; the more distant ones are the result of intense, market-oriented cultivations (Scaramellini 2008, 10). One of the main components of the agrarian dry stone wall landscapes are *dolci*⁴² – enclosed karst dolines (Figure 10), who however, often appear also in mosaic landscapes and amid the pastures.

⁴¹ Author's free translation.

⁴² N pl., DIM.*dolčići*; N sg. *dolëc* or *dōlac* (Houtzagers 1985, 234), *dolëc* (Nikolić 2000, 119).



Figure 8. Field enclosures in the town of Cres olive grove (Goran Andlar, 2019)



Figure 9. The dry stone wall terraces of the shepherd's dwelling Veli Bok (2021)



Figure 10. a) An enclosure on the terrace in the town of Cres olive grove and b) one of the most preserved dry stone wall-lined karst dolines on Vićetin (2021)

3.2.1.2. Pastoral dry stone wall landscapes

Pastures lined by dry stone walls are one of the most distinctive components of the island of Cres's landscape (Figure 11). Its most distinctive parts are the middle and eastern pastures, due to their legibility. They were previously referred to as *Arabia Petrea*,⁴³ but due to the today's overgrowth with the juniper shrubs Sokolić (1999) named them *Arabia Juniperus*. The sheep husbandry was organised mostly individually, which means that every household was concerned about their herd. Joint work would occur for shearing or repairing the dry stone walls between neighbouring parcels (Jurkota Rebrović 2009, 8:25) or on the commons. Accordingly, landscapes related to sheep husbandry and pastures can be divided into two major categories: private pastures (*ogrâjice*) and common pastures/commons (*komunāde*).⁴⁴ Traditional sheep breeding practices on the island of Lošinj were historically the same as those on Cres (Pavlovsky 2000, 109), not lagging behind even when it came to livestock count (Stražičić 1981, 211). However, in the 18th and 19th centuries, the island of Lošinj had turned a large part of its pasture areas into terraces for vineyards and olive groves and directed its economy to maritime and trade. These changes drastically reduced sheep husbandry intensity, which

⁴³ Lit. 'a rocky desert'. The name was first documented by Fortis ([1771] 2014, 125). He stated the name was used by the locals for the then barren commons between Orlec and Vrana. In today's vernacular, this term can be attributed to the larger island areas of similar characteristics, as for example the eastern shores.

⁴⁴ *Komunāda* (G sg *komunāda*, N pl *komunādi*), besides a common, means a wasteland (Velčić 2003, 174).

has made it less representative in this context.⁴⁵ The abandonment of the traditional method of communal grazing caused the change to constructing enclosures made of farmer's mesh and wooden stakes.



Figure 11. Dry stone walls 'from sea to sea' along the eastern shores of the island of Cres, Lukovac Bay (2018)



Figure 12. Rectangular medium-scale pastures in the Germov environs and the impending vegetation overgrowth (2021)

⁴⁵ The number of sheep on Cres has also declined by half since the early 1900s, with recent estimates of 15,000 (Centar za stočarstvo 2021, 35).

3.2.1.3. Mosaic dry stone wall landscapes

Most of the pastures demonstrate a certain degree of heterogeneity since they are marked with cultivated dolines. Nonetheless, a separate category of mosaic dry stone landscape is delineated to present the landscapes of a higher degree of intertwinement of cultivated land and pastures (Figure 13, Figure 14). They are conditioned by the higher availability of fertile land, either due to the denser occurrence of karst dolines or karst fields. The latter is usually a condition for forming the island's settlements.



Figure 13. A mosaic landscape on Sergovi (Belej environs): a combination of small-scale pastures, enclosed dolines (overgrown round enclosures in the bottom), terraces abutting to the right of them with a crop processing facility to the right (a livestock shed with a threshing floor), all connected by dry stone wall-lined pathways and the presence of sheepfolds in the angles of pastures (2021)



Figure 14. Typical enclosure of karst dolines with dry stone walls with a clearance wall and two outer walls from the Belej environs (Pervej). The area between the two outer walls was sometimes used for cultivating olive trees or vines (2020)

3.2.2. Dry stone walls (*gromača*, *gromaca*, *masiera*, *mocira*)

On the Cres-Lošinj archipelago, the following variants of dry stone walls are generally used:

- *gromâča* – Tramuntana, Punta Križa, other locations,
- *gromâca* – the town of Cres and Loznati,
- *mocîra* – Veli Lošinj environs and the island of Ilovik, the island of Unije, and
- *mašierà* (Chalvien Saganić 2014, 78) – used in various regions of the archipelago, of *istoveneto* dialect origin.

They can all denote a dry stone wall, regardless of their type. Simultaneously, the types have their own names.

3.2.2.1. Double (*dùplice*)

The fundamental feature of a double dry stone wall is that it consists of two vertical layers of stones, and the space between the two ‘faces’ is filled with hearting (*grùh, sagùrna, piflò*).⁴⁶ The foundation of the dry stone wall is the first row of stone blocks, which is buried 10 cm deep in the ground. It is the most typical type of dry stone wall construction and often serves as the basis for building more complex forms. Due to their durability and better static characteristics than single dry stone walls, double dry stone walls were erected as solid boundaries for properties, fences for arable land in valleys, garden walls, or parts of more complex architectural structures such as shelters and small field houses.



Figure 15. A cross-section of the double wall a) close to Pukonjina (2021) and b) close to Stanić (2021)

3.2.2.2. Single (*ùnjul(o/a), ùnjulica*)

A single dry stone wall is a stone wall that is one-stone thick; the friction between stones generates stability, and gaps allow for the passage of wind without compromising the wall’s integrity (Laheen 2010). Local pronunciations vary from *ùnjule* (Jurkota Rebrović 2009, 8:47); *ùnjul*, and *ùnjulica* (dim.) (Velčić 2003, 503; Nikolić 2000, 182); all of these pronunciations denote the general meaning of ‘onefold’. These walls are a strong indicator of sheep husbandry. Single walls are generally more recent than others –

⁴⁶ *Sagùrna* for the area of Punta Križa and Ustrine, *Gerbin*, Unije (Nikolić 2000, 166), *piflò* (Gović 2011a, 65; Jurkota Rebrović 2009, 8:47), in the town of Cres environs and Tramuntana *grùh* (N sg). (Velčić 2003, 125).

pastures would primarily be enclosed with thicker double walls, then further divided with single walls after the property was divided among the heirs to that land.

This type of wall commonly leaves an impression on visitors. Kulušić emphasises it enables 'breathability' of the sheepfolds (2004b, 66), others assert the holes enable low resistance to the strong bora wind, and its ability to provide shelter for livestock. However, it is more probably that these benefits came as a side-product of the initial intention of the single wall builder – to construct walls faster and with less material in times of the rapid property division due to the increase of inhabitants in the 19th century.

They are not as stable as they are often praised for being – experience shows it is the most fragile type of structure (Šrajer 2019, 163); if not constantly repaired, such walls are rarely older than 150 years (Kulušić 2004b, 66). This instability is perceived as an advantage – single walls look 'so unsteady that all livestock are supposed to be deterred from climbing it' ('Conservation Handbooks', 2017).



Figure 16. Single walls a) reinforced with wire (2021) and b) on the eastern shores of the island of Cres (2019)

3.2.2.3. 'Galloway' walls (*pićohûanda*, *pićokānda*)

This type of wall is a combination of the previous two. It is a dry stone wall in which the lower part is constructed as a low double wall consisting of a series of small stones (i.e. stones not large enough for a single wall). It is a type of construction which commonly surprises viewers since it defies the logic that the stones' size should decrease with the wall's height (Jurkota Rebrović 2009, 8:47). However, on the island of Cres, these structures are quite often, especially in the middle and southern pastures. Here, this constructive form is regarded as – *na pićohûandu* in the region of Punta Križa, and *na*

pićokāndu in Ustrine. They can also be found in *Gerbin* and Cres olive grove area (Figure 18, Figure 19). Both pastures and fields are regularly enclosed by these structures.

After approximately half a meter of height, the wall is stabilised with a flat through stone⁴⁷ or any large stone at hand. This layer is a foundation (*postěja*), upon which a single wall with more massive blocks is placed. Often, this type of wall is combined with the upright stones '*na kultel*' or '*na nož*' (Figure 17).

Gović wrote that such combined dry stone walling was simpler than the construction of a double wall and, at the same time, would provide more reliable protection against sheep than single walling (2011a, 65). However, most informants agree that it is simply the result of finding an efficient walling style in places where there is a lack of larger stones (either because they were already used in the previously built dry stone walls or because such were available at the particular location, due to lithology). By using this combined method, it is relatively easy to construct a higher wall (in comparison to a double wall) and is more stable than a single wall. By stacking the bigger stones above the smaller ones, a higher level of the stability of the structure is enabled.

Albeit similar structures have been noted on the island of Krk, they are not a common dry stone structure in Croatia (See: Šrajer 2019, 164). In Ireland, this type of wall is called the Feidin wall (or Irish family wall), and in Scotland, it is called a 'Galloway wall' or 'half-dyke' ('The Galloway Dyke and the Feidín Wall' 2016). Provost (1957) contrasts the Galloway dyke with the normal half-dyke, in which the doubled section extends to half the wall's height.



Figure 17. A dry stone wall built in a combined manner with stones '*na nož/na kultel*' in the Gerbin area
(© Dorijan Lovrečić, 2021)

⁴⁷ Also called 'coverband' in Scotland (Conservation practical handbook, 2017).



Figure 18. A combined dry stone wall in the town of Cres olive grove, possibly built after the introduction of sheep in 1950s (2019)



Figure 19. A combined dry stone wall along the road from Osor to Punta Križa (2021)



Figure 20. A combined dry stone wall reinforced by mesh to protect against allochthonous wild animals (Osor environs, 2021)

3.2.2.4. *Barbakâni*

Diachronic changes and polysemy in the dry stone wall terminology of the Cres and Lošinj islands may best be observed in all the meanings ascribed to the term *barbakan*, which seems to create the most ambiguity among the archipelago inhabitants. Below, its etymology is investigated, and its definitions in the literature and current use among the Cres and Lošinj inhabitants are compared. The current use of the word was part of a set of questions during the conversations with the informants. Most of the informants do not seem to be aware of the semantic variations adopted by others and quite strongly reject the possibility that other meanings exist.

3.2.2.4.a Pronunciation

- Orlec environs and the town of Cres: *barbakân* (*N sg*) (Houtzagers 1985, 207; Tentor [1907] 2020, 46)
- Tramuntana: *barbakân* (Velčić 2003: 34)
- Punta Križa and Nerezine environs: *barbakûân*⁴⁸

South of Nerezine, the term *barbakan* has not been registered to be in use.

3.2.2.4.b Etymology

Since the Cres-Lošinj archipelago was uninterruptedly part of the Republic of Venice from 1409 to 1797 (and within many periods since the 11th century), it is most probable that *barbakan* entered the Cres dialect as a loanword from the Italian-Venetian dialect word *barbacane* (Similar assumption can be found in: Skok 1971, 1 (A-J):111).

According to the Treccani dictionary, the word *barbacane* is of ‘uncertain etymology, probably of oriental origin’ and has multiple meanings. Generally, it indicates any structure reinforcing a building and, in particular military fortifications, made either of stone or more temporary materials. In the fortifications of the past, it also implied other protective elements such as walls and escarpments (‘barbacane in Vocabolario - Treccani’ n.d.).⁴⁹

Within the dictionary of the Trieste dialect ‘Il nuovo Doria’ (Doria 2012, 120–21), it is assumed the word might be of Arabic origin: ‘*B-al-Baqàra*’ (i.e. ‘*Bab-al Baqara*’ – ‘the cows’

⁴⁸ Although a restaurant in the village of Nerezine bears the name ‘Barbakan’.

⁴⁹ Second meaning is a slit-shaped opening that is made within the soil retaining walls (therefore in a rural setting), in order to allow water drainage (‘barbacane in Vocabolario - Treccani’ n.d.).

door'), or the door for which water supplies were passed in medieval cities and which, therefore, had to be particularly protected with fortifications. Alternatively, it could be derived from the Arabic '*barbah*' ('drain, aqueduct tube' or 'embankment against floods').⁵⁰

In the case of its use on the Cres-Lošinj archipelago, it can be assumed that the term had transferred from urban-architectonic context to a rural-architectonic one, conveying the meaning of 'protection' and 'reinforcing' to the soil – the element which, in the karst environment, needed protection the most.

3.2.2.4.c Meanings from local literature sources, dictionaries, and informants

1) *Barbakan* as a low double dry stone structure connected with vineyards:

- *Barbakân* is a 'low stone wall (built when making terraces on an inclined terrain)' (Houtzagers 1985, 207). Houtzagers's definition is based on extensive dialectological research of the village of Orlec in 1980 and 1982.
- Andrija Bortulin, describing the customs of Tramuntana, describes *barbakani* as 'smaller and lower dry stone walls, which intersect *liha*',⁵¹ and notes that *lihas* arranged in this manner seem 'like stairs or terraces, since each *liha* is laid higher than the first'.
- According the Velčić dictionary (2003, 34), *barbakan* is 'a low dry stone wall in the field, used to collect excess stones from the field'.
- 'The great number of stones which had to be removed from the ground – particularly the small ones – led villagers to use them to stack lower, broader walls inside the plots (*barbakani*). These were used as paths of sorts beside the plots and as supports for grapevines', from the ethnographic work of Muraj (1999, 186).⁵²
- Stražičić does not define the term specifically. He mentions them as an indicator of the newly reclaimed land used for vine growing during the period of vine

⁵⁰ Original text: '*Insieme allo sp. barbacana deriverebbe, a dar ragione al Corominas, dall'ar. b-al-baqàra, ossia bab-al baqara 'la porta delle vacche', cioè la porta per la quale passavano i rifornimenti di viveri nelle città medievali e che perciò andava particolarmente protetta con fortificazioni. D'altro parere il Pellegrini (8.1): dall'ar. barbah 'scolo, tubo d'aquedotto' e poi 'argine contro le inondazioni' ecc. (Con attestazioni a Pisa fin dal 1193, 1194)'.*

⁵¹ *Liha*, dialectal for land enclosed by a dry stone wall (Croatian: *lijeha*).

⁵² Muraj specified the low dry stone walls as *barbakani* only in the Croatian version of the article (1999, 186).

conjuncture, 'often standing out in the landscape with a geometrically regular grid of terraces with solidly built *barbakani*' (1981, 4:204).

2) *Barbakan* as a dry stone wall terrace:

- In 1900, Antonio Petris mentioned *barbacane* as terraces: 'un ettaro di uliveta (compresi nell'area i muri, le terrazze o barbacani, le strade ecc.)' (Petris 1900, 40).
53
- 'On the karst sloped ground, filled with rocks, and soil is divided by parallel lines made of excess stones. Such a line is in Cres called a *barbakan*. The word is probably of foreign origin' (Tentor [1907] 2020, 46).
- Kremenčić states that the words *barbakani* and *barbakanići* (DIM.) indicate both the terraces and the walls which sustain them (J. Kremenčić, n.a.).

3) *Barbakan* as a pile of stones:

- Within the 'Dry stone heritage study of the Town of Mali Lošinj', the words *barbakan* and *menik* are used interchangeably based on the following definition: 'Piles of stones formed by clearing the agricultural land are a ubiquitous phenomenon in the agricultural parts of the archipelago. They are often secured by a retaining wall to increase their retentiveness. On densely parcelled karst agricultural lands, which required a lot of cleaning, regular wide boundaries of the local name *manjik* or *barbakan* were formed' (Frangeš et al. 2015a, 29).
- Houtzagers defined *menik* as 'a higher version of *barbakân*' (1985, 293); from this formulation, the transition to a pile of stones can also be understood.

4) *Barbakan* as a part of cultivated land

- Mario Doria's dictionary entry for *barbacane* states that, in Cres, *barbakan* also designates a cultivable land (*A Cherso barbacan significa anche 'pastino'*⁵⁴). It further states that in the mugliese dialect (surrounding of the Italian town of Muggia) 'Barbaccian' is a toponym for a cultivated area in the Porta Magna district (Doria 2012, 120–21).

⁵³ In fact, instead of *barbacane*, it was written *sarbacane*, however, the initial 's' has been assumed as a typing or a printing error: 'one hectare of olive groves (including walls, terraces or *sarbacane*, roads, etc. in the area)'.

⁵⁴ *Pastino* comes from the Latin *pastinum* with the meaning of land worked with a mattock, that is dug to accommodate the vine (Paoletti 2011).

In one of the conversations, the term was used as a verb – *barbakanđt* – which means to disintegrate the dry stone wall in order to gather the hummus and organic material which has been trapped inside. Such a procedure was described by Muraj as well:

‘With the chronic lack of manure, from time to time the Cres villagers would fertilise their groves with the intact fresh soil. This hummus lay under the stacked stones in the middle of the plots under the abovementioned low, broad walls – *barbakani*: walls – *paths*. To gather hummus, the villagers had to disassemble this dry stone wall using picks, move the stones to another location and rebuild it after the soil had been removed. This really was an unusually tedious procedure. It shows not only their inventiveness, but also the Promethean persistence shown by these islanders in their struggle against the scarcity of their natural resources’ (Muraj 1999, 189).

Informants use the term in all the above-mentioned meanings.



Figure 21. Both terraces and the retaining dry stone walls are considered as *barbakani* (2019)



Figure 22. The very low and wide placement of the stonework, with the intention of preserving soil humidity, has been considered a barbakan (2019)



Figure 23. A low stone path is considered a barbakan (2020)



Figure 24. Barbakani as double walls in Tramuntana: a) close to Konac (2021) and b) close to Dragozetići (2021)

Conclusively, in the case of the island of Cres and the northern part of the island of Lošinj, where the term *barbakan* is in use, this structure is connected to land use – mostly vineyards (Muraj, Stražičić, Bortulin). Typologically it is a variant of a double wall, a very low and wide one (Muraj, Stražičić, Bortulin, Houtzagers), and it is used to for disposal of excess stone, as a walking path, and for soil stabilisation. It is always placed within the agricultural plot, and not as its boundary.

3.2.2.4e Other uses of the term *barbakan* in Croatia

On the neighbouring island of Krk *barbakan*, their variant – *vrjakan* – is a type of clearance pile or wall (*gomila*), as are *slizenica* and *nos*.⁵⁵ On the island of Brač, the term *barbakon* is used for another dry stone wall structure, which is more in line with the original meaning of *barbacane* as a fortifying structure. A *barbakon* is a retaining outer rim wall which encircles the lime kiln and on which its dome is placed (Puljak 2014, 125). In the Croatian settlement of Potomje, *barbakan* means an embankment that protects against flooding (Skok 1971, 1 (A-J):111).

⁵⁵ From a private correspondence with Berislav Horvatić (08 Feb 2021).

3.2.2.5. Clearance/consumption walls (*menići*)

One of the most important dry stone structures are the clearance or consumption walls, which are known on the Cres and Lošinj archipelago as *menik* or *minjik* (*Ilovik*).⁵⁶ Tentor suggests its etymology to be of Slovenian origin: *meja, mejnik* (border), as enclosing is one of its functions ([1907] 2020, 56). *Menići* are elongated and wide piles of stones created as a result of the massive field clearances. They appear in a form of a wide elongated wall, either structured or as structureless piles - round mounds scattered in the agricultural fields or pastures. In case they form part of the agropastoral area, above them another single or double wall is built (Figure 28).

These structures can be observed mostly in the town of Cres olive grove (Figure 25), and on the slopes of the island of Lošinj (Figure 26). Clearance walls in the town of Cres olive grove are used today⁵⁷ as a way on which to clear new gravel road (olive grove paths for vehicles). In this way, construction over the agricultural area is avoided and the probability to enter someone's private parcel is minimal.



Figure 25. The amount of effort to liberate the agricultural could be calculated with the cubic metres excavated from the ground and deposited on clearance walls (on the right). The town of Cres olive grove (2020).

Figure 26. The island of Lošinj is densely reforested. The canopy covers most of the terraces, however, clearance piles can still be observed, due to their width. Southern island of Lošinj (close to Trasorka) (2021)

⁵⁶ In other places of the Croatian Adriatic, these consumption walls or piles are known as *gomile*. However, on the island of Cres, name *gomila* means a designated place on the margins of the town, in which discarded matter or refuse was thrown.

⁵⁷ *Menići* were used as places where children would prove their courage. According to the recollection of one of the informants (LJ. F.), they would race from top to bottom on these piles of unstructured stones.



Figure 27. Consumption piles are similar in its shape to prehistoric tumuli (Rudovi environs, 2020).

Figure 28. A typical menik (elongated consumption wall) found in the town of Cres olive grove, with a dry stone wall above it (© Goran Andlar, 2016).



Figure 29. Consumption walls and piles (menici) appear in many shapes: as elongated wide built dry stone walls, as unstructured round piles, as elongated piles (with or without a dry stone wall on top). (Belej environs, 2020).

3.2.3. Other dry stone structures

3.2.3.1. (Multicellular) sheepfolds (*mrgari*)

3.2.3.1.1. Introduction to multicellular sheepfolds

In the world of dry stone architectural heritage, one category to which special attention has recently been given is multicellular sheepfolds. Their distribution is associated with transhumance cultures and cooperative systems of common land and common pasture with the function of gathering, sorting, milking, shearing, marking, and inspecting livestock. In Croatia, they owe their popularity mostly to people from the southern part of the neighbouring island of Krk, with the local name of *mrgari*, which have become a tourist attraction⁵⁸ on the island and stand out in terms of their number, size, and aesthetic significance, primarily due to their flower-shaped aerial-perspective appearance (Figure 30). Sheepfolds of similar dimensions and shapes have been recorded on other Kvarner islands of Prvić (Horvatić 2000a), Rab and Dolin (Frangeš 2012), and Pag (Kale 2012). Fučić refers to one of them as ‘the most monumental work of our shepherd’s architecture’ (1998, 181), and Kale emphasises the value of the multicellular sheepfolds in the embodiment of a sustainable solution of spatial management (Kale 2012, 259).



⁵⁸ One of the sheepfolds became part of the cultural podium for the needs of the programme ‘Rijeka - European Capital of Culture 2020’, where the art installation ‘Kapi’ (Drops), which is the work of the architect Smiljan Radić and the sculptor Marcela Corre, could be seen. In May 2021, an exhibition of aerial photographs by Sanjin Ilić, called ‘Drop by Drop, Stone by Stone – Life’, was set up, along with a hiking tour that led to these structures. Also, representations of Krk sheepfolds are used as souvenirs in the list of the Tourist Board of the City of Krk.

c



Figure 30. Flower-shaped multicellular sheepfolds of the island of Krk: a) Na Starošćini, b) Na Vratudih, and c) Na Rebici (© Sanjin Ilić, 2019, 2021)

According to currently available knowledge, multicellular flower-shaped sheepfolds can be found in only three other places in the world: in the province of Snowdonia in Wales (F. Johnson 1998), in Iceland (*réttir* [Aldred 2006]), in Switzerland (*Färricha* [Gnesda 2020]). Other multicellular sheepfolds are common in the mountains of northern England and in Scotland. It is most probable that further research will uncover new examples, given that they are a universally logical solution for collecting and sorting sheep on the commons.

Considering the similar practices on the islands of Krk and Cres regarding traditional sheep breeding, land ownership, and commons management, their large and remarkably similar area ($\approx 405 \text{ km}^2$), and the fact that Cres inhabitants intended to use and adapt most of their island for sheep, it is logical to assume that on the island of Cres there should be a large number of similar structures, or at least more than previously recorded.

3.2.3.1.2. Notes on locations, forms, etymology, and practices

A sheepfold (i.e. locally *margār*, *mergār* or *margūār*) is a small dry stone wall enclosure located in the corner of a private pasture (*ogrājica*, N sg.) or a common (*komunāda*, N sg.). These simple sheepfolds are the most frequent type and are usually constructed with single dry stone walls (*ūnjulica*) (Figure 31). The entrance to a *mrgar* is through an opening in the wall (*lāz*), which can be closed by a wooden door (*lēsa* or *zātoka*). More important sheepfolds are paved, constructed with double walls (*dūplica*), and might have a niche for tools or paint.



Figure 31. The large multicellular sheepfold of Stivan: a) an aerial view of the sheepfold and abandoned common and b) a terrestrial view of the double walls enclosing the *komunada* and a single wall enclosing the sheepfold (2021)



Figure 32. One of many small one-cell sheepfolds on the island of Cres, but with the distinction of the pavement with *škriji* and a niche for tools (the environs of Osor [Mikaskegarine], 2021)

Less often, the term *mrgar* denotes a roofed dry stone livestock shed (Konestra 1997:61). The term has a Latin origin (*mulgĕo*, *mulgāre*, *mulgarium* [Olivetti 2003]) and denotes milking or a milking pail. The diachronic linguistic change is explained by consonant assimilation (sound change) of *l - r > r - r*, resulting in *mulgare* -> *murgare* (Skok 1972, 2 (K-poni):476). '*Murgar*' then becomes '*mrgar*'. In some places, '*mrgār*', '*margār*', or '*mergār*', is used, following a common Čakavian replacement of the syllabic *r* with *ar* or *er* (Horvatić 2000a, 100).⁵⁹ Dialectal variants on the archipelago include *mergār* (N pl. *mergarŕi*, L sg. *mergarĕ*) (Houtzagers 1985, 294), which is used in Cres,⁶⁰ Loznati, Orlec,⁶¹

⁵⁹ Horvatić's explanation of diachronic linguistic change of the word was used for the island of Krk but is applicable to Cres as well, considering their historical and linguistic similarities.

⁶⁰ Tentor ([1907] 2020) uses the, probably incorrect, variant *margār* variant for the town of Cres.

Belej, and Srem; *margār*, used in Tramuntana and Ustrine; *margarić*, used in Osor (according to Pavlovsky (2000, 109), *margâr* on the island of Unije (Nikolić 2000, 144)⁶² and *margûâr* (with a diphthong) is used in the region of Punta Križa and in Nerezine.

Despite the creation of multiple partitions and the subsequent addition of functions beyond just milking, multicellular sheepfolds, as a whole, have maintained the name and singular form of *mrgar*. They are logical, somewhat complex solutions for sorting sheep from large pastures. Sheep are sorted according to various criteria, such as ownership (by making ear stamps [*belēzi*]) colouring (*bùla, senjāl*), activity (milking, shearing [*strîh*], protection against ticks (coating with diluted insecticide) or their removal [*čepērenje*]), or by age and purpose (e.g. rams, lambs, older sheep).

Large pastures are part of shepherds' dwellings (*stâni*) and their agricultural lands or the commons. When used as part of *stâni*, they can be found either right next to them (e.g. *Matualda, Batajni, Sveti Vid, Grabrovice* [Jovović 1993]) or further away (e.g. *Jedro, Loze, Konac*).

Multicellular sheepfolds of the Kvarner islands, including the islands of Cres and Lošinj, follow a similar logic. Each must have a large, designated space where all the sheep are first gathered. On the islands of Krk (*sala*) and Dolin (*zagon*), they are round and located in the middle of the sheepfold. From this area, sheep are filtered into the smaller pens surrounding it (*mrgarići* on Krk, *mošuni* on Dolin), thus creating an associative flower shape. The author found no specific name for the large inner cell on Cres.⁶³ A similar but wider and partially delimited area is called a *pregrājčić*. The outer enclosed spaces are sometimes called *pèrzgari* or *pàrgaji*. Each *przgar* has a lunky hole (*škùja*) through which the sheep are later released back to pasture.

A (half) flower-shaped multicellular sheepfold could only be found on the island of Lošinj. Topography permitting, the sheepfolds of Cres follow a more orthogonal floor plan shape (e.g. *Mihojski, Betkav, Tarbijanščica, Ustrine* – new). Such floor plans or elongated forms (*Matualda, Lovreški*) enabled 'labyrinth-like' but irregular movement (Sveti Vid – Plasa, *Jedro, Ustrine* – old, *Batajni*). Also, unlike sheepfolds on Krk, which predominantly consist of single walls, many of those found on the archipelago are built with solid coped double walls. These are associated with ecclesiastical (*Lovreški, Matualda*) or feudal estates (*Sveti Vid, Lovreški, Veli Tržić*). These estates had an established stocking rate of sheep on their pastures, and there was no need for frequent reconstructions of the dry stone walls. This was also the case on Krk, where sheep

⁶¹ Pavlovsky incorrectly mentions that Orlec inhabitants use the *margār* variant (Pavlovsky 2000:109).

⁶² Where it denotes livestock sheds in general.

⁶³ In conversation with interlocutors, sometimes would be addressed as '*dvor*' or '*veli mrgar*'.

breeders, owners, or users often changed the shape (floor plan) of sheepfolds according to their immediate needs (Horvatić 2000a, 94).

Because of nationalisation after WWII, many of the currently preserved multicellular sheepfolds are used by the Agricultural Cooperative Cres. From the end of the 19th century until the 1950s, some of the shepherds' dwellings were bought by inhabitants of Cres or Lošinj and are now under private ownership.

Sheepfolds should be paved for sanitary purposes. Historically, paving was achieved with stone pebbles or thin, flat limestone (*škriži*). Concrete has only been used in the Hrasta sheepfold for the needs of a former cheese factory. Due to the narrowness of the traditional paths lined by dry stone walls, some of them became improvised sheepfolds and were additionally fenced with farm wire or mesh.⁶⁴

3.2.3.1.3. Multicellular partitions

3.2.3.1.3a *Przgar*

A *przgar* is a sheep pen with two functions: to enclose stray sheep and to sort lambs or sheep according to their owners or their characteristics (old sheep, rams, lamb for selling or keeping). In the (non-philological) literature, this structure has been registered as *przgar* (Jardas 1964, 128; Stražičić 1981, 4:212), and this is also how it will be addressed in this paper. However, the local dialect does not use the syllabic 'r'. Instead, for easier pronunciation, a vowel ('a' or 'e') is placed in front of 'r'.⁶⁵ Island variations are as follows: *pèrzgal* in Orlec (Houtzagers 1985, 321) and Valun (Desanti 2003), *pèržgalj* in Belej (Konestra 1997, 61), *pàrgaj* in Ustrine and Punta Križa (Galjanić 2010, 30); *pèrzgaj* in Srem, *pèzgar* in Vidovići, and *parnjāč* in Tramuntana.

'There are always sheep that are very restless and jump over the stones, however high they might be. A sheep that enters someone else's pasture should not be killed or taken but should be brought to the village and placed in a '*pržgalj*', a small, enclosed space close to the house, where its owner would come to pick it up, recognizing it by a special mark on its ear' (Konestra 1997:61; informant: Ivan Benvin).

⁶⁴ In the documentary movie '*Ovca u muzeju*' (Croatian for 'Sheep in the museum'), one of the island's interlocutors made a remark how, after it became the shepherds' duty to guide their own sheep by building ever higher and stronger walls, to increase their height with farm mesh and to underpin them in concrete, the area seems more of a concentration camp, rather than a pasture (Pavlovsky 2020).

⁶⁵ I thank Bernard Balon for the conversation on the local dialect pronunciation.

Therefore, the main function of a *przgar* is to enclose (*'sterdīt va pèrzgal'* = 'enclose in a *przgar*') a stray sheep (i.e. a sheep that does not belong to the pasture in which it was found). This was anticipated due to the mosaic arrangement of the Cres communal and private pastures and the sheep's ability to cross walls.⁶⁶ Outside villages, within the multicellular sheepfolds, the floor plan of a *przgar* is usually circular or semi-circular (which is unlike other multi-cell sheepfold compartments; Figure 13, Figure 26). Furthermore, the walls were higher than the rest of the dry stone walls, with the *škuja* serving as the only exit.⁶⁷



Figure 33. A *mrgar* (left) and *przgar* (right) in Kraji, north of Osor, attached to one another. The *mrgar* on the left has a passage (*škuja*) at the bottom (not visible in the photograph, as it is enclosed by stones) (2021).

3.2.3.1.3b *Strigar*

Jardas writes that a '[*m*]*rgar* for shearing is divided into several smaller spaces, namely *strigar*, in which the shearing is performed, and *przgari*, which are considerably smaller, and are designated for lambs. Larger *mrgari* for shearing have six compartments' (Jardas 1964, 126). In the '*mrgari* for shearing' formulation, the full transfer of function can be

⁶⁶ For the same reason, the dry stone walls of the archipelago, but also along the Croatian Adriatic coast in general, are sometimes reinforced with horizontally laid stones (*ōzubi*) that protrude about 30 cm outside the dry stone wall.

⁶⁷ Etymologically, it could be associated with a prison (*peržūn*) for stray sheep. Local author Marijan Desanti tried to explain the etymology by connecting it to *prkat*, which means 'a small room' but which is not part of the local dialect; then *prkatorij*, or rather *purgatorij* (purgatory), which has some footing in reality, since the stray sheep at times might stay in a *przgar* for days in inadequate conditions. While Desanti did not resolve the etymological dilemma, he did conclude that 'the poor animal is being punished for no reason, as it is created free to seek according to its need both good and fresh pasturage. What does she care if the people built fences, dry stone walls...' (Desanti 2003).

noticed – these multicellular *mrgari* do not serve for milking but still bear the original name. Within the multicellular sheepfold, the *strigar*⁶⁸ is the biggest one. The name comes from the word *strîh* (N, sg., *strîga* G, sg.), which is a local term for shearing. The shearing of sheep is preferably completed within one day. For this reason, shepherds from neighbouring *stâni* come to assist, and this work is regularly done voluntarily.

3.2.3.1.3c Pregrajčič

Pregrajčič is the name for the semi-delimited entrance area to a *mrgar*. It is needed since the sheep are reluctant to enter confined spaces. This compartment lacks a dry stone wall at the entrance (Figure 42).

3.2.3.1.4. Multicellular sheepfolds of Cres and Lošinj: An inventory and evaluation

Below follows a list of the inventoried and assessed multicellular sheepfolds. Multicellular sheepfolds whose descriptions were beyond the scope of this paper (*Grabrovice, Batajni, Matualda, and Loze*) have been included in the map in Figure 34.

⁶⁸ The interlocutors included in this research were not acquainted with the term *strigar*.

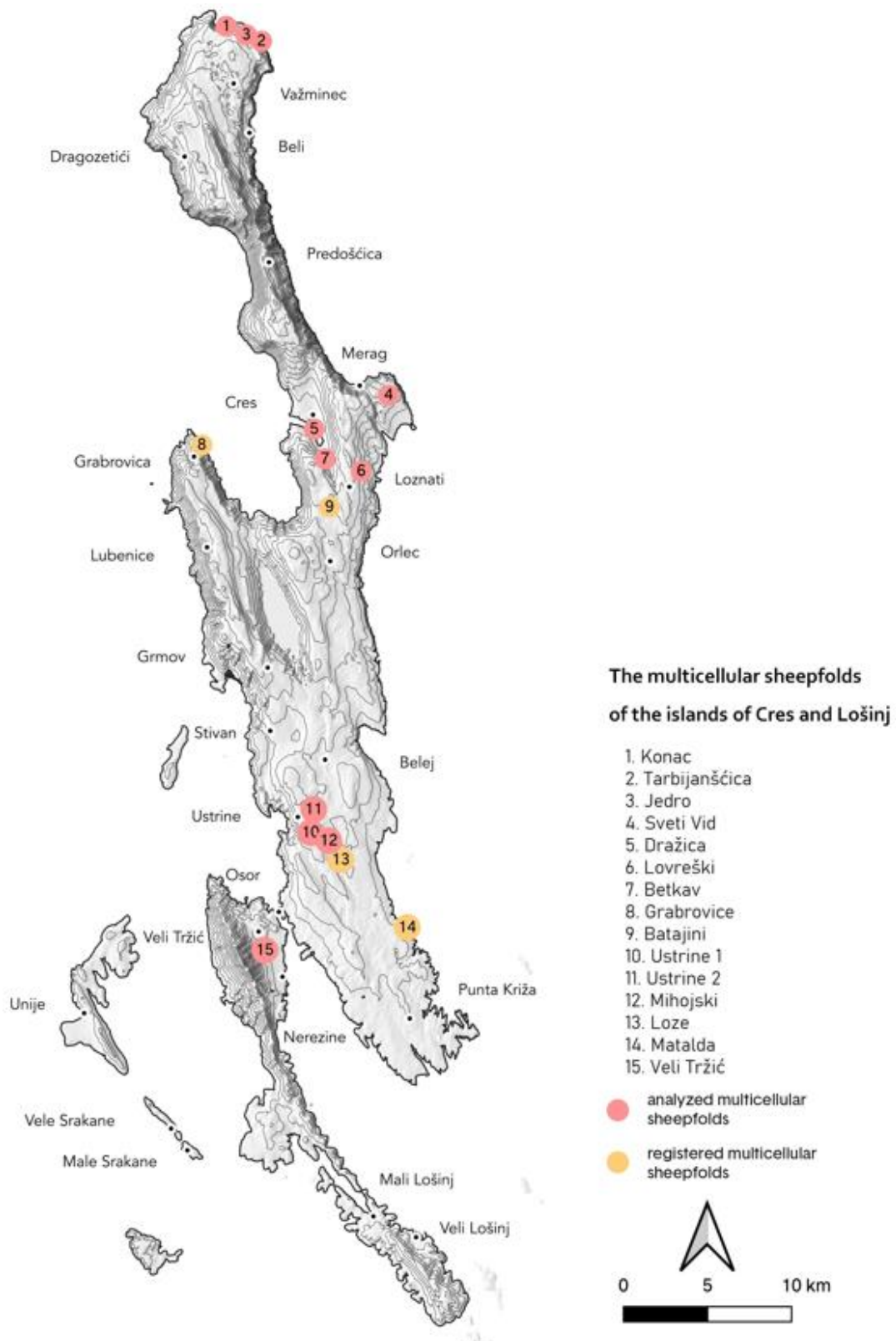


Figure 34. Locations of the registered and analysed multicellular sheepfolds of the Cres-Lošinj archipelago (map elaboration by Goran Andlar and Tanja Kremenčić)

3.2.3.1.4.1. The multicellular sheepfold close to *stan Konac*

This sheepfold is located along the gravel road that leads to *Konac*. Abandonment and vegetation overgrowth did not enable representative photography, but the structure is still standing, partially due to its solid double-wall construction. It has an area of 428 m² and contains eight partitions (Figure 6).



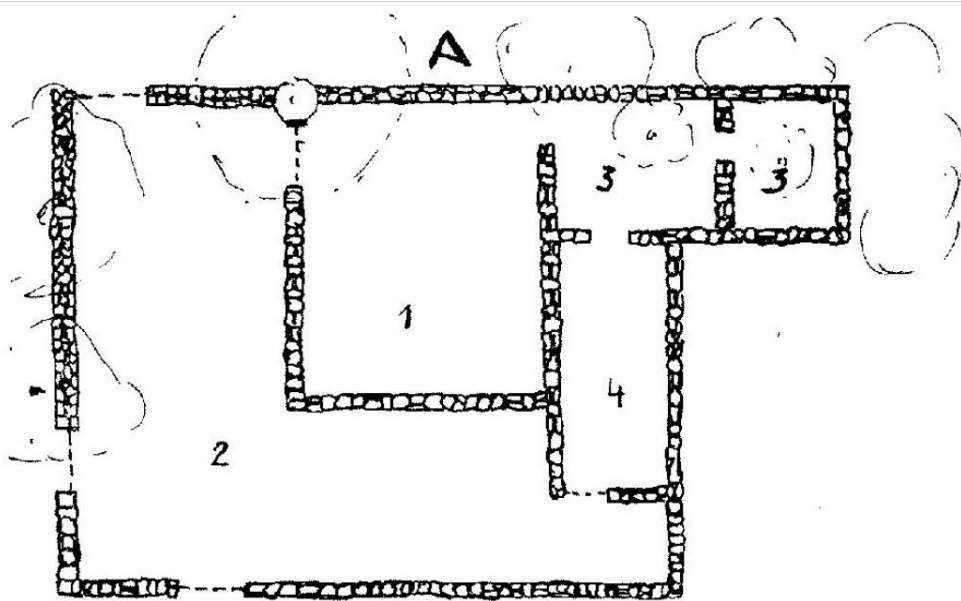
Figure 35. Multicellular sheepfold close to *Konac* (2021)

Table 1. Evaluation of the *Konac* sheepfold

Criteria	Evaluation 0-5	Result
level of preservation	4	3.25
accessibility	3-4	
aesthetic value	3-4	
cooperation on the field	2	
HTRS	E 329354.58 N 5004640.41	

3.2.3.1.4.2. The multicellular sheepfold of *Tarbijanščica*

This multicellular sheepfold is imposing in size – based on measurements from a cadastre, it has a total area of 1,154 m² and a capacity of 3,000 sheep.⁶⁹ It is located in the *Tramuntana* forest on the northern part of the island of Cres, on the toponym *Tarbijanščica*, and is accessible only by off-road vehicle. It is separated in the cadastral registry from the pasture to which it belongs with the term '*Margari*'. The double-wall construction is relatively well-preserved but quite imbued with vegetation (Figure 37). A clear overview and its labyrinthine floor plan are given in the draft by Frane Jarda (Figure 36).



MARGAR ZA STRIG OVACA
A NA PAŠNJAKU „TREBIJANČICA“

Figure 36. *Tarbijanščica margar* layout by Jarda (1964). 1 = strigar, 2 = area for shorn sheep, 3 = przgar, 4 = unshorn sheep. This ground plan is barely recognisable in the field.

⁶⁹ According to the recollection of Valentin Mikičić.



Figure 37. Current state of the Tarbijanščica sheepfold (2020)

Table 2. Evaluation of the Tarbijanščica sheepfold

Criteria	Evaluation 0-5	Result
level of preservation	3	3.375
accessibility	2-3	
aesthetic value	4	
cooperation on the field	4	
HTRS	E 331433.86 N 5003816.09	

3.2.3.1.4.3. The multicellular sheepfold of stan *Jedro*

It is located 90 m south of the shepherds' dwelling *Jedro* and is accessible by off-road vehicle from the direction of Beli. The fact that only the outlines of this *margār* remain (it has been delimited by living rock and the moss that is taking it over) conveys the reality of Tramuntana – specifically, the harshness of its terrain, the humid continental climate, and the advanced stage of overall abandonment (Figure 38).



Figure 38. The advanced stage of degradation of the Jedro sheepfold, symbolic of Tramuntana's status as a neglected area with specific climatic and vegetation features (2020)

Table 3. Evaluation of the Jedro sheepfold

Criteria	Evaluation 0-5	Result
level of preservation	1	1.625
accessibility	2-3	
aesthetic value	2	
cooperation on the field	1	
HTRS	E 330561.1 N 5004151.53	

3.2.3.1.4.4. The multicellular sheepfolds of stan *Sveti Vid*

The *Sveti Vid stân* had 25 inhabitants in 1945. This number dropped to nine in 1961, which was the last year it had residents (Stražičić 1981, 4:215–16, 248). One of the two sheepfolds, designated for milking, is located right next to the residential buildings (which serve as hunting lodges today). This sheepfold comprises two longitudinal 18-m long structures; it has an area of $2 \times 125 \text{ m}^2$ and a capacity of 200 sheep (Figure 39). Utilitarian architectural details speak of wealth and long-term production – the *mrgari* are paved with pebble stones (*koguli*) and transverse stone blocks. The dry stone walls are covered with capstones and constructed with double walls.



Figure 39. One the multicellular sheepfolds of Sveti Vid, designated for milking (2020)

Table 4. Evaluation of the Sveti Vid sheepfold

Criteria	Evaluation 0-5	Result
level of preservation	5	4.25
accessibility	5	
aesthetic value	2	
cooperation on the field	5	
HTRS	E 339128.28 N 4982542.77 E 339035.04 N 4982700.13	

Sheep shearing took place in the second part of this multicellular sheepfold (Figure 40), located in the valley below (Plasa) with an area of 600 m² and a capacity of 800–900 sheep.⁷⁰ Today, it is in active use by the Agriculture Cooperative Cres. It is built mainly of double dry stone walls reinforced with mesh (Figure 41).

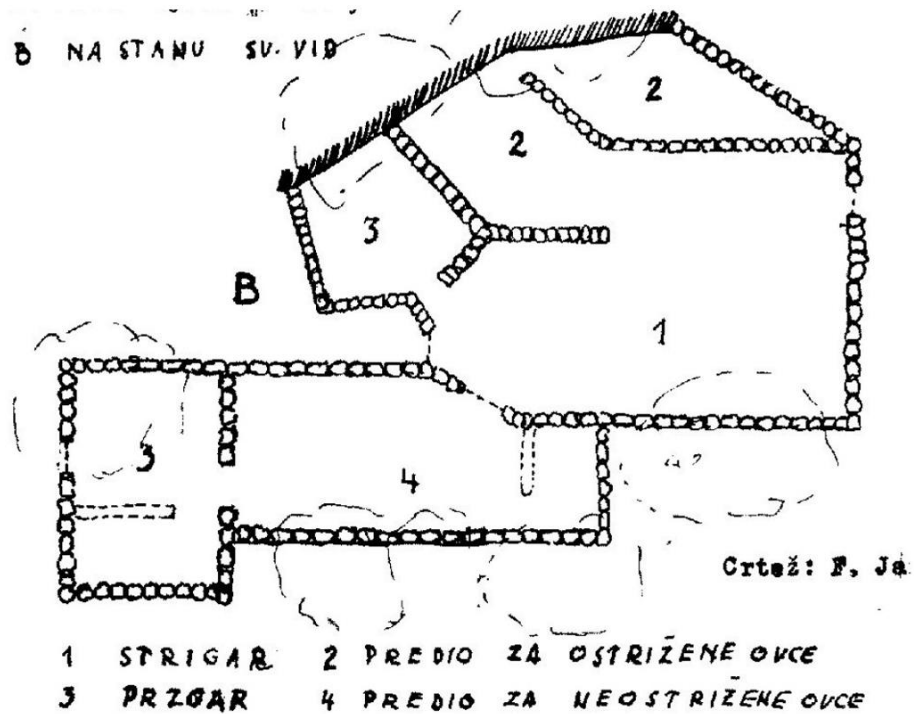


Figure 40. Layout of the multicellular sheepfold in the valley (Plasa) below the Sveti Vid dwelling, drawn by Frane Jardas (1964)

⁷⁰ According to the recollection of D.B.



Figure 41. Aerial photograph of the visible part of the sheepfold in the valley below the Sveti Vid dwelling (2020)

3.2.3.1.4.5. The multicellular sheepfold in *Dražica*

Cres Bay is surrounded by an area of about 21 km² of dry stone wall-lined fields and olive grove terraces, which makes the location of this multicellular sheepfold stand out. It highlights the strategic functional upgrade of the Cres olive grove from an agrarian to an agro-pastoral system (T. Kremenčić, Andlar, and Varotto 2021). After WWII and the subsequent drastic demographic decline, maintaining such a large olive grove was not possible. Thus, in the mid-1950s, the Agricultural Cooperative decided to place sheep in the olive grove after a favourable experience with a similar system at another island site where sheep had entered. Several dry stone wall additions had to be introduced in the olive grove, including the construction of three sheepfolds,⁷¹ of which only the one in *Dražica* has been preserved (Figure 42).

⁷¹ A similar sheepfold existed on *Gavza* and another one existed on *Karaula*. Both are demolished, the former to make a pathway and the latter for touristic infrastructure.



Figure 42. The Dražica sheepfold with nine enclosures: a) The parking lot probably served as a pregrajčić. The przgar is in the middle (the round enclosure with vegetation). b) In the upper left corner of the photo, the dry stone wall terracing is visible – stones from the terraces became part of the single walls of the new sheepfold. The long dry stone wall on the left served as a tres – a wall along which the sheep were driven to the sheepfold (2020).

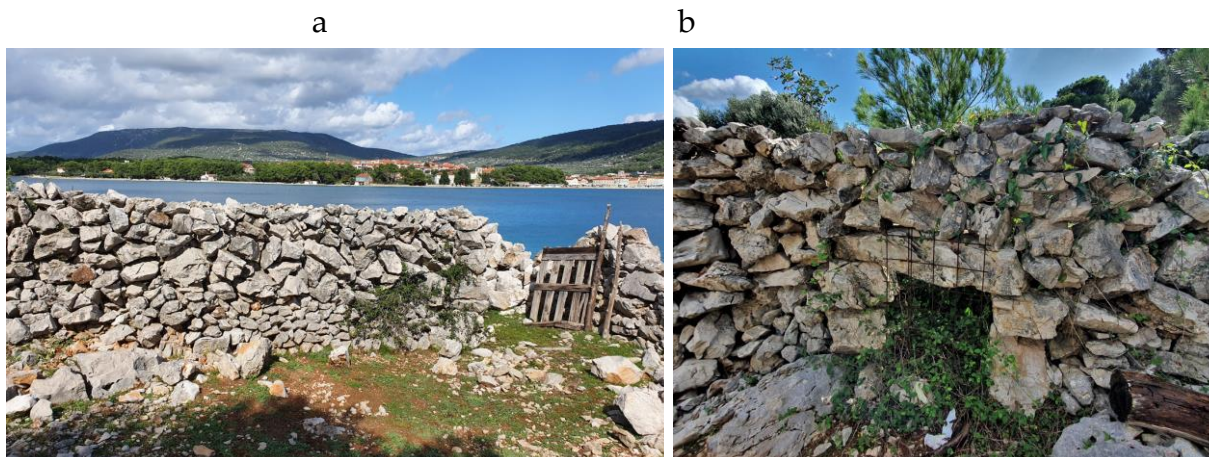


Figure 43. Dry stone details of the multicellular sheepfold of Dražica. a) The dry stone walling here is done in a combined manner (i.e. the 'Galloway wall' method); the lower part is constructed with double walls, and the upper part is constructed with a single wall. b) The lunky hole served as an entrance/exit of przgar (2020).

Table 5. Evaluation of the Dražica sheepfold

Criteria	Evaluation 0-5	Result
level of preservation	4	4.5
accessibility	5	
aesthetic value	4	
cooperation on the field	5	
HTRS	E 334522.83 N 4981325.88	

3.2.3.1.4.6. The multicellular sheepfold on *Betkav*

This six-cell 'labyrinth' sheepfold is located on the plateau *Betkav* above the Cres olive grove. The entrance is part of a former road lined by dry stone walls (Figure 44). It is built either with single walls or in a combined manner (Figure 46). Before 1953, four partitions were visible (Figure 45), after which two new walls were built, suggesting its use in the second half of the 20th century. The surrounding pasture is used by the cooperative, while the sheepfold itself is not in use.

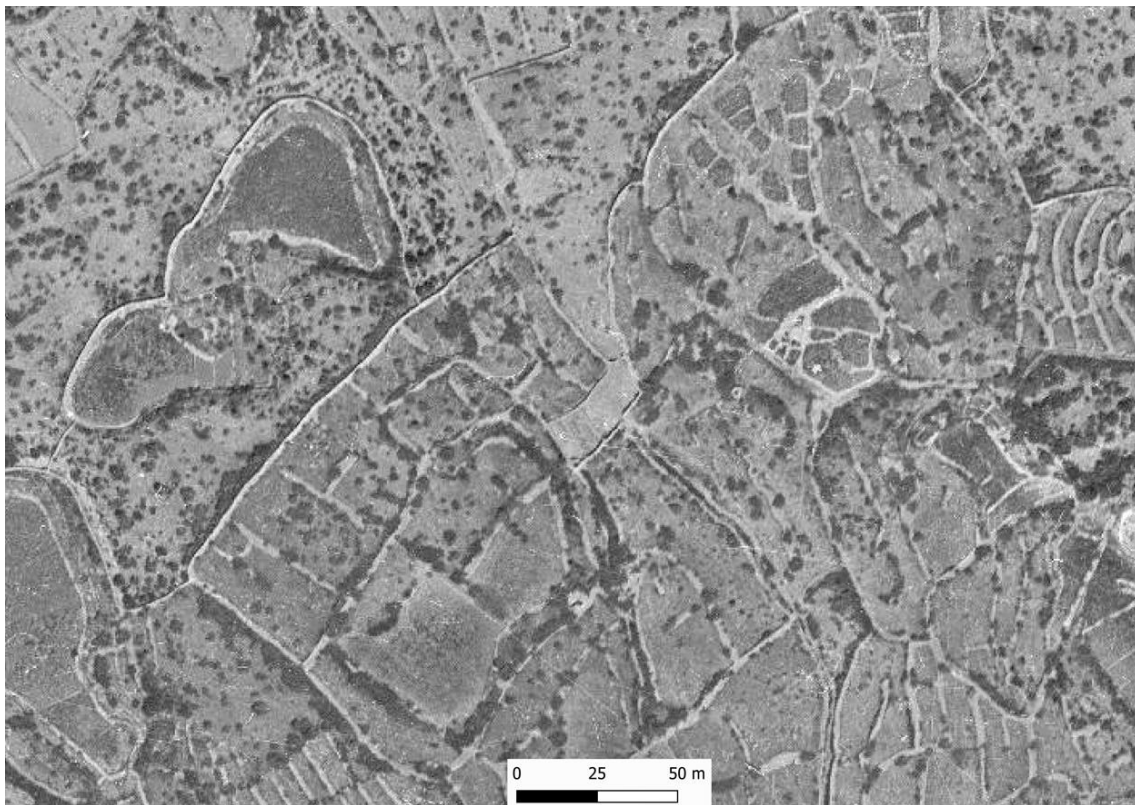


Figure 44. Sheepfold on *Betkav* in 1953 (DOF 1953). North is up.

a



b



Figure 45. Aerial images of the multicellular sheepfold on Betkav (a-b). This multicellular sheepfold was additionally partitioned after 1953. Its shape enables 'labyrinth-like' movement (2020)



Figure 46. Multicellular sheepfold on Betkav is mostly built of single and combined walls (2020).

Table 6. Evaluation of the sheepfold on Betkav

Criteria	Evaluation 0-5	Result
level of preservation	4	3.875
accessibility	2-3	
aesthetic value	4	
cooperation on the field	5	
HTRS	E 335236.27 N 4978887.64	

3.2.3.1.4.7. The multicellular sheepfold on *Lovreški*

With an area of approximately 140 m², this multicellular sheepfold has always been under ecclesial ownership. Its most recent use is connected to the cheese factory in Loznati, and today, it is used by shepherds from the Agricultural Cooperative Loznati. It is easily accessible by gravel road from the village of Loznati. This sheepfold is completely preserved, presumably due to its construction quality (double walls) and active use.



Figure 47. The multicellular sheepfold below the village of Loznati (2021). This sheepfold has an elongated shape, which is relatively common in the southern part of the island of Cres, where long cells are referred to as 'kanūal' (2021)

Table 7. Evaluation of the sheepfold *Lovreški*

Criteria	Evaluation 0-5	Result
level of preservation	5	4
accessibility	4	
aesthetic value	2	
cooperation on the field	5	
HTRS	E 337423.49 N 4978131.5	

3.2.3.1.4.8. The multicellular sheepfolds of the Ustrine commons

Two multicellular sheepfolds were built in the village of Ustrine common (*komunâda* or *kuminâda*) throughout history. The common's area is about 2 km², and it can accommodate 300–400 sheep.⁷² The construction of the more recent sheepfold was conditioned by the concreting of the road, which split it into two segments. From the 1953, it seems still unpartitioned (Figure 48). The older sheepfold is constructed with double walls and has an irregular ground plan (Figure 42), which could partly be attributed to its age and to the morphology of the terrain. The southern *pargaji* of this sheepfold are probably functionally associated with the nearby *malžicarica* – aerial imagery shows how the dry stone walls of these pastures are directed to the sheepfold (Figure 19).

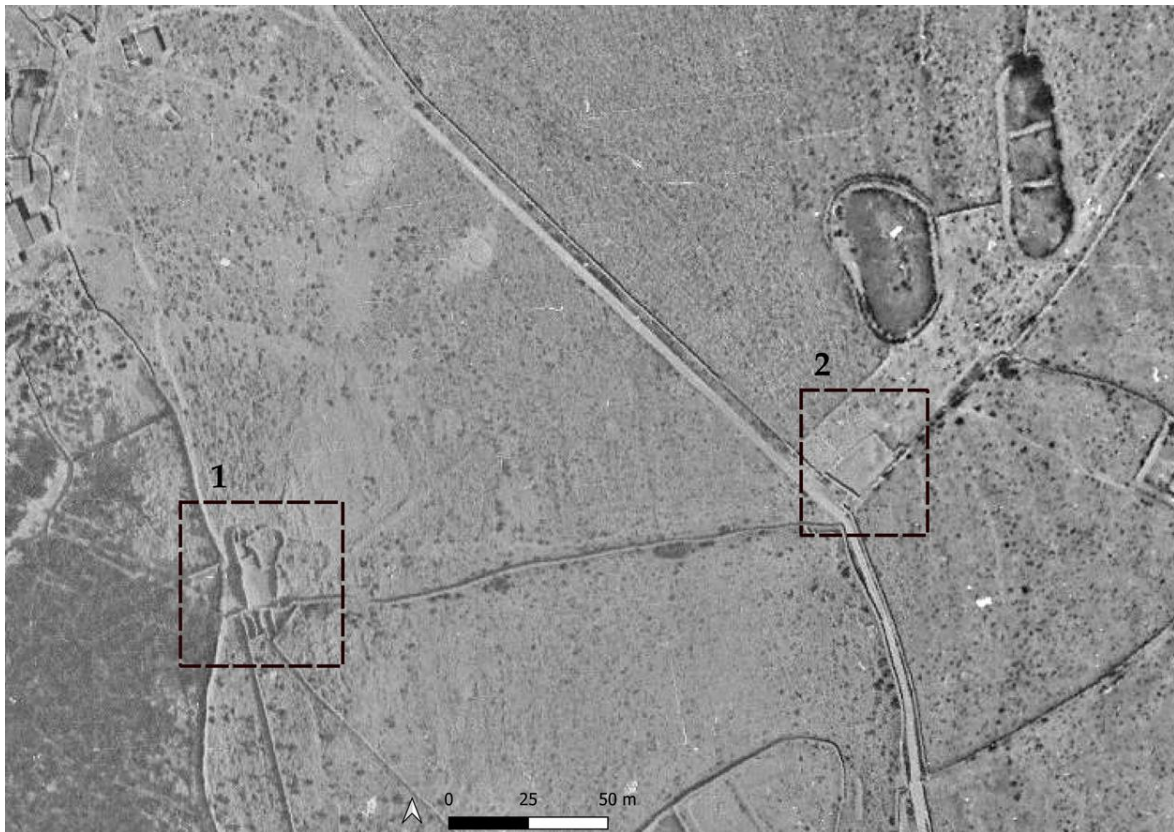


Figure 48. The location of the sheepfolds in relation to the village of Ustrine (upper left corner). 1 = the older sheepfold, 2 = the newer sheepfold (DOF 1953)

⁷² According to the recollection of D.M.



Figure 49. Irregular organic contours of the older margār of Ustrine common (2021)



Figure 50. Details of the Ustrine commons older sheepfold (2021)

Table 8. Evaluation of the older Ustrine sheepfold

Criteria	Evaluation 0-5	Result
level of preservation	3-4	4.375
accessibility	4-5	
aesthetic value	4-5	
cooperation on the field	5	
HTRS	E 334118.37 N 4957962.92	

The younger sheepfold of Ustrine is the only Cres sheepfold that has been reported in the literature and journalism (Gotthardi 2013). It is rectangular and follows the usual spatial organisation: the sheep are first gathered in the corner of a fenced pasture and then placed in the inner (largest) partition, where the shearing was done (Figure 51). The five peripheral compartments (*pargaji*) in which sheep of different owners were placed became a necessary spatial solution only after 1953. Each family oversaw the construction of their own *pargaj*.⁷³ This sheepfold was used until recently; nostalgia and a reluctance to abandon this traditional activity are evident from conversations with its recent users.⁷⁴



⁷³ In talks with informants, it was stated that the more kilometres you built of the perimeter dry stone wall of the *kuminada*, the more sheep you could keep on the pasture.

⁷⁴ The people gathered around the association 'Tunera' from Ustrine proved to be very enterprising heirs of their own rural environment. Through the work of the association, the village is represented through a multitude of educational boards and marked paths. The common space of the association can be considered a small ethno-museum.



b

Figure 51. Aerial view of the newer multicellular sheepfold of the Ustrine commons: a) Pargaji overgrown in vegetation despite a relatively recent abandonment and b) a sheepfold within the narrower part of the common (2020)

Table 9. Evaluation of the newer Ustrine sheepfold

Criteria	Evaluation 0-5	Result
level of preservation	4	4.625
accessibility	5	
aesthetic value	4-5	
cooperation on the field	5	
HTRS	E 334310.87 N 4957997.08	

3.2.3.1.4.9. The multicellular sheepfold *Mihojski*

This 550-m² big multicellular sheepfold is located within a pasture known as *Mihojski* and is easily accessible from the main state road on the island (D101). It remains in active use today by the Agricultural Cooperative Cres (Figure 52) and is one of the most representative sheepfolds since it still has most of its compartments and construction details.



Figure 52. The multicellular sheepfold *Mihojski*. a) The two upper partitions are currently the only ones in active use. b) The *pregrajčić* is the wider space at the entrance to the *mrgar*, visible on the left side of the photograph. Two *przgari* are visible; the left one belongs to the *Mihojski* sheepfold (2020).

Table 10. Evaluation of the sheepfold Mihojski

Criteria	Evaluation 0-5	Result
level of preservation	5	5
accessibility	5	
aesthetic value	5	
cooperation on the field	5	
HTRS	E 335141.07 N 4956425.99	

3.2.3.1.4.10. The multicellular sheepfold close to *Veli Tržić*

This abandoned multicellular sheepfold is located 900 m SW of *Veli Tržić*, at the foot of the hill *Osorščica* on the island of *Lošinj*. The construction details suggest this sheepfold was part of the *Veli Tržić* dwelling, although the dwelling has other sheepfolds right next to the buildings. Its solid double wall (Figure 29) and ground plan that resembles a halved flower are similar to those on the island of *Dolin* and *Krk* (*Va Pothlamac*).



Figure 53. The multicellular, half-flower shaped eight-cell sheepfold close to the abandoned village of *Veli Tržić*, on the hill *Osorščica* (island of *Lošinj*): a) Full aerial view, b) an image showing that structures are still mostly preserved, and c) an image of one of the sheepfold compartments made with a massive double dry stone wall (2021)

Table 11. Evaluation of the multicellular sheepfold close to Veli Tržić

Criteria	Evaluation 0-5	Result
level of preservation	4	3.375
accessibility	1	
aesthetic value	5	
cooperation on the field	3-4	
HTRS	E 331317.66 N 4950645.1	

3.2.3.2. Dry stone-lined pathways (*klanci*)

Dry stone-lined pathways – *klanci* (*N pl, DIM. klancići, klančići; klanèc 'N sg*) (Houtzagers 1985, 62) were relatively narrow paths that enabled connections from the settlements to agricultural parcels or pastures. Each farmer was responsible for enclosing their plot and ensuring that its outer dry stone wall did not obstruct the pathway.⁷⁵

Some of the more important historic roads were paved with cobblestones, which were necessary to prevent erosion and level the ground. This technique (pitching) is based on the dense vertical placement of stones in the space enclosed by natural rocks or dry stone walls. The gaps between the cobblestones are filled with soil or sand. Since they have been rounded with use, they are locally called *kôguli, kôvuli, or krôguli* (Velčić 2003, 169; Houtzagers 1985, 271), which is derived from the Venetian word *cògolo* - a 'round stone' (Boerio 1867, 177).

There are no certain data about their construction. Most of the visible cobblestoned roads which can be found on the island of Cres today probably date from the period between the 16th and 18th centuries; during this period of Venetian rule, traffic on these islands was done primarily by land. However, a network of roads was built since the Roman times (Imamović 1975, 225).

Another category of roads includes those constructed during the short French rule (1805–1814), which fit more into the category of engineering undertakings. Focusing on road construction was necessary in this period due to the naval blockade on the Adriatic by the British Navy (Stražičić 1981, 4:198). Where these roads have been preserved, they are the most representative examples of cobblestone roads on the island (Figure 54). In addition to *koguli*, pavement can be made from blocks and stone slabs. Stone slabs are more common on Lošinj (Figure 55).

⁷⁵ According to A. D., one of the Cres farmers would, while walking towards his parcel, intentionally rupture a wall with his pickaxe if he noticed that a belly was starting to form on it, to urge the owner to repair it.

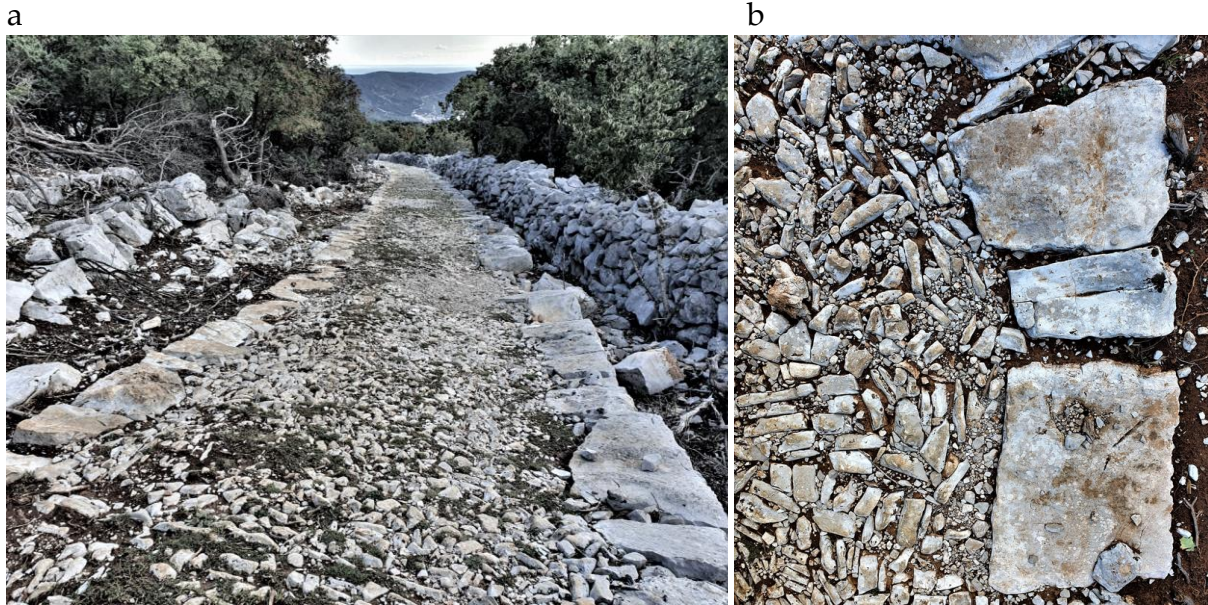


Figure 54. The 'Napoleon road' from Cres to Predošćica, paved by koguli and lined with bankina (2021)

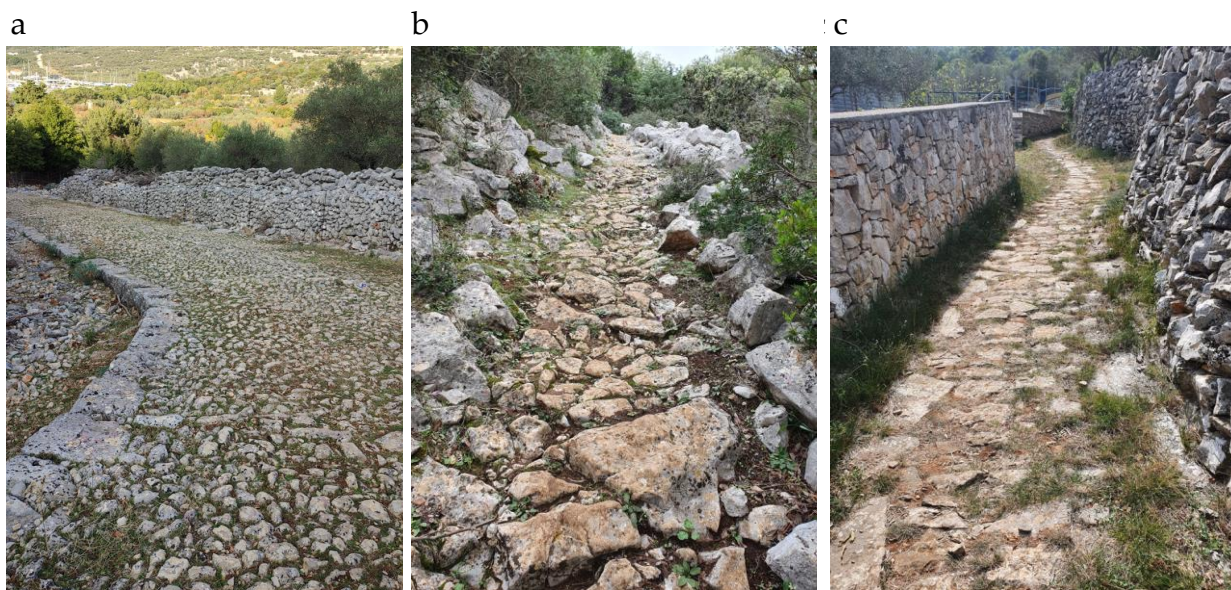


Figure 55. Different pavement styles: a) bankina and koguli of the Napoleon road from Cres to Krčina (2021), b) koguli on the pathway from Osor to Tržić (2020), and c) stone slabs on the pathway from Veli Lošinj to outer parcels (2020)

3.2.3.3. Water courses (*konali*, *konalići*)

In the karst area, building an effective drainage system is just as important as providing a water supply. Dry stone wall-lined watercourses are not a common vernacular architecture on the Cres-Lošinj archipelago but are found in certain terraced areas or cultivated dolines. Scarce soil, topography (slopes), and ephemeral heavy rainfall necessitated their construction, in order to prevent erosion of the strenuous efforts of anthropogenically formed soil. These dry stone structures, to the best of the author's knowledge, were not part of the research in the local literature. They were often not even part of the interlocutors' memories⁷⁶ and, therefore, are a subject of assumptions based on comparisons with other terraced landscapes and canal usage. However modest in their constructive form they may seem (Figures 51-60), overlooking them equals neglecting the important engineering component of this site.



Figure 56. From right to left: a canal entering a dry stone-lined cistern, with stairs below the second canal that funnels the water to the next parcel when the cistern is full (2020).

⁷⁶ Acknowledging that more comprehensive ethnographic field work should yet ensue, which would employ a greater number of interlocutors.

Dry stone canals were naturally well-maintained in the past – some of the most important ones are in Piskel/Pišće (in the southern part of the Cres Bay) (Figure 57) and the one in the centre of Martinšćica (300 m long, 4 m wide).⁷⁷



Figure 57. The canals in Piskel in 1910 (Cres Library archive).

In the case of the Cres-Lošinj archipelago, the dry stone canals have been most often noticed in the olive grove surrounding the town of Cres. They converge into the bay from all the valley's slopes. On the northern side of the grove, they can be followed for at least 2 km, cascading from the Stret locality towards the town of Cres. Through these canals, the stormwater is diverted and distributed in a series of cisterns (*vaške*), which are built in dry stone, sometimes reinforced with concrete, and roofed (Figure 56).

⁷⁷ An often-told story in Martinšćica is that, during one of the heavy rainfalls, the torrent from this canal brought a mule to Martinšćica, all the way from Vidovići, which is a village 1.8 km away.

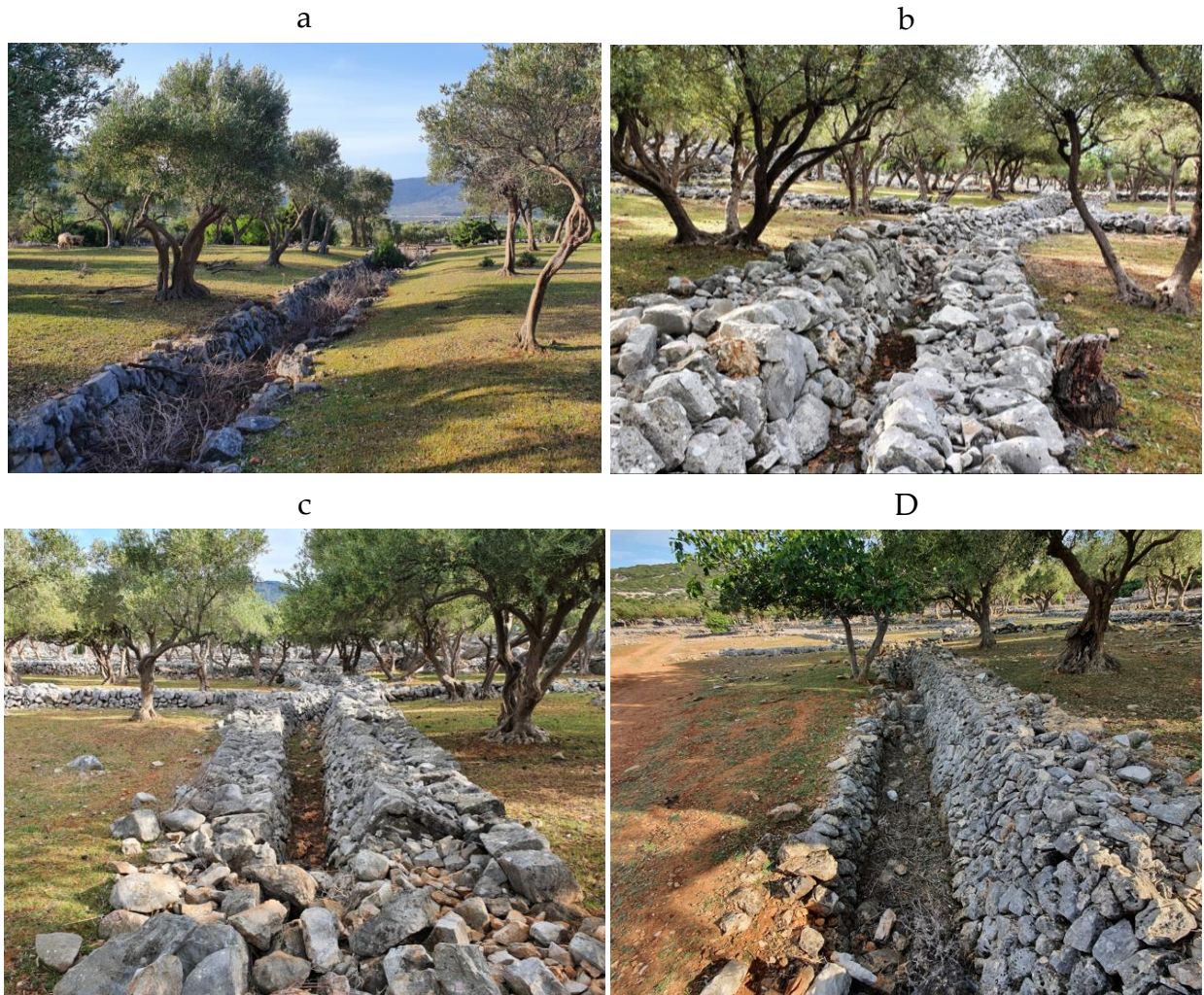


Figure 58. Examples of the well-maintained or well-preserved dry stone canals on the northern slope of the Cres olive grove: a) The canals are frequently used as places to dispose of pruned olive tree branches. b-c) Dry stone canals of thicker construction and c-d) the chamfer mode of construction, found at the margins of a parcel (2020).

Besides preventing damage to crops, canals and cisterns might have been made to irrigate and supply water. None of the cisterns was found intact – most of them are recognisable only due to the canal leading to them (Figure 59). The canals are also frequently filled with accumulated stones and various other materials which obstruct their intended function.

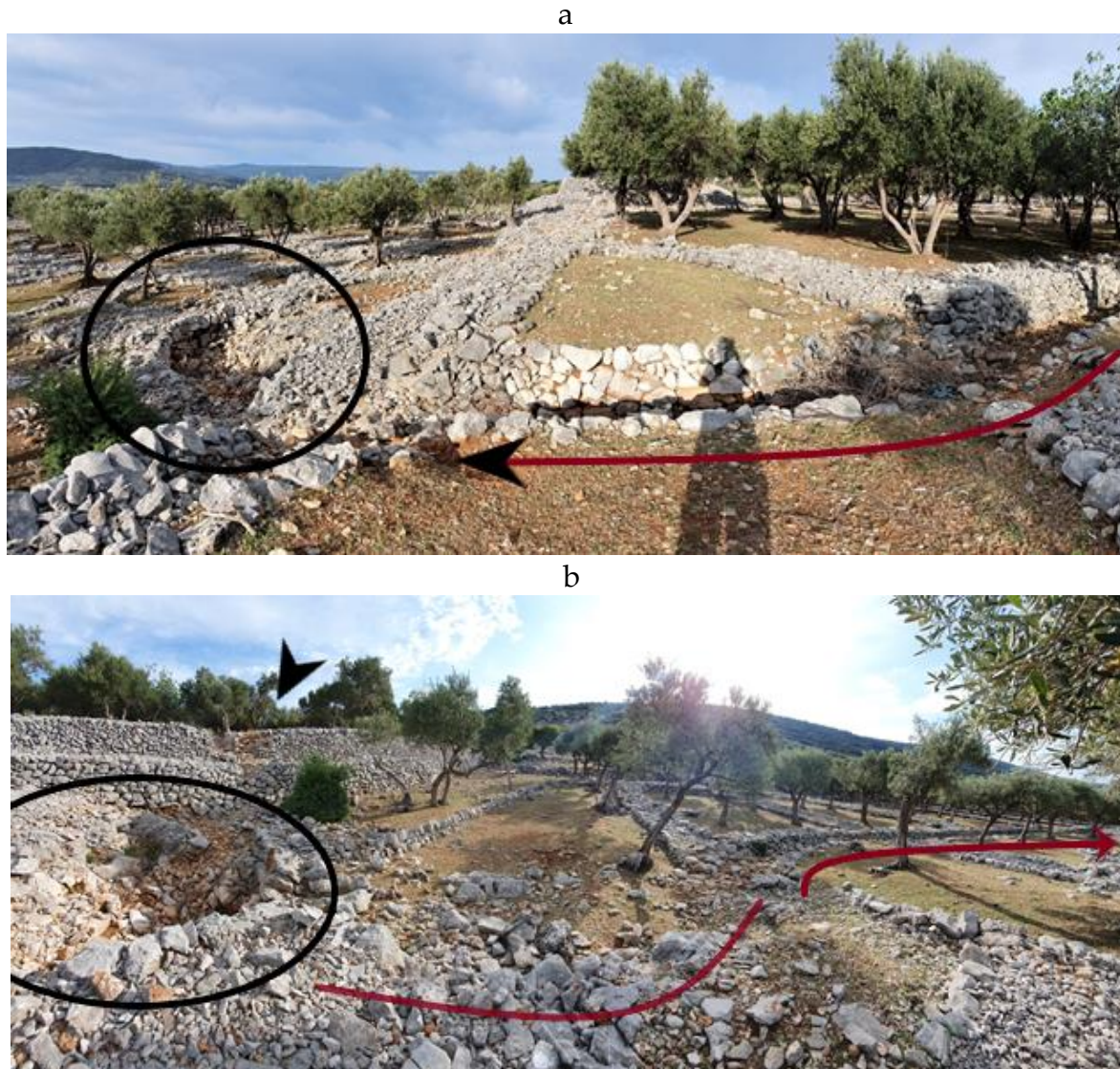


Figure 59. Complex network of canals and cisterns (late spring photographs of the canals in the town of Cres olive grove directed from the locality of Stret (above Gracišće) to the town: a) The upper terrace – the dry stone canal from the right leads to and falls into a demolished cistern on the left (towards the southern, town direction). b) The continuation of the stream on the lower terrace, with a barely recognisable trajectory (red), leads to a subsequent canal (2020)

The depth of the canals varies from a subtle elongated furrow lined by a single lane of stones to one-meter deep drainage canals. Some of them are constructed as chamfers (Figure 58). They often have access stairs and small stone bridges that cross them (Figure 60). The actual drainage canals, deeper canals that direct stormwater deeper into the ground, can be found at the bottom of the slope (*podènek, podĝnak*) or in deeper karst valleys, which gather more soil (*rũnki*) and water. Such canals can be found in Poje (a large plain area in the town of Cres olive grove [Figure 65]), Dol (north of Beli) and Dol (close to Loznati).

a



b



Figure 60. Details of the construction of canals: a) A small bridge over the canal (Pregon, 2020), b) stairs to facilitate passing over (Gracišće, 2020)



Figure 61. A simple can and a pathway lined by škriji in Arat (Veli Lošinj) (2020)

Figure 62. The remnants of a canal, close to the Sveti Kuzma and Damjan church (southern part of the Cres Bay) (2020)

a



b



Figure 63. A water conduit funnelling excess water from the agricultural parcels to the street a) near Halmac b) and on Piskel (2020)



Figure 64. A water conduit below the pathway Germov in Miholašćica (2021)



Figure 65. The drainage canal in the fields (Poje, 2019)

3.2.3.4. Ponds and dry stone walls

Ponds do not necessarily require dry stone walling – only impermeability achieved by laying a clay or loam foundation on naturally occurring concaves. They are commonly several meters to a dozen meters wide. Their function has been to collect rainwater and provide water for both livestock and the inhabitants (Figure 66).



Figure 66. Pond Nova lokva (as marked on HOK) or Sublaška (as it is called by the workers from Agricultural Cooperative), formed on the karst doline (2020)

In cases where the dry stone walls make part of the pond, they either fully encircle the pond or converge into it (Figure 67). There are also multiple, mixed-purpose (i.e. both for human use and livestock) ponds, which caused the occasional spread of infection, mostly malaria.⁷⁸ Today, their value is reflected primarily in their exceptional biological diversity ('PPPPPO Tramuntana' 2002; Jardas 1964, 125; Jurkota Rebrović 2009, 8:58; Stražičić 1981, 4:72). The majority of them are completely abandoned and are not being restored. One pond which has been restored relatively recently is the pond Bušuanska, close to Punta Križa.⁷⁹ Its restoration took place in 2014 as part of the Interreg project between Slovenia and Croatia (KAMEN-MOST), led by the association Dragodid, with the cooperation of local inhabitants (10 from the association Puntari). Two days were not

⁷⁸ One of the options of gathering rainwater was to carve a in the stone, creating a *kalčič/kalčič*.

⁷⁹ Bušuanska was a pond intended for the inhabitants, with dry stone walls (partially single, partially double walls), with a traditional wooden door (*lesa*) was placed at the entrance prohibiting livestock from entering.

enough for 20 skilled people to restore the pond⁸⁰ (*Puntarski fuoj* 2017, 6–7), which underlines the effort needed to restore them.



Figure 67. The dry stone wall-lined, heart-shaped pond on the left was intended for human use; the one on the right was used for livestock of different pastures (Sergovi, 2020)

The dry stone wall-lined ponds in the following photographs are not representative of the island in terms of their preservation and occurrence. Neglect caused most of them to be overgrown with vegetation and disintegrated. As was the case with the sheepfolds, most of the photographs are from the island of Cres, considering its higher activity in sheep husbandry.

⁸⁰ Members of the association observe how ‘[i]t is a shame that more members of the Puntari association did not participate in this action, nor the younger locals of the Punta Križa, because it is to them that this art and skill should be transmitted’ (*Puntarski fuoj* 2017, 7).

3.2.3.4.1. Dry stone wall-lined ponds

The first type of the ponds marked with dry stone walls are the ones intended exclusively for drinking water and household needs. Such can be visually singled out as they were fully enclosed to prevent access to livestock. They were occasionally built close to naturally occurring rocks (Figure 68). They can be small if made on private property or large if they were used as community ponds (*komūnske lōkvi*). The latter type usually represents a reliable source of water and were occasionally located close to a spring (e.g. pond Lavdin above Dragozetići, Dol near Predošćica, Tiha and Slavoja near Martinšćica, Vele lokvi near Lubenice).



Figure 68. A community pond close to Vidovići, said to never evaporate fully, attached to an escarpment, lined with thick dry stone walls, and containing a paved stair entrance (2021)

Figure 69. Pond Simitesa, functionally part of the stan Grabrovice, with a supply canal noticeable in the back (2018)



Figure 70. Partially lined pond close to the abandoned village of Padova (2020)

Figure 71. Fully lined pond with dry stone walls on locality Sergovi (2020)



Figure 72. A dry stone pond in the locality of Sergovi. Access is enabled by stone stairs which were later partially concreted (2020)

Figure 73. A dry stone pond in the Cres town olive grove, close to the locality of Pržići (2020)



Figure 74. A pond 'Vele lokvi', which lies between Lubenice and Zbičina, composed of two ponds. The one on the right is peculiar for its two rims of dry stone walls and dry stone pier made from large, layered stones (2021).

3.2.3.4.2. Dry stone walls converging into ponds (*deriti*)

The second type are the ponds with dry stone walls converging into them. They were intended for livestock and designate special regulations concerning rights on how and where to access water. Namely, many large ponds that exist on vast pasture terrains, located among the private pastures (*ogrâjice*), are commonly owned, and each pasture has a secured dry stone wall-lined pathway (Stražičić 1981, 4:211) which directs the sheep to the water. This dry stone wall-marked pathway denotes the right to access water and is called *derit* (Houtzagers 1985, 229), which is a derivative of the Italian word *diritto*. This type of pond can be seen on the island of Krk (pond Diviška), and on the island of Pag (close to Kolan).



Figure 75. Two ponds with the same name: Pogana, derived from pagan: a) pond Pogana, close to Srem (2021) and b) pond Pogana, close to Sveti Juraj church (2017)



Figure 76. Pond Jabelna, which gives access to water to six private owners. An underground passage for sheep is dug below the elongated sheepfold on the right (2020).



Figure 77. Pond Ravni, close to Germov (2020)



Figure 78. Pond on Hropni (close to Belej) with eight rights to access. The newer parcellation is recognisable from the single wall on the left (2021)

3.2.3.5. Resting stones (*pocivālići* / *pocivālišća*)

Farmers from the town of Cres did not own pack animals, and most of them did not own any livestock. The tight town infrastructure did not allow for it, and, for hygiene reasons, people were forbidden from keeping cattle in the city. Those who did have animals had their livestock sheds outside the city walls. Furthermore, there was no grazing area left since the entire agricultural area surrounding the town was cultivated with various crops. Therefore, Cres farmers had to carry all their yields (olives, pyrethrum, figs, and grapes) on their shoulders.⁸¹ Due to this arduous method of transporting goods, dozens of resting places – *pocivālići* – were built. They were mainly 500–1000 m apart along the roads and paths that led to the town (Figure 80 and Figure 81). A *pocivālić* is a stone platform – a self-standing dry stone cuboid that is over 2 m long, about 1 m wide, and about 1.5 m high. Its height had to correspond to the height of the farmer’s shoulders or the height of the mule’s back (Medarić 1975; Stražičić 1981, 4:205; Jurkota Rebrović 2009, 8:49). It was often covered in stone slabs.

Its name derives from *pocivāt*, *pocìnut*, which means to rest. Varieties of the term are *pocivālići* (N pl) for the area around the town of Cres, *pocivālišća* in Tramuntana (Velčić 2003, 316), and *pocivālišća* in *Gerbin*, *pocivala* on the island of Ilovik. The examples from the island of Ilovik are different in shape and form (Figure 79). They are equivalent to what would be called *skalîni* or *stèlbice* on the island of Cres.⁸² In the case of Ilovik, the lower stones were used for sitting, and the higher ones were used for depositing the load carried on a person’s back, most often *brince* (Pavoković 2016, 228).

⁸¹ To bring grapes from more distant vineyards, such as *Lovreški*, they would sometimes hire *gonjaci* – people from the villages of Loznati or Orlec, who would bring grapes to Cres on their mules.

⁸² See paragraph 3.2.5.4. Stone stairs (*skalini*, *stèlbice*).

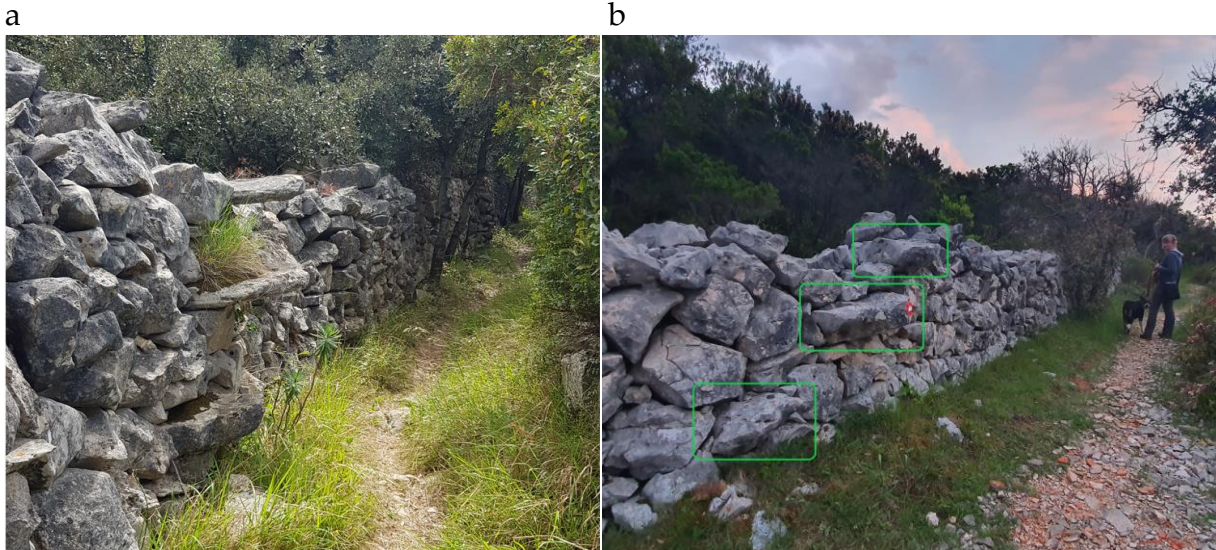


Figure 79. Resting stones on the island of Ilovik (*pocivala*) made from a) flat stones (2019) and b) thick, wide stones (2021)



Figure 80. *Pocivalić* on the path connecting the village of Loznati and Cres: a) The left side of the path had additional steps, probably for the villagers, b) while on the right was *pocivalić* for the burden. The rocks stacked above are not functional; they were placed by the hikers and tourists afterwards (2021).

Pocivalić can also designate other suitable places for rest, such as rocks of adequate shape and position (Figure 82). An example is a stone called '*počivališće Svetog Gaudencija*' (the resting place of the Saint Gaudent), located at the foot of the hill of Osorščica as part of a thematic hiking trail.⁸³

⁸³ Šetnica Sv. Gaudencija. n.d. ASL Agency. Accessed: December 28, 2021. https://www.otok-losinj.hr/news/setnica_sv_gaudencija_129/.



Figure 81. *Pocivalić* at the location of *Križ*, in the *Cres olive grove*, as part of a touristic trail (2019)

Figure 82. A naturally carved rock, named the *počivališće* (or *throne*) of the *Saint Gaudent* (© Ruben Polonio, 2021)

3.2.3.6 Lime reservoirs (*fòš*)

Fòš is the name for a reservoir (a hole lined with a dry stone single or retaining wall) in which lime is slaked (Houtzagers 1985, 62). They can be found on the margins of villages and settlements. They have been registered in *Predošćica*, *Sveti Petar*, and *Lubenice* (Figure 83) but probably occur in most settlements since lime was used to construct the buildings.

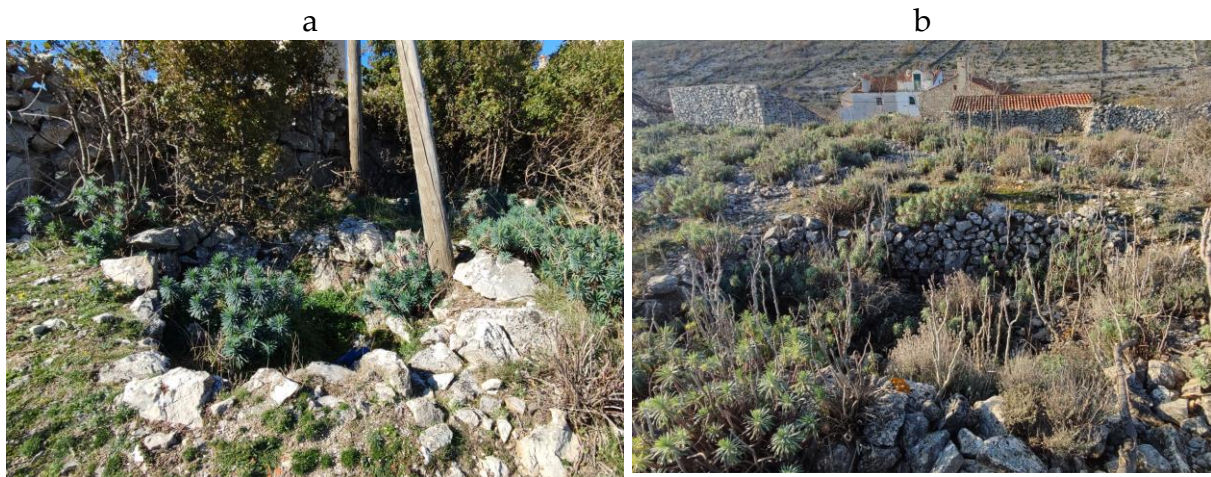


Figure 83. Reservoirs in which lime is slaked can be found on the margins of the villages: a) *fòš* of *Lubenice* (2021) and b) *fòš* of *Predošćica* (2021)

3.2.3.6. Other purposes of dry stonework

3.2.3.6.1. Defensive and military structures

Several dry stone structures used for military purposes can be found across the archipelago. On the offshore islands, such as Vele Srakane, Unije, and Ilovik, stone structures were used as surveillance stations during the period of the Yugoslavian rule. Their equivalent can be found at Ostrojni area (Figure 84), close to Hrasta. Many of these structures have also been built around the nearby valley for military exercises (Figure 85, Figure 86).



Figure 84. A line of dry stone shelters on Ostrojni (2021)



a



b

Figure 85. a) A dry stone shelter made for military exercise purposes overlooking b) the valley which was used as shooting ground during the 1980s, close to the village of Hrasta (2021)



a



b

Figure 86. Different shapes of each of the dry stone shelters for military exercise purposes near Hrasta (2021)

3.2.3.6.2. Artistic purposes

Due to the different vegetational and climate elements in Tramuntana, its abandonment and (according to some) the mystical experiences it provides, this region has been the location of art colonies and art decorations along the forest paths. The seven stone labyrinths were built along the forest paths as part of the activities of the former eco-centre 'Caput Insulae – Beli'⁸⁴ (Figure 87). The other structures were designed as part of the artists' colonies, accommodated by the family farm in the village of Filozići (Figure 88).



Figure 87. One of the seven stone labyrinths in Tramuntana (2020)

Figure 88. Part of the artistic colonies in Filozići (2021)

⁸⁴ The centre was active from 1993 to 2012, at the site of the current 'Beli Visitor Centre and Rescue Centre for Griffon Vultures'.

3.2.4. Dry stone roofed structures (buildings)

3.2.4.1. Dry stone huts (*kůćice*)

Dry stone huts and livestock sheds with square ground plans are numerous and prevalent. Even though they are constructed mostly of dry stone and although many of them show interesting dry stone walling construction details (Figure 89), they were not the primary object of the study as they are mostly covered by roofs of wood or tiles.



Figure 89. Dry stone livestock sheds and their dry stone constructive elements: a) an arch on the entranceway to a livestock shed, close to Lubenice (2021), and b) a livestock shed close to Arcić (Lovreški), with double lintel (2021)

A less frequent type of structure are fully dry stone constructions with a round ground plan and a corbelled roof made only of stones. In English language they are known as bee-hive hut,⁸⁵ and in Croatian, they are generally called *bunja* (Dalmatia) or *kažun* (Istria). The word *bunja* is a localism of some parts of Dalmatia, which has been accepted as a generic Croatian name since the works of Iveković (1925) and Freudenberg (1962, 43–59). Dry stone shelters are commonly simple structures – comprising a small entrance and one chamber, with just enough space to accommodate 1-2 persons (See: Šrajer 2018, 87-91). However, many examples from Dalmatia are impressive due to their size and constructive features, having several outer rims (See: Kale 2006, 83-85, 90-91).

Dry stone shelter with a corbelling dome from the Cres-Lošinj archipelago have not been part of a systematic study. They have been nominally mentioned in the work of Štepinac-Fabijanić (1988, 114), and only one is thought to be located on the island of Cres (Šrajer

⁸⁵ In Ireland, they are known as ‘*clochán*s’ (Aalen 1964).

2019, 213), a conclusion probably drawn based on Kljaković drawings (1953). During this study, more than 20 huts with corbelled domes were registered and based on the conversations with informants, plenty more are known to exist. They have mostly been found in *Lovreški* and on the marginal parts of the Cres olive grove, as well as in Tramuntana. They are predominantly simple, made of one chamber,⁸⁶ and have several utilitarian elements. A stone bench and a niche for tools or meal are commonly found in its interior. The entrance is built to a height of 50–60 cm, which necessitates entering on all fours. The entrance has no doors; instead, there is only a simple horizontal stone lintel. To protect the interior from atmospheric conditions (rain and wind), a rudimentary antechamber is sometimes built (Figure 96, Figure 101). No predominant entrance orientation was observed. These structures can have a corbelled roof over a round ground plan or over a rectangular floor plan (a sort of pendentive). Most of them – both the ‘square’ and ‘round’ ones – are already in an advanced state of degradation. Since most of the field houses are built on or inside the clearance walls, the internal construction is not shown in the external form, as is usually the case with elementary types of construction.

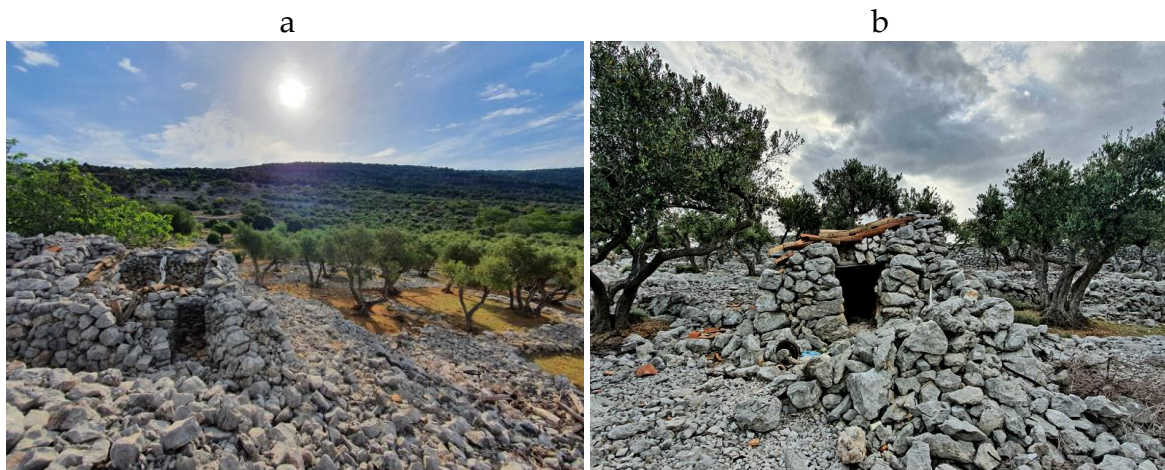


Figure 90. a-b) The predominant type of field huts found on the Cres-Lošinj archipelago with a square ground plan located on the clearance wall, with a mono-pitch roof made from tiles (2020).

⁸⁶ One example on the path from Cres to Loznati has two roofed chambers, but due to the vegetation cover, representative photography could not be made.



Figure 91. The common current state of many field huts: a) Roof collapsing as the first stage of degradation. b) In an advanced stage of degradation, one of the last indicators of its use is the interior niche (2020)

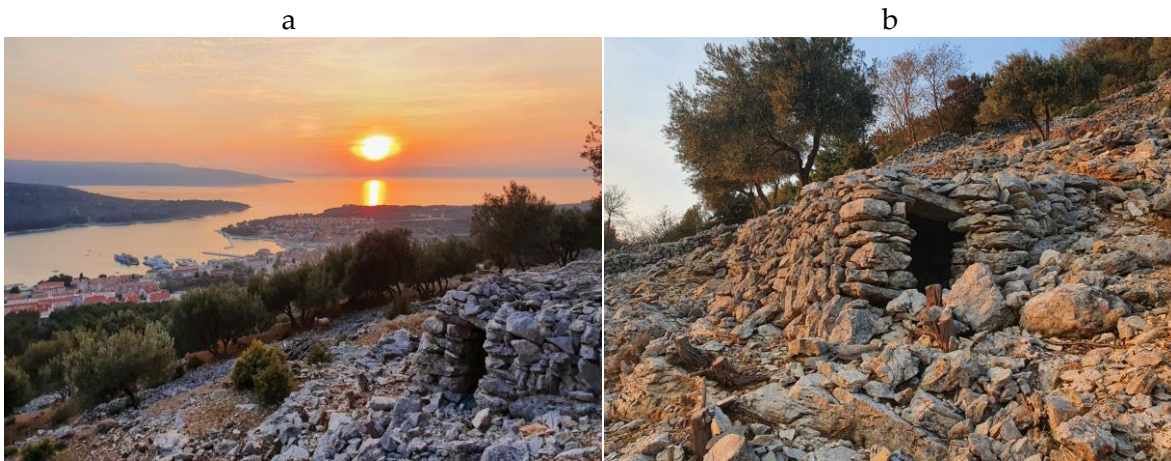


Figure 92. An example of a fully dry stone hut with a square ground plan on the eastern slope above the town of Cres (2021)

Drawings of the stone huts between Cres and Vodice by Kljaković (1953) (Figure 93) convey misconceptions about these huts. The size ratio is not accurate, and the presentation of a countrywoman gives an impression of habitation, even though these were temporary auxiliary structures.

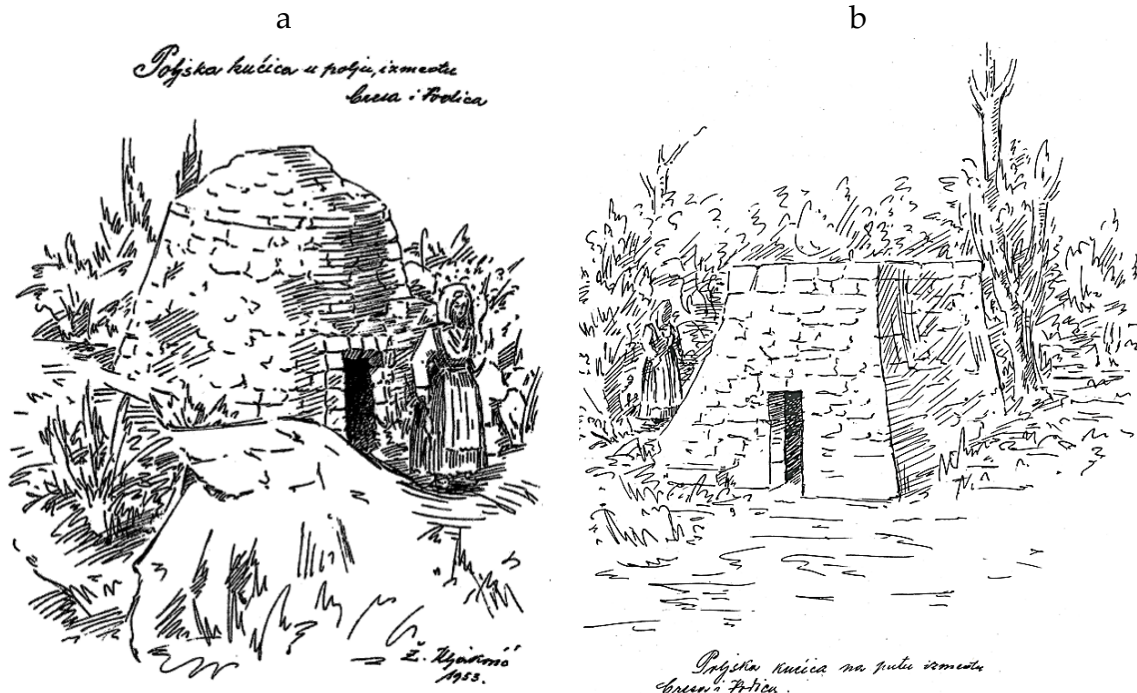


Figure 93. Drawings of dubious accuracy of two types of dry stone huts between Cres and Vodice by painter Žioko Kljaković (1953), who was hired by the Institute of Ethnology in Zagreb in the 1950s to record various objects and sights of Croatian heritage.



Figure 94. A dry stone hut, placed inside a clearance wall on the border of an isolated field among the pastures of Tramuntana (Ponehovice) (2021)



Figure 95. A dry stone hut with a preserved roof made from stone slabs, on the pathway to Lovreški dol (© Simon Radić, 2019)



Figure 96. Different angles of the dry stone hut at the Stret locality, in the northern part of the Cres olive groves. Its interior is about 1.80 m high and allows for no more than one person to stand upright. It has one of the most preserved outer dry stone protective walls (2020).

a



b



c



d



Figure 97. A dry stone corbelled hut in the pine forest close to Pržiči (a-d), located close to the clearance wall, with a roof corbelled with stones and inner bench (2020)



Figure 98. A dry stone hut with a square ground plan and a corbelled roof of stone plates, between the bays of Banja and Kruščica (© Dorijan Lovrečić, 2020)

Figure 99. A dry stone hut with a corbelled roof of stone plates and a pocivalić next to it, in the town of Cres olive grove (© Franko Fučić, 2020)



Figure 100. In its constructive form, this hut (located in the middle of the town of Cres olive grove) is similar to lime kilns; however, the entrance is too wide to make it one. It is unique in that its roof is made of stone slabs. (© Martina Krznarević, 2019)

Figure 101. A corbelled dry stone hut on Židimer, the interior of which is equipped with a stone bench and provides enough space for two to three persons (2020)

3.2.4.2. Dry stone water closet (*kundõt*)

Older houses did not have a toilet in the house, and a separate hut was used for that purpose (*kundõt* – Ilovik, *kondût* Tramuntana). These huts are mostly built of stones and mortar, but one dry stone example (with a roof partially covered in tiles) in *Veli Tržić* was found (Figure 102).



Figure 102. A dry stone water closet, part of one of the buildings in Veli Tržić (a-d), partially covered with stone slabs and roofing tiles (2021)

3.2.4.3. Lime kilns (*japnênice*)

Lime kilns are one of the rarest dry stone structures on the archipelago due to the abandonment of traditional lime production and the nature of their use. One of the only traces of them that can be found on the ground is their outer rims since most of them are burnt. These structures were built to produce quicklime by burning limestone and the lime kiln itself. Limestone used for burning was derived from natural, high-quality deposits which had to be freshly excavated. The production of lime is an important way in which natural resources were utilised across the Adriatic coast (Faričić and Juran 2021, 19). The process of burning limestone in the lime kilns would last for approximately two weeks, with people guarding the kiln and periodically inserting wood, thus maintaining a high temperature (ca. 1000). Lime was produced both for local needs (as mortar for houses) and for export to the coast (Rijeka, Venice).

The local name is a variant of *japnenica* (from *japno*), which is a dialectal Croatian word for *vapno* (lime): *japnênce* in *Tramuntana*,⁸⁷ *Garbin*, and *japlênca* in *Martinšćica* environs. *Tramuntana*, the western coast of the island of *Cres*, and *Punta Križa* were the most prominent areas for lime production and the construction of lime kilns. Here it was relatively easy to provide the necessary wood and favourable conditions for loading lime in ships (Stražičić 1981, 4:218). The outer rims of these lime kilns are still recognisable from digital orthophotos taken in 1953.

They look very similar to dry stone shelters: ‘the real stone pyramids, made out of stone excavated from the ground and for days exposed to fire ignited from the remains of the cutting of wood crunches – *pruašće*’ (Galjanić 2019, 46–47) (Figure 103). Traditional lime production is well documented for the area of *Punta Križa*: a group of skilled workers employed to construct a lime kiln were called *suocij*. Such a group consisted of three to four farmers (*težuaci*) and one manager (*pruoto*). The lime kiln would be built with stone that had to be recently extracted from a quarry (*kuava*) close to the limestone (Gović 2011b, 75–76).

⁸⁷ *Japnênce* (G sg. *japnênci*, N pl. *japnênci*) in *Tramuntana* is both the name for the lime kiln and a hole in the ground in which the lime is kept and *Japnêncina* is toponym for one of the areas in *Tramuntana* (an area which comprises pastures, forest and fields (Velčić 2003, 141).



Figure 103. An assumed lime kiln close to Veli Bok (Tramuntana): a) The height of the structure above earth is about 2 m. b) Advanced vegetation and earth mounds prevented the whole dry stone structure from being captured. c) Missing stone from the upper part of the structure enabled the top perspective view, which shows a spacious area within. d) The recognisable 'stone pyramid' shape of the lime kiln can be seen. (2021)

A 'Permission to construct a lime kiln' from 1925 tells the story of the inexorable bureaucracy that was to be followed in cases of the lime kiln construction. An individual from the Punta Križa environs wanting to construct one had to request it from the municipality of Mali Lošinj (at the time 'R. Sottoprefettura di Lussino'), who then forwarded the request to the town of Nerezine (*Comune di Neresine*). At the time, one had to walk from Punta Križa to Osor and Nerezine, and sometimes even all the way to Mali Lošinj (Galjanić 2019, 47) (Figure 105).



Figure 104. The remnants of a burnt lime kiln, Peščenji (2021)

N. 21
LUSIGNUOLA 31.1.1925
Risposta al foglio del N. _____
R. Sottoprefettura di Lussino
ELENCO delle carte che si trasmettono al Municipio - Neresino -

Numero delle carte	DESCRIZIONE DELLE CARTE Motivo per cui si trasmettono
1	<p>percesso per costruzione calchiera a Marussich Vario di Giovanni da Punta-croce</p> <p>per la compiacente consegna all'interessato.</p> <p>IL SOTTOSEPPETTO (CARTONI)</p> <p>MUNICIPIO DI NERESINO</p> <p>FEB. 4 FEB 1925 1925</p> <p>allegati</p>

101.60

Stampa: 8/4/25

Figure 105. Documentation of permission given to Mario Marušić (Marussich) of Punta Križa to construct a lime kiln (Veneto: calchiera) in 1925. From Ivo Rušin collection, published in *Puntarski fuoj* vol. 19 (2019, 46)

3.2.4.4. A dry stone oven (*pêc, pećnica, fornâž*)

Pećnica in its shape seems like a smaller version of a dry stone huts. It has been used for drying figs in case they were significantly affected by rain or if the natural drying in the sun in August was in any way impeded – for example, if too many of them were already ripe, leaving no place on the wooden boards (*bâras*)⁸⁸ or clearance walls for drying. This structure had to have a hole on the top to release extra smoke from the fire ignited from the inside. The figs were placed on its roof, which was flat and levelled by smaller stones (*gruh, žalnjaci*) and sand (Bortulin [1904–1907] 1949, 98). Normally, they would have to be heated for about two days.⁸⁹ These structures are recognisable by their openings, which were typically made of two large flat stones forming an inverted letter V. These structures have been registered in Tramuntana, in Vrana, and close to Lubenice and in the town of Cres olive grove (Figure 106).

a



b



Figure 106. A fig 'oven' a) close to Lubenice (2021) and b) in the Cres olive grove (© Loredana Velčić, 2020)

⁸⁸ A 'knitted' artifact of branches and wood, designated for the drying of fruits.

⁸⁹ I thank B.D. for the recollection.

3.2.5. Construction details

3.2.5.1. Capstones (*ōzubi*)

Ōzubi is the name for the ‘crowns’ of stones placed on top of double dry stone walls. They protrude towards the side which they are ‘defending from’; even though they are placed horizontally, they need not be made of flat stones, especially on the island of Cres, where such stones are rare. Their function is to prevent sheep from jumping over them between pastures or from the pasture or into the cultivated enclosure. They are also an indicator of the builders’ assumption of the dry stone wall’s longevity (Kulušić 2004b, 68).

On the island of Cres, *ozubi* are a common dry stonework element. One distinctive example is found west of Predošćica, on the massive dry stone walls which seem to delineate the border between the regions of Tramuntana and the town of Cres environs. Above this wall, two lines of capstones are placed, each of them angling towards their direction.⁹⁰

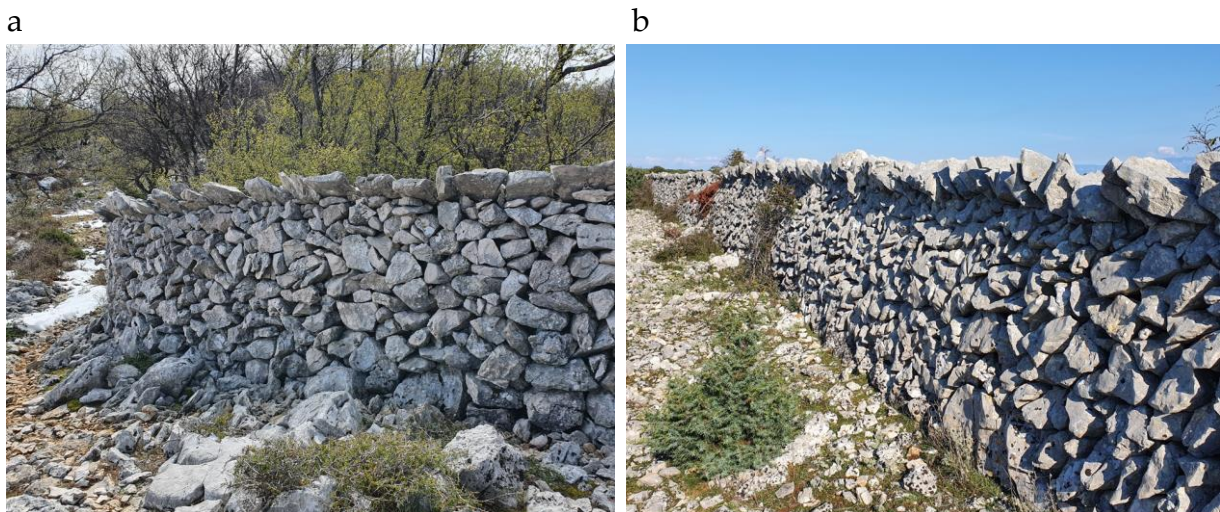


Figure 107. *Ozubi* on the double dry stone wall of a) a field enclosure (*dolac*) in Tramuntana (2021) and b) in the pastures between Ustrine and Belej (2020)

⁹⁰ According to E.B., this dry stone wall was built in the first half of the 20th century.

3.2.5.2. Lunky holes (*škùje, pasāji*)

Lunky holes are openings in dry stone walls, locally called *škùje*, which is a dialectal word for ‘hole’. They can be divided into two types, according to their size and function. The first and most common type is large lunky holes, approximately 50 cm wide and 60 cm of high.⁹¹ These were made to allow sheep to pass from one plot to another as part of the rotational grazing practice. They served as an alternative to common ‘doors’ (*lěsa, N sg*) of the enclosures. They differ according to their constructive details, for instance, their lintels are commonly large stones and sometimes wooden (Figure 108). When the passage is no longer in use, it is closed by stones (Figure 109) or branches. The construction of traditional wooden doors (*lěsi, Npl*) has been almost completely abandoned; therefore, it was interesting to notice one example of such a door made for the passage of sheep (Figure 110).

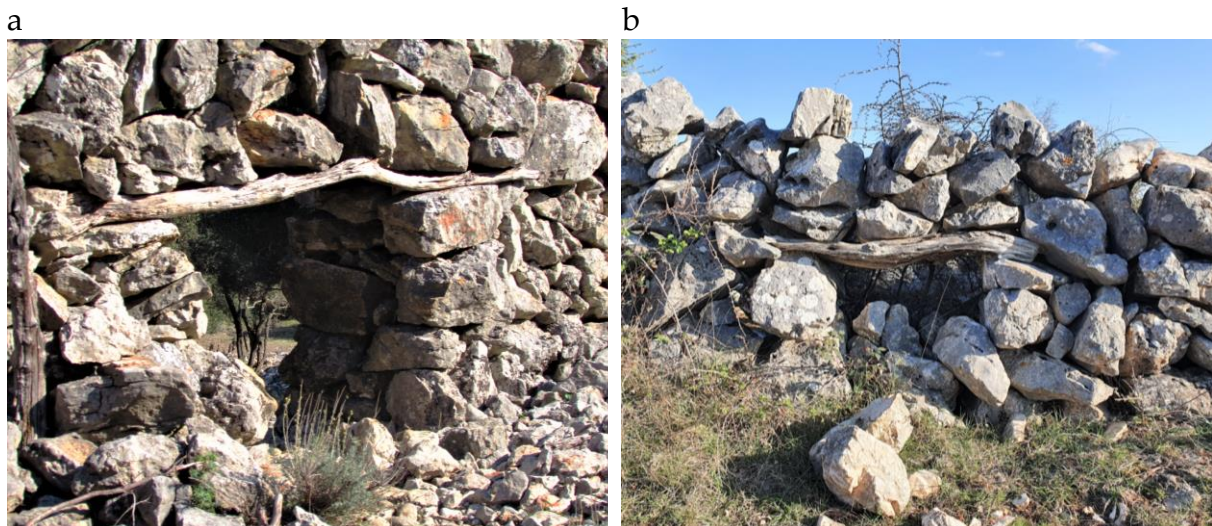


Figure 108. Lunky holes (*škùje*) covered with wooden lintels a) on the ‘Napoleon road’ north of the town of Cres (2017) and b) on the pathway to Zbišina (2021)

⁹¹ Jurkota Rebrović writes that the width was determined by the distance between the ram’s horns (2009, 8:48).

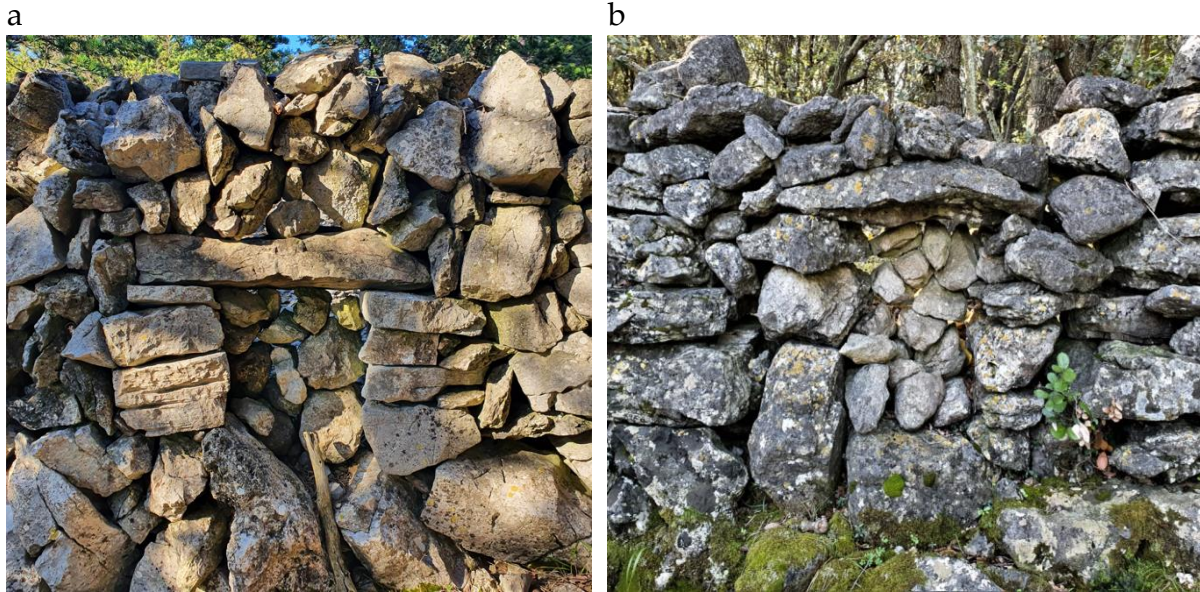


Figure 109. Lunky holes (*škùja*) closed with stones a) on the pathway between Germov and Miholaščica (2021) and b) between Halmac and Veli Tržić (2020)

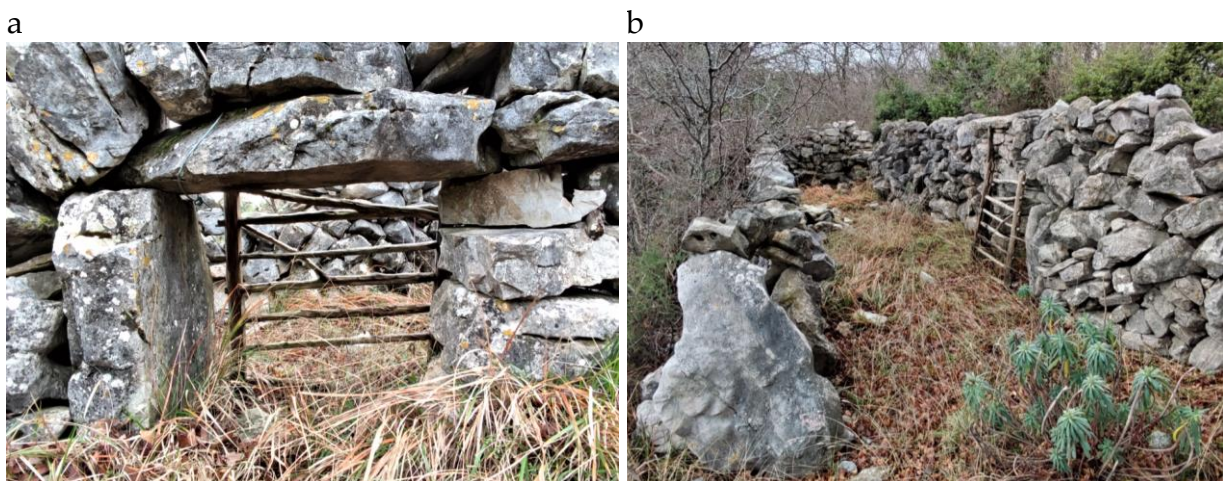


Figure 110. Lunky holes (*škuja*) of a sheepfold closed by a wooden door (*lesa*) in the area of Bagen (2021)

The second type, a smout hole, has smaller dimensions than the sheep passage – about 30–40 cm in height and 15–20 cm in width (Figure 111, Figure 112) and is sometimes referred to as *pasâji* or *pašâji za zece / za zâjci* (passage for hares). *Pasaji* means a passage, which does not accurately depict its function, as these ‘passages’ are intended to trap hares. On the other side of the wall, two types of traps are placed: a loop of a snare (*lâc*) or a large flat stone, one side of which is propped up with one or more sticks (*lâbur*); if a hare knocks down the sticks, it is crushed by the stone (Houtzagers 1985, 282).⁹²

⁹² See the whole story of catching hares in Houtzagers (1985, 194–95).

a



b



Figure 111. Smout holes ('pasaji za zece') a) close to Loze (2021) and b) in the Osor environs (2021)

a



b



Figure 112. Smout holes ('pasaji za zece') close to Hrasta (2021) and b) on Zgor Piskela (2021)

3.2.5.3 Border stones (*ōšuli*)

Considering that dry stone walling is not easy work and that marking the borders between agricultural land was of the utmost importance, additional solutions were needed, in the form of ‘bordering stones’ called *ōšuli*. In agricultural plots, *ōšul* made of flat stone would be placed one after the other and dug deep into the ground.⁹³ The other type is stone stacking (Figure 114). When gathering sheep on vast areas such as the common, shepherds would build a stack of a few stones to let other shepherds know where they had passed (Jurkota Rebrović 2009, 8:36–37).

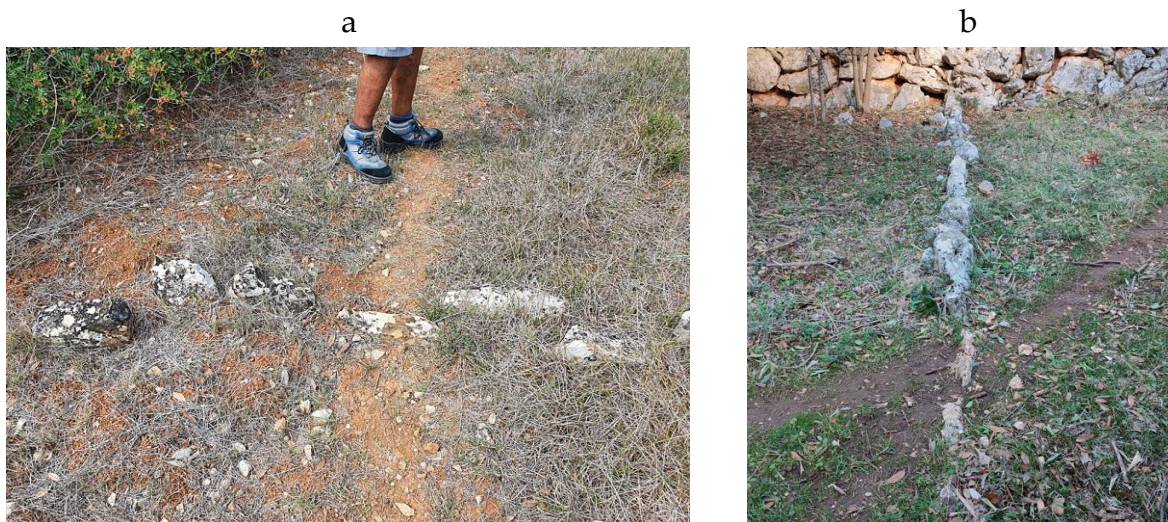


Figure 113. One type of bordering stones (*ōšuli*) on cultivated land a) close to Veli Lošinj (2020) and b) below Dragozetići (2021)

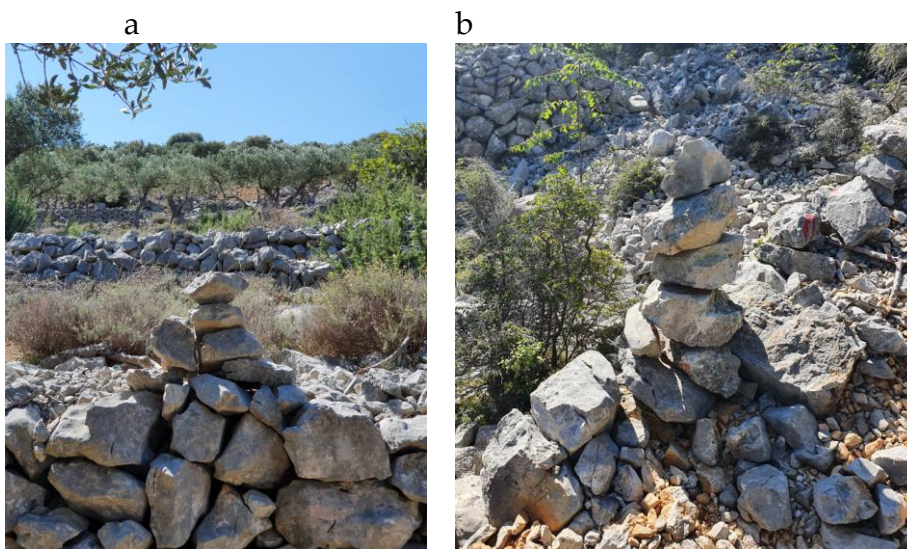


Figure 114. Bordering stones (*ōšuli*) in the environs of the Cres olive grove. Such stones were commonly used on pastoral landscapes but also on terraces. They are also a common way of marking a path for other shepherds or hunters. (2020)

⁹³ ‘If you kick it with your leg and it hurts, you know it’s an *ōšul*’. (D. B.)

It is not typical for two commons to be adjacent, like the ones of Ustrine and Belej. To mark the centre of a shared dry stone wall between these two commons - and thus to denote until which point shepherds are responsible for repairing the wall - another type of *osul* was utilised. The stone marking the central point is hardly recognisable today as it is underneath overgrowing shrubs. Nevertheless, the direction of the capstones (*ozubi*) above mark it – those pointing towards the common of Belej signal the Belej common users' duty to repair this part of the wall and vice versa for the capstones pointing towards the Ustrine common (Figure 115).⁹⁴



Figure 115. Different directions of the capstones above the dry stone wall separating the Ustrine and Belej commons mark the point up to which the shepherds of each common are responsible for its repairs (2020)

⁹⁴ I thank J.K. (+ 2021) for the information and guidance.

3.2.5.4. Stone stairs (*skalîni, stelbice*)

Stone stairs were constructed to facilitate crossing dry stone walls and entering agricultural parcels (Figure 116). They come in two major forms: as steps, or *skalîne* (Nikolić 2000, 167) and as *stelbice*, depending on where they are placed. *Skalini/skaline* are more common for terraced areas. Here their massive slabs can form the whole step. *Stelbice* (stile in English) are more commonly constructed in pastoral landscapes, though it is not a rule. They are constructed of two or three long and flat slabs, which are integrated into the dry stone wall on both sides (for free-standing walls) or just on one side (for retaining walls).



Figure 116. Forms of dry stone stairway access to agricultural parcels, in the environs of Stivan: a) and b) represent *skalini*; c) and d) represent *stalbice/stelbice* (2020).

3.2.5.5. Dry stone wall niches

Niches are built-in spaces inside of double dry stone walls or clearance walls. They were made as a sort of outdoor closet in which farmers could safely put their meals in case of bad weather or so that they do not need to carry their tools each time (Figure 117).



Figure 117. Niches for farmer's meals and tools a) in a plot close to Veli Lošinj, b) Gracišće, c)-d) Pregon (2020)

An uncommon 'niche' in the dry stone wall – a form of a hole in *barbakan* (Figure 118) – was made to lower the height of mules and facilitate placing the burden of the yield on it.⁹⁵

⁹⁵ I thank F.F. and F.C. for the information.

a



b



Figure 118. A niche in the barbakan used to lower the height of a mule and place a burden on its back (© Franko Fučić, 2021)

3.2.6. Semi-dry stone structures

3.2.6.1. Cisterns (*vaške*)

Most of these structures on fields are cemented, but their bases and outer rims are mostly made from stones. The outer rim served to increase the efficiency of rainwater collection. Its purpose was to collect and store rainwater, but it was also often used to prepare pesticides (a 'Bordeaux mixture', based on copper and slaked lime, which has been used since the 19th century to suppress downy mildew). Its name – *vaška*⁹⁶ – is derived from the Italian word '*vasca*' (tub). It is an indicator of vine growth, though it can be found in olive groves since some of the olive groves were planted where vineyards were cultivated and because olive trees were previously grown in consociation with vines.

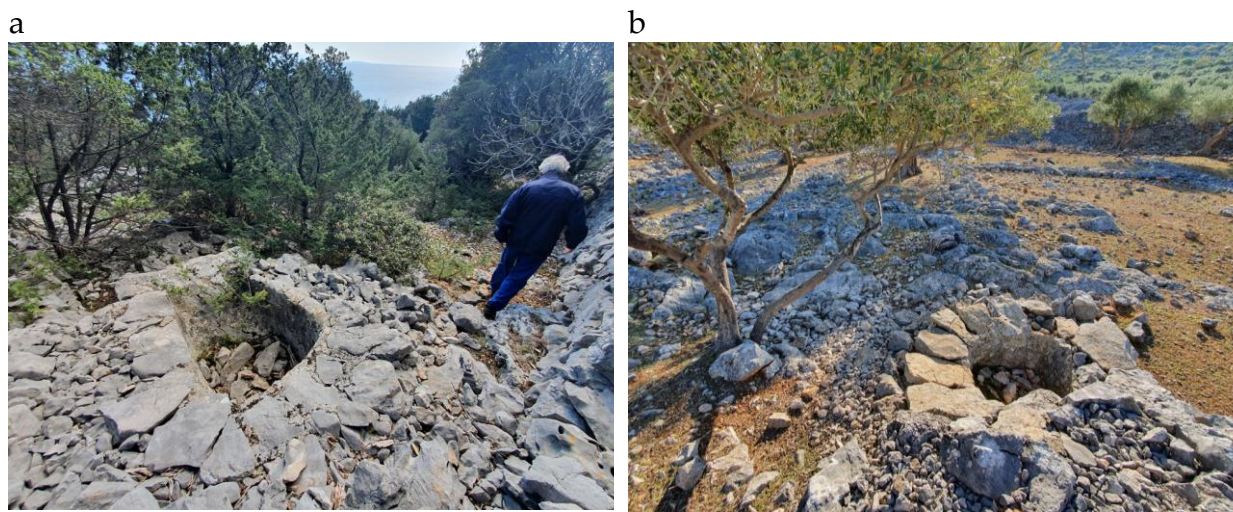


Figure 119. *Vaške* with rims of stone 'petals' a) in Lovreški (2021) b) in the Cres olive grove (2021)



Figure 120. *Vaške* in the vineyards came in pairs; the larger one was used to collect rainwater, and the smaller one was used for pesticide preparation (© Karla Glavočić, 2019)

⁹⁶ Pronunciation from Nikolić (2000, 183).

3.2.6.2. Threshing floors (*gvoṇṇà*)

Threshing floors are elevated semi-dry stone platforms for threshing (separating seeds from stems) cereals, locally called *gṽvo* (N sg, *gvoṇṇà* N pl).⁹⁷ They are enclosed by upright stone slabs and have a low entryway (which is closed during threshing) (Figure 122), at times occurring with a small ‘bulge’ for storing seeds (Figure 121). They are usually part of a settlement, village (Figure 125), or shepherds’ dwellings (Figure 123), erected on a neatly walled pile or placed in a location that is exposed to the wind. The most common ones have a circular ground plan, a central pillar, and an area for the use of animal labour. On rare occasions, threshing floors are rectangular (Figure 124), most probably for manual threshing. The base can be made of compacted earth or stone slabs. They are between three and seven meters in diameter, and their work surfaces are covered with packed clay or stone slabs (Frangeš et al. 2015a, 34).



Figure 121. One of two threshing floors outside of Ustrine, with a bulge (on the upper right) for storing separated seeds (2021)

⁹⁷ Pronunciation from Nikolić (2000, 126).

a



b



c



d



e



Figure 122. Different perspectives and constructive details of the threshing floor below the village of Stanić (2021)

a



b



Figure 123. Threshing floors – part of the shepherds' dwellings a) in Verin (2021) and b) in Zbišina (2020)

a



b



Figure 124. Threshing floors which are not of regular circular shape: a) a rectangular threshing floor in Predošćica (2021) and b) a half-rectangular, half-circular threshing floor in Vela Čarnika (2020)

a



b



Figure 125. An elevated threshing floor in Veli Tržić: a) a rim covered in stone slabs, with a staircase, b) in the foothills of Osorščica (in the back) (2020)

3.3. Discussion and conclusions

3.3.1. Dry stonework's place in the Cres-Lošinj archipelago and Croatian Adriatic

Dry stone walls and structures on the Cres-Lošinj archipelago have been, to a certain degree, presented in the local literature, as well as in the customs and habits which accompany them. However, this chapter has provided a conceptual framework from which a deeper appreciation of the various dry stone structures has been achieved, by observing their form, occurrence, diversity, regional variations, complexity, and their places in the broader regional context of the Croatian Adriatic. Field mapping is thus used as one possible tool for interpretation, reversing the perspective of this heritage as being 'hidden' or uninformative. Fieldwork results, which were based on field visits and conversations with local inhabitants, demonstrated that, in comparison to previous knowledge:

- there are significantly more types of dry stonework (e.g. dry stone canals, dry stone multicellular sheepfolds, dry stone ponds or wells)
- some of them appear in greater numbers (e.g. corbelled dry stone huts of round ground plan, multicellular sheepfolds),
- some of them exhibit higher complexity (e.g. multicellular sheepfolds)
- the island of Cres bears more similarities to the island of Krk than to the islands of Lošinj and Ilovik
- the islands Lošinj and Ilovik have very similar forms of dry stone walling, mostly comprising wide double dry stone walls which retain terraces and fields,
- greater insights into the details of construction is highly informative, as it conveys different stories on the customs, agreements, and aspects the inhabitants deemed important
- the most distinctive dry stone structures of the island of Cres, which are less common in the rest of the Croatian Adriatic, include:
 - ponds with the right to access water marked by the dry stone walls
 - multicellular sheepfolds
 - 'combined' dry stone walls (*piflo*, *pićohuanda* (local) or 'Galloway dyke' method of construction)

The island of Cres is more similar to the island of Krk than other islands, especially when comparing its stone huts (*komarde*),⁹⁸ multicellular sheepfolds, and *deriti*. Naturally, the differences between the dry stone walling of the islands of Cres and Lošinj-Ilovik are the

⁹⁸ For examples of the island of Krk dry stone huts – *komarde*, see Horvatić (1999; 2000b).

result of different economic choices. The island of Cres remained more closely related to sheep husbandry than the islands of Lošinj and Ilovik. Furthermore, the similarities between the Veli Lošinj environs and the island of Ilovik regarding the dry stone walling is ascribable to builders from the same town – most of the Ilovik population were immigrants from Veli Lošinj. This is the only area which uses a different name for dry stone walls (i.e. *mocire*, a name of Dalmatian origin) as a result of emigration from the islands of Pag and Rab and from the Zadar environs.

The dry stone structures listed and described in this chapter do not bear a unique nomenclature. Ascribed names have been transferred from ‘urban’ and daily life usage to the rural context. For example, the narrow town streets and dry stone wall-lined pathways bear the same name (*klanci*); a bathtub or a vase share the same as cisterns in the field (*vaške*); the fortified outpost of a town wall shares the name of a retaining wall of an agricultural terrace (*barbakani*); *unjulo* in addition to a dry stone wall, refers to a candle; *duplica* in addition to a dry stone wall means ‘double’ (Houtzagers 1985, 236, 385–86). It is particularly interesting in the case of dry stone huts. Both types of huts of the Cres and Lošinj archipelago bear the name *kućica*, which is merely a diminutive form of ‘house’ (*kuća*). In Dalmatia, there are many names used for a ‘dry stone hut’ which do not seem to have any etymological connection to a house (e.g. *bunja*, *čemer*, *jama*, *poljarica*, *trim*, *komarda*, *trin*, *toreta*, *ortujak*).⁹⁹

3.3.2. Dry stone huts

In the case of the dry stone field huts, attention was given to those built entirely in dry stonework, roofed with a corbelled dome, and that have a round ground plan. This research direction arose after the notion of their regular occurrence in other areas of the Croatian Adriatic, while lacking on the Cres-Lošinj archipelago. These corbelled huts are found to be more prevalent than initially registered and commonly thought. In form and shape, they are not similar to the ones from Istria or Dalmatia but, as mentioned above, are similar to those from the island of Krk. Differences with the huts from Istria are attributed to differences in lithology and stone – the Cres-Lošinj archipelago has very scarce stone slabs, whereas in Istria, most of the huts are built from them. It is hard to pinpoint the differences with the Dalmatian style of construction, whose huts and lime kilns are noticeably more aggrandized and elaborated but can be attributed to the differences in lithological bedrock and the craftsmanship of the local builders.

⁹⁹ Several of them do – *kućarica*, *kućerica*, *kujica*.

Since most of the huts were found in the outer parts of the Cres olive grove and in the region between Kruščica and the *Lovreški dol* area, they could be associated with the viticulture of the last 150 years, related either to the vine conjuncture at the end of the 19th century or post-conjuncture planting and clearing in the first half of the 20th century. In the area of the island of Lošinj, according to conversations with the informants and field visits, they typically have a square ground plan and a mono-pitched roof. None were found during the three-day field visit on the island of Ilovik.¹⁰⁰

3.3.3. Multicellular sheepfolds

The complexity, occurrence, and description of the archipelago's multicellular sheepfolds were presented as part of a systematic study for the first time. Many multicellular ones have been presented within this work, but more of them are known to exist (particularly in Tramuntana). Most of the registered sheepfolds are larger than 500 m². Except for the one in *Jedro*, all of them are in a good state of preservation. However, abandonment is evident from the vegetation cover and the lack of recollection in the communities.

A comparison with the island of Krk shows variety in construction. On the island of Cres, not all communal sheepfolds are multicellular – e.g. the commons of Belej, Stivan, Garmožaj have large, one-cell sheepfolds. They are more often built with double dry stone walls, and they do not follow the recognisable flower-shaped form.

By reviewing 11 prominent multicellular sheepfolds on Cres-Lošinj and evaluating the available criteria, five of them were singled out as the most suitable for renovation or presentation to the public. Despite a low total score, the sheepfold of *Veli Tržić* was included for the sake of its rarity and placement near the well-marked tourist and mountaineering area of Osorščica hill.

1. Multicellular sheepfold of *Mihojski* (5)
2. Multicellular sheepfold of Ustrine – new (4.6)
3. Multicellular sheepfold of *Dražica* (4.5)
4. Multicellular sheepfold of Ustrine – old (4.4)
5. Multicellular sheepfold of *Veli Tržić (Ograja)* (3.4)

¹⁰⁰ None of them were found on the island of Unije, but this can be attributed to the insufficient number of days spent on the island; therefore, the data is not considered representative.

The evaluation criteria can be modified depending on spatial changes and new research. For example, 'accessibility' and 'potential cooperation' are subject to change, 'aesthetical value' may be subjective, and the weight given to the criteria may vary (e.g. if there is no willingness in the field to preserve the structure, do the other criteria matter?). The 'historical significance' criterion was subsequently excluded since age, as a criterion, is still considered a matter of debate – is something that is extremely old more valuable than more recent achievements, the ones that the population feels connected to and can relate to?

Secondly, it is difficult to determine the time of sheepfolds' construction prior to 1953. The Austrian Empire Cadastre, one of the most valuable historical cartographic sources for this area, does not register these structures as a separate category. The chronology of the internal sheepfold partitions can only be traced by looking at orthophotos and maps from 1953 (DOF68), 1979–86–88 (HOK) and the 21st century (DOF2011 - 2020).

Research from neighbouring islands could not date these structures as more than 100 (Horvatić 2000:97–98) or 170 years old (Kale 2012:259). In England, a review of historical maps and currently available photographs yields similar conclusions. That is, the number of sheepfolds increased, and they were additionally enclosed in the late 19th and early 20th centuries. It can be assumed that on Cres, the older sheepfolds belong to shepherds' dwellings, while the sheepfolds on the commons could be younger, built only after the population increased during the 19th century.

3.3.4. The question of the aesthetics of dry stone walls

Dry stone structures differ in their constructive details, form, and/or structure, even if of the same — from multicellular sheepfolds to dry stone huts. These variations, which can occur even within a very small area, emphasize the role of the individual builder in its final formation. It brings up the question of the intended or unintended consideration of this vernacular architecture's aesthetic.

Purposefulness is generally advocated as the primary consideration in vernacular construction (Živković 2013, 22); meanwhile, aesthetics are thought of as merely a by-product of extreme pragmatism and the necessity to position every stone carefully for safety and sustainability. J. Kremenić (n.a.) and the authors of the texts on the educational tables of the touristic paths claim that the Cres *kopaci*¹⁰¹ paid additional

¹⁰¹ *Kopac* is a name given to the farmers from the town of Cres who by digging (*kopati*) transformed the rocky terrain into an agricultural terraced area.

attention to the aesthetic component when transforming the terrain. When observing the structures, their details, and their outlook, either from an aerial perspective or on the ground, these assumptions about the 'intended beauty' become understandable. Freudenreich, who also claims that purpose produced vernacular architecture, describes how '[e]very detail of the traditional architecture of the work of human hands is placed in a sumptuous frame of nature: unobtrusive, harmonious and measured, and evokes the impression that they have emerged directly from it' (Freudenreich 1972, 247). Many people have been inspired by the scenes of dry stone wall forms, and it is one of the reasons for the popularity of the multicellular sheepfolds of the island of Krk. A considerable amount of artistic creativity is stimulated by the visual component of dry stone wall construction. It is evident in the artistic oeuvre of academic painter Oton Gliha, who uses dry stone walls as his main motive (*Exhibition Oton Gliha - Gromače* 2014); and in the words of art historian Branko Fučić, who compares dry stone walls with fine art: 'dry stone walls are human plans and blueprints drawn not on paper, but on the face of the earth' (Fučić 1998). The attribution of aesthetic value is more common among non-locals than the inhabitants of the area, who often perceive their traditional landscape as a production zone, or something taken for granted. Therefore, we should strive to redefine these spaces as 'intermediate landscapes' (Varotto 2008, 114), which represent a reconciliation zone between the seeming dichotomy of the natural and the human world, as well as the world of utilitarianism and aesthetics.

3.3.5. Suggestions for further research

Descriptions and assessments of the dry stonework vary in its approach, content, and volume based on the available information and the aspect which drew particular attention. Therefore, certain dry stone structures should be a part of a more comprehensive research effort, continuing the ethnographic approach comprising a larger group of informants and more extensive fieldwork. In addition to focusing on the local inhabitants who fully use the territory, such as shepherds, hunters, foresters and hikers, the interviews should consider people who have emigrated as well. The memories and attachment of emigrants and their heirs provide a clear picture of the locations, structures, as well as a pure archaic local dialect.

Other proposed research directions are as follows:

- Remaining lime kilns should be located, and their architectural features should be assessed to enable comparisons of the construction techniques used to build them. This will also enable correlations to be made with the geological bedrock, as done in the work of Faričić and Juran (2021).

- The architectural features of the dry stone huts should be measured and described following the work of Juvanec (Horvatić and Juvanec 2002; Juvanec 2009).
- Dry stone canals should be mapped and used as part of a broader study to understand whether they were part of collective systems or private initiatives.
- Dry stone wall landscapes should be classified for the entire archipelago area, revising the work done by Frangeš et al. (2015a) by the inclusion of the dry stone wall pattern as done in Andlar, Šrajer & Trojanović (2017; 2018). Such a study should be enriched with landscape evaluations so that the most representative landscapes and patterns can be determined.

CHAPTER 4

MAPPING THE DRY STONE WALLS OF THE CRES-LOŠINJ ARCHIPELAGO

4.1. National and international mapping and inventory experiences

International experiences in the inventory and evaluation of dry stone wall construction are mostly estimations and lack comprehensiveness. However, they are gaining momentum and are valuable, as they provide a range of approaches and classifications. Advanced achievements can be found in the inventories from Great Britain. Mapping the dry stone walls in Great Britain was part of the Countryside Survey – a larger project of national estimates of the changes in land, soils, and habitats based on measurements made in a sample of 1-km squares across each country in Great Britain (Wood 2011, 3). In it, ‘stone walls’ were recorded as part of the linear habitats, among hedgerows and woody linear features. Mostly, traditional dry stone wall construction was recorded, but the measurements also included mortared walls (Carey et al. 2008, 51–53). Additionally, inventories can be made by anyone who wants to conduct a local survey of the dry stone walls by filling the Dry Stone Walling Association (DSWA) leaflet (Carey et al. 2008).

Publicly available interactive web-GIS maps of dry stone structure localities include Catalonia, Andorra and Croatia. Catalan Observatory Landscape *Wikipedra* and its data are accessible via the WFS service, which is currently the most comprehensive inventory of dry stone buildings with more than 20,000 entries.¹⁰² Andorra’s website *Primera Pedra*¹⁰³ have divided its entries into five categories: ‘pastoral structures’, ‘agricultural’, ‘hydraulic’, ‘industrial’, and ‘other’. Despite its technical deficiencies, Croatian’s

¹⁰² Wikipedra. n.d. *Observatori del Paisatge*. Accessed: February 03, 2021. <http://wikipedra.catpaisatge.net/>.

¹⁰³ Pedra seca, un patrimoni per descobrir. Primerapedra. 2018. *CAL PAL. Govern d’Andorra*. Accessed: February 04, 2021. <https://www.primerapedra.com/>.

platform *Suhozid.hr*¹⁰⁴ is a database with 2,000-3,000 different entries and can provide as a good source of knowledge on the diversity of the dry stone heritage. As Andorra's platform, it functions as an app, facilitating participant mapping.

In order to render more concrete the implementation of the part of the Good Agricultural and Environmental Condition that protects dry stone walls (GAEC No 13), a study was done on their historical and landscape importance (Land Use Consultants and with AC Archaeology 2007). For the same purpose, measurements of the main technical-construction parameters of dry stone walls were also taken in Tuscany (Italy) for the 18 most intensely terraced sites (Agnoletti et al. 2015). This analysis also provides guidelines for the assessments of the overall state of conservation of walls. Within an international EU project led by Council de Mallorca (with 10 Mediterranean partners, such as Italy, France, and Croatia), a model was developed that included a cataloguing of terraced sites, with two tables/catalogue forms.¹⁰⁵

Several Croatian areas have been mapped within separate initiatives or projects, including the following islands, islets and regions:

- island Žut – 14.83 km² (mapped by S. Krtak, URBING Ltd, 2014),
- island Kornat – 322.95 km of walls on 32.44 km² (mapped by L. Mihelčić, NP Kornati, 2015),
- island Ba(v)ljenac – 0.14 km² (mapped by M. Sabelja, Suhozid.hr, 2016),
- peninsula Srima ≈ 30 km² (mapped by M. Sabelja and R. Škugor by supplementing the 'built barriers' layer, Suhozid.hr, 2018)
- southern part of the island of Krk – 497 km of walls on an 85-km² area (mapped by M. Sabelja by modifying and adding to the 'built barriers' layer, Suhozid.hr, 2018) (Šrajer 2019, 34)
- Krka National Park,¹⁰⁶
- parts of the Konavle region (Trojanović 2017),
- Modrave region (Andlar et al. 2020),
- town of Cres environs (School of Landscape architecture, Faculty of Agriculture 2016).

¹⁰⁴ Suhozid.hr, 2013. Accessed: May 24, 2020. <https://suhozid.giscloud.com/>.

¹⁰⁵ Publications from this INTERREG III project 'REPS: Réseau Européen de la Pierre Sèche' (2003–2006) can be found at <https://caminsdepedra.conselldemallorca.cat/en/dry-stone-work> (Accessed: 19 Apr 2019).

¹⁰⁶ In the National Park 'Krka' Atlas (Andlar 2022), which is in process of publication.

There are a few official state vector layers that partially include the dry stone walls of Croatia. These are the vector layers of the State Geodetic Administration ('built barriers' of the CROTIS 2.0 database and cadastral parcel perimeter layer) and of the Agency for Payments in Agriculture, Fisheries and Rural Development (ARKOD) entries.

The first mapping of the dry stone walls on the island of Cres was made by students of landscape architecture (Faculty of Agriculture, University of Zagreb) as a follow-up to a Landscape study of the island of Cres (Andlar et al. 2015). Here, the mapping involved the vectorisation of different structures of different geometries: clearance walls as polygons, retaining and free-standing walls as polylines and dry stone huts as points (Figure 131). Dry stone huts were inserted based on field identification.

Dry stone wall landscapes have been largely inventoried in international studies within the category of the terraced landscapes. The typology of terraces was presented by Grove and Rackham (Grove and Rackham 2001), who classified Mediterranean terraces on the basis of their construction and structural characteristics into step terraces, pocket terraces, braided terraces, check-dam terraces and terraced fields. Within the transnational project which aimed to research terraced landscapes in the Alps region ALPTER (2008), a typology of terraces was proposed, and the nomenclature was mostly drawn from Italian experiences, such as balk (Italian *ciglioni*), fanlight (Italian *lunette*), step (Italian *gradoni*), terrace and terrace construction (Scaramellini 2008, 11). Countryman (2012) implemented a survey designed to assess the spatial distribution of agricultural terraces in the archaeological landscape of Monte Pallano (Italy) to describe major patterns of form, construction style and degradation. Other Italian experiences include the inventory of Sicilian terraces (Barbera and Cullotta 2012) and other registers within the Italian Historical Rural Landscapes (Agnoletti 2013).

Varotto and Ferrarese (2008), following the work by Scaramellini (2005, 126), proposed the preliminary qualitative terraces division. Within the research Terraced Landscapes in Slovenia as Cultural Values (2011–2015) project, Slovenian authors produced an inventory of terraced landscapes on the level of the entire country, which was characterised by construction techniques, purpose, metrics, biophysical features, and the history of terracing (Ažman Momirski 2019; Drago and Perko 2017; Ažman Momirski and Kladnik 2009; Šmid Hribar et al. 2017). The first classification of the enclosed and terraced landscapes in the Croatian Adriatic was proposed by Andlar, Šrajer and Trojanović (Andlar, Šrajer, and Trojanović 2017; 2018). The first Croatian typologies of the dry stone walls was given by Kulušić (2004b; 2004a). The other important typology is from Gams (1991). Finally, Šrajer proposed the most significant methodological step by creating a sophisticated universal dry stone wall inventory model. He combined classifications from Gams and Kulušić while adding hierarchy and complexity. This

model will be largely followed and referenced throughout this study, as his levels of inventory correspond to the inventories presented in chapters 3, 4 and partially in chapter 5.

4.2. Issues with the reliability of the existent cartographic data

Literature on rural landscapes and dry stone structures in Croatia is substantial and provides a good groundwork for further research; however, many authors discuss dry stone walls mainly in a descriptive manner. Cartographic data regarding these manmade works are either inaccurate or devoid of typological consistency. National maps feature only a part of the existing walls. The numbers referring to the total lengths of walls are generally underestimates and are not always substantiated by detailed investigations. The classifications are often associated with borders or other linear structures in general, including fencing and boundary walls. Their identification relies on retrieving historical maps and data. Currently, the best resources for the dry stone walls are the Croatian Base Map, digital orthophotos from before 1968, digital orthophoto from 2011, and the official vector layer.

4.2.1. The Croatian Base Map (HOK)

The Croatian Base Map (HOK) covers a large share of the dry stone walls due to the time when they were published (1979, 1986 and 1988), when the canopy was still not as prevalent. HOK marks the dry stone walls with designated symbology, usually with a line and three circles. The symbology is different for other types of walls. For example, retaining walls are marked with an additional thicker line, clearance walls are marked as polygons (whose perimeter is marked with smaller dots and its inner area is marked with four irregular circular shapes). Walls which are jointly owned are marked by the three circles alternating their position on both sides of the wall (Figure 126). An important limitation is that Croatian Base Map is analogue – made in a raster format – which impedes quantification and spatial analysis.¹⁰⁷

¹⁰⁷ A methodology for the digitalisation of these maps was developed by the Croatian State Geodetic Administration as a part of the Croatian – Norwegian geoinformation project (Landek et al. 2004), but it was never completed.

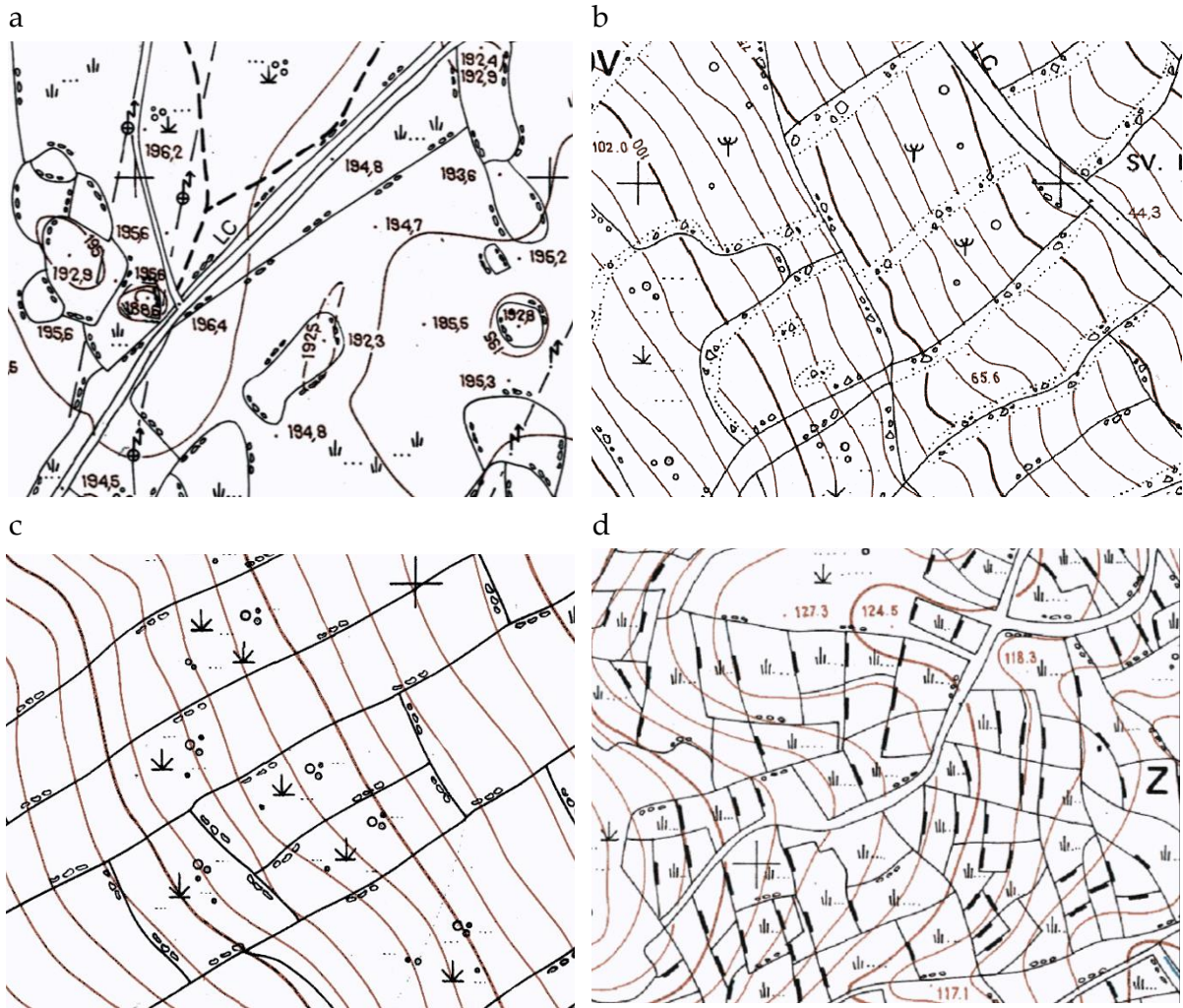


Figure 126. Dry stone structures symbology as presented in the Croatian Base Maps (HOK): a) three circles mark a dry stone wall, b) clearance walls (the area of which is mapped as polygon while the perimeter is marked with smaller dots), c) the walls which are jointly owned (marked by the three circles alternating their position on both sides of the wall) and d) retaining walls marked with filled rectangles (*‘Zbirka kartografskih znakova mjerila od 1:500 do 1:25 000 (Pravilnik o kartografskim znakovima ‘Narodne novine’)* 2020, 27, 108).

4.2.2. 'Built barriers' – CROTIS 2.0

Vector layers containing dry stone walls are part of the new topographic system (CROTIS, Croatian Topographic Information System) introduced by the State Geodetic Administration (updated in 2014). They can be retrieved from their geoportal, under the name '*Izgrađene barijere*' (built barriers). Built barriers fall under the category of human-made structures that represent a physical barrier, such as embankments, walls, noise barriers and aqueducts. The category of 'walls' is further divided into free standing (or retaining) walls and dry stone walls. Their inclusion in the vector layer is specified as follows:

'The walls can be free standing or retaining walls and dry stone walls. Free standing walls of a height smaller than 2 m or of a width smaller than 0.5 m are not represented, as well as walls which have no importance. Dry stone walls that have the functional importance of exploiting a particular area must be displayed. Retaining dry stone walls are displayed if they are equal to or higher than 3 m. If they meet the above mentioned criteria of height and width or have a minimum length in accordance with Table 7, the walls are displayed by one line' (DGU 2014, 41).

Based on the layer provisions specified above, the meaning behind the 'functional importance' of the dry stone walls is not precisely explained. From the cartographic visuals, it can be noted that the included dry stone walls do not have a functional role. Their placement is irregular and dependent on the vegetation cover. Furthermore, the road retaining dry stone structures are not recorded in this layer.

Two case studies on the Cres-Lošinj archipelago were considered to compare the coverage of the dry stone walls between vectorisation employed in this study and other official cartographic data: the Croatian base map and 'built barrier' layers (Figure 127, Figure 128). The first case study was chosen as representative of the terraced agricultural landscapes (mostly overgrown with vegetation), and the second was considered as representative of pasture areas (mostly without a canopy).

The terraced area example occupies a total area of 74.53 ha, on which 57,653.51 m of dry stone walls were mapped based on DOF53 vectorisation. The 'built barrier' layer for the same area counts 6,957.18 m of dry stone walls (only 12%). From the HOK86, 31,216.99 m (54%) were vectorised on the same surface. Pasture area occupies 548.94 ha, on which 59,619.15 m of dry walls were mapped based on DOF53 vectorisation. The 'built barriers' layer accounted for 40,439.23 m (71%), while the vectorisation based on HOK79 resulted in 56,789.53 m (95%) of dry stone walls (Table 12). A similar outcome was estimated for other areas in the Croatian Adriatic (Šrajer 2019, 31).

The results show that both cartographic data do not include a complete stock of the dry stone walls, even though HOK measures sufficiently in the case of the pastures. On the other hand, 'built barriers' demonstrated particular insufficiency for the dry stone wall landscape.

Table 12. Comparison of the coverage of the dry stone walls between vectorisation of DOF53 employed in this study and other official cartographic data: Croatian base map and 'built barrier' layers (Michela Trevisan and Tanja Kremenčić)

	Case study 1: terraced area	Case study 2: pasture area
Area (ha)	74.53	548.94
Length of the DSW vectorised from DOF53 (m)	57,653.51	59,619.15
Length of the DSW in the 'built barriers' layer (m)	6,957.18	31,216.99
Percentage of the DSW 'Built barriers'/DOF53 (%)	12	54
Length of the DSW vectorized from HOK (m)	40,439.23	56,789.53
Percentage of the DSW HOK/DOF53 (%)	71	95

These case studies could be used for the sampling methods for estimating the full length of the dry stone walls if the comprehensive vectorisation of the DOF68 is not possible. In that case, it would be necessary to include several other case study areas of heterogenous features, like the terraced areas without a canopy (e.g. the olive grove surrounding the town of Cres) and overgrown pastures (e.g. *Punta Križa, Tramuntana, Gerbin*).

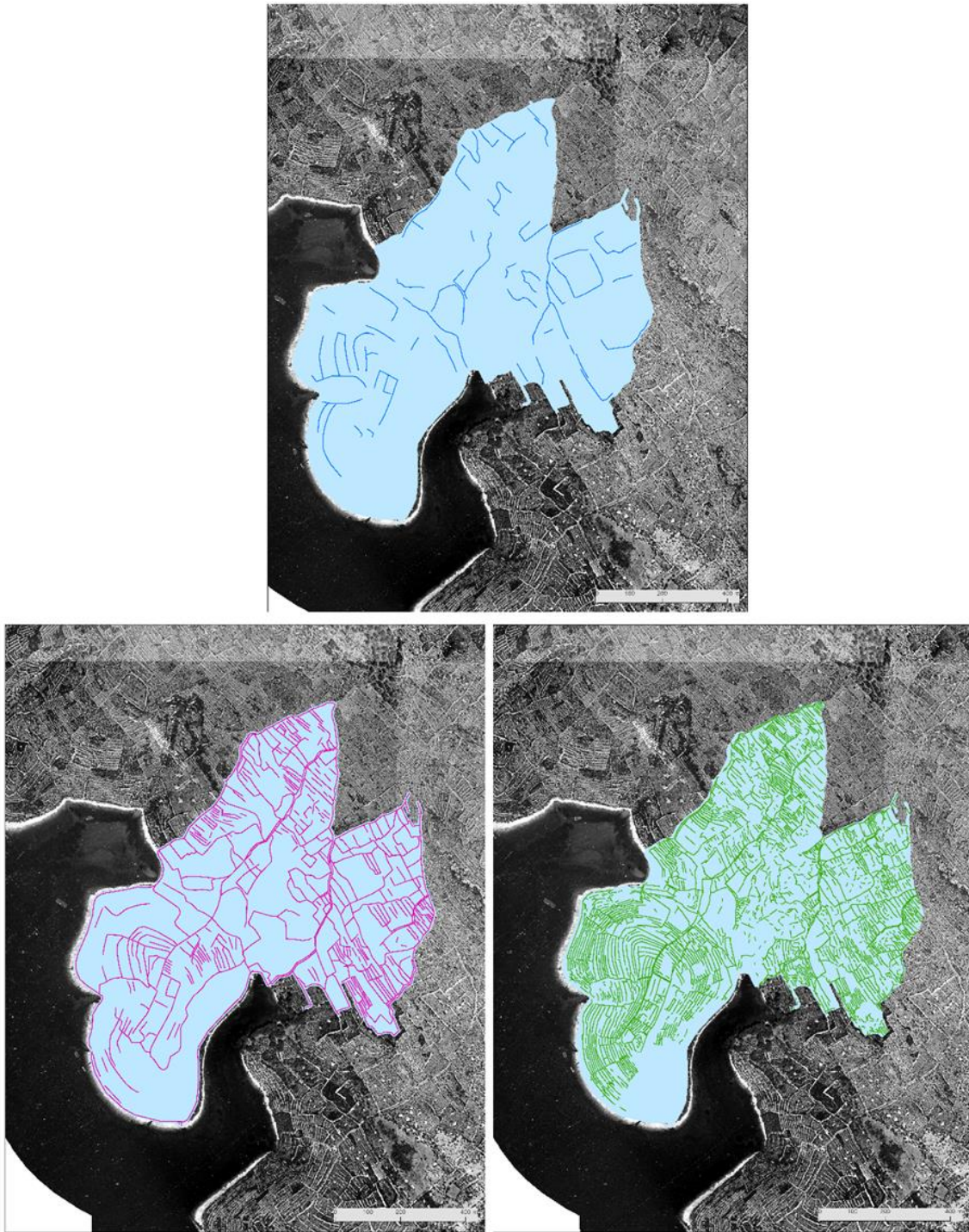


Figure 127. Example of the coverage of the previous cartographic layers in an agricultural terraced area on the island of Lošinj (between Krivica and Sunfarni bays): a comparison between the extension of dry stone structures present in the official cartography ("Crotis") (top), those present in HOK (lower left) and those mapped within this study (bottom left) (Trevisan 2021, 66).

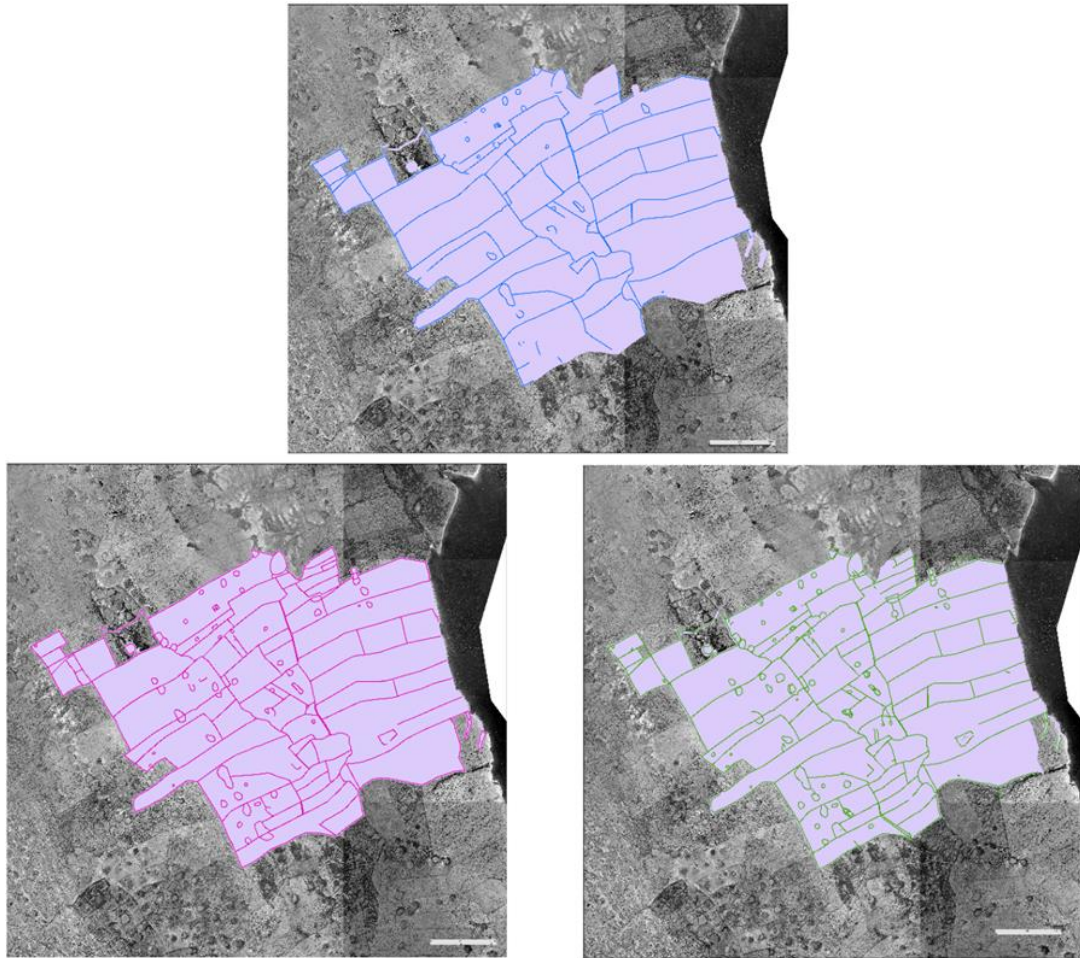


Figure 128. Example of the dry stone wall coverage of the available cartographic data for a pastoral area (on the island of Cres between Vručica e Prestanić bays): a comparison between the extension of dry stone structures present in the official cartography (“Crotis”) (top), those present in HOK (lower left) and those mapped within this study (bottom left) (Trevisan 2021, 67).

4.2.3. Digital orthophotography after 2011

The increasing availability of the satellite and aerial imagery does not translate to an increased availability of data sources for the dry stone structures, as they are progressively being abandoned and covered with a canopy. Mostly, for the purposes of agricultural production monitoring and subventions, regular and often aerophotogrammetric documentations are being employed increasingly often, resulting in the availability of DOFs from 2011, 2014/2016, 2017/2018 and 2019/2020 for the territory of Croatia. DOFs from after 2011 are useful for updating and revising the current stock (built after 1953)¹⁰⁸ by excluding those that have recently been overridden by new constructions (normally housing, parking lots, or new roads, retrievable from the spatial planning documentation).

¹⁰⁸ See the case of *Pere* in chapter 5 – Dry stone wall patterns and the underlying historical processes.

4.2.4. ARKOD layer

The layer of dry stone walls registered for aid from the Agency for Payments in Agriculture, Fisheries and Rural Development is visible under the category of 'Landscape features' (*Obilježja krajobraza*).²² Inputs for the dry stone walls are not representative of their occurrence but of the farms of families who registered them for subventions. They are quite rare, fragmented and interrupted entries, and can be registered as the landscape characteristics, as polygonal structures (clearance walls) and as linear structures. Naturally, the data of the ARKOD layer are not indicative of the occurrence and distribution of the dry stone walls but of (registered) agricultural activity and dry stone wall maintenance.



Figure 129. The comparison of the dry stone walls registered for subventions in the ARKOD registry (marked in red) and visible dry stone walls (of the DOF2011 base layer) in the area of the town of Cres olive grove: a) The registered dry stone walls are marked in red; b) registered dry stone walls in comparison with the cadastral parcels (marked in yellow) (DOF11, ARKOD)

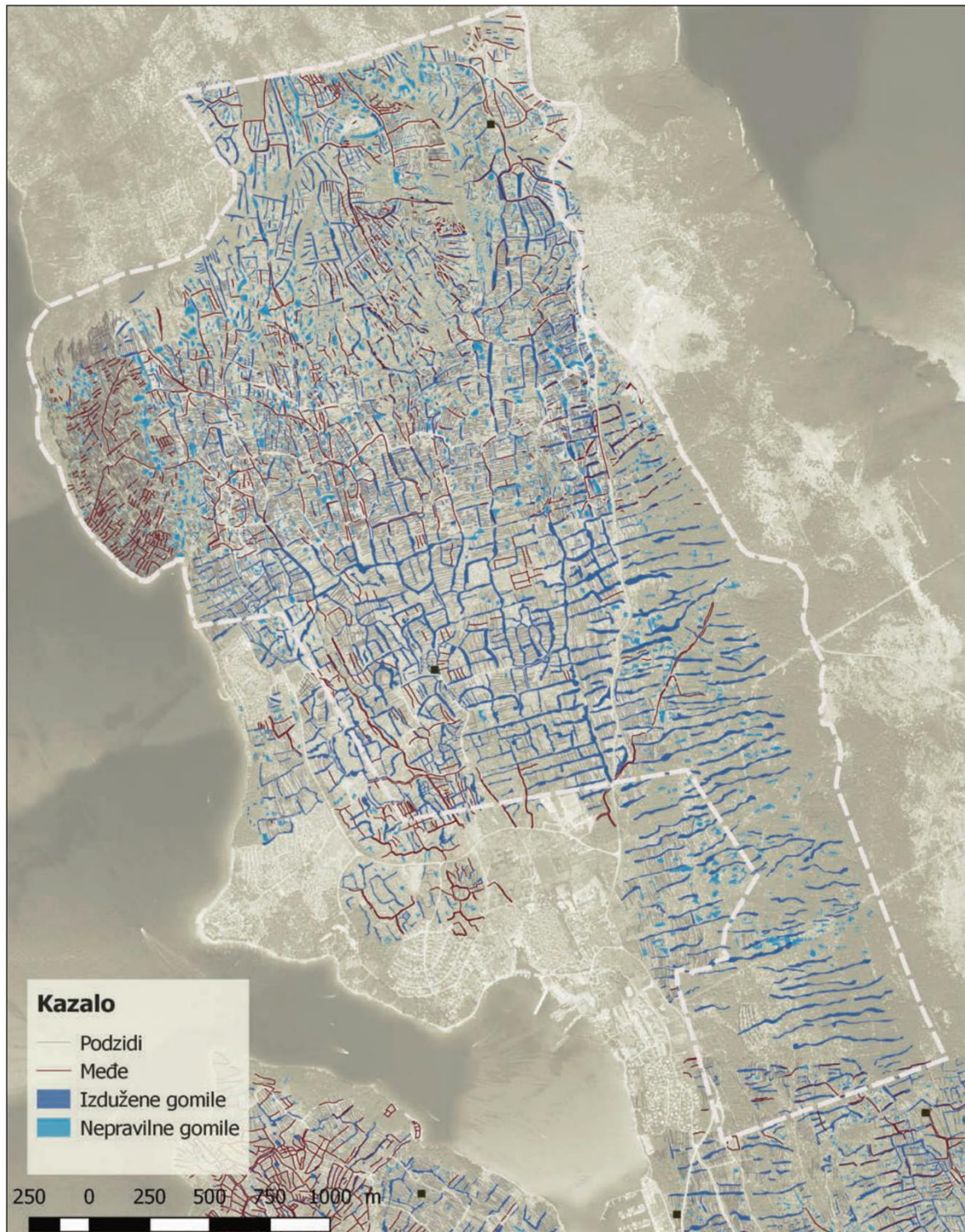


Figure 131. The vectorisation done by students from the School of Landscape Architecture, Faculty of Agriculture, University of Zagreb, who mapped dry stone structures around the town of Cres as part of a semestral course in 2015. In addition to the dry stone walls ('međe' on the legend), clearance walls ('gomile') were mapped as polygons and divided into two types ('izdužene' elongated and 'nepravilne' irregular); retaining walls ('podzidi') were part of a separate typology.

4.3. Testing the mapping methodologies

While chapter 3 focused on mapping individual dry stone structures and buildings (largely based on fieldwork), chapter 4 proceeds to describe the technical work of the vectorisation of the linear features in GIS, recording in detail the spatial distribution of dry stone walls and creating thematic maps. The aim was to establish a full database of the dry stone walls covering the entire research area of the Cres-Lošinj archipelago based on the above mentioned Croatian and international experiences. Vectorised raw data were part of the subsequent several quantitative analyses, and the results were discussed and compared with those of other areas. Finally, the relevance of such mapping and the importance of this data were discussed. The research and work included the following topics:

1. Obtaining the relevant cartographic data
2. Digitalising (vectorising) the dry stone walls
3. Attributing wall typology to the mapping (two sub-study areas)
4. Analysing in the GIS environment to determine the quantification and density of the dry stone walls
5. Analysing the GIS environment to determine the prevalence and distribution of the dry stone walls in relation to the surface of the island

4.3.1. Vectorisation

In this chapter, the term vectorisation includes manual digitisation of the dry stone walls, i.e. transferring walls as lines from raster to vector data in GIS software (ArcGIS by ESRI and QGIS). Vectorisation was done based on digital orthophotos interpretation, primarily using orthophotos from 1953, zooming the data to scales of 1:600–1:1000. The technical process took seven to eight months, with another two to three months required for revisions. This part of the research was enabled by the extensive work of digitisation employed by Michela Trevisan, who produced a base vector layer for each of the potential dry stone walls.¹⁰⁹ This work was supervised and subsequently revised by the author of this thesis.

¹⁰⁹ Her work included other spatial analyses utilising the raw data, some of which will be presented in this chapter.

Since the DOF53 are monochromes of slightly lower resolution than the newer digital orthophoto imagery, linear structures in white – corresponding to the dry stone walls – occasionally presented some ambiguity between walls, paths and ravines. In these cases, comparisons with HOK maps, recent DOFs from 2011 and Google Earth images were effective. HOK was utilised as a comparative layer to differentiate walls with pathways and ravines based on its symbology. DOFs from after 2011 were used to update and revise the current stock of the walls by including those built after 1953 and by excluding those recently overridden by new constructions. The verification of the existence of certain walls also included the use of Google Street View (Trevisan 2021, 44).

Further verification of the structures included fieldwork. Additional site visits were carried out to verify the initial assumptions about the dry stone wall location. One important example was the mapping of the island of Ilovik. Due to its regular patterns of dry stone wall terraces and the parallel extension of the dry stone walls, it was assumed that the same direction continues beneath the canopy. Field visits in 2018 and an investigation of the island's history confirmed the absence of the walls beneath, which required a revision of the previous mapping. Another example is the long-time degraded enclosures of the eastern pastures of the island of Cres, whose mapping was omitted due to uncertainty about their current state and function. Dry stone walls situated in the settlements were excluded.

All the dry stone walls were mapped as linear features (polylines). Such geometric generalisation was chosen to facilitate comparisons between quantifications, especially with the official CROTIS layer, even though some of the structures might also need to be mapped as polygons due to their large width (such as the dry stone clearance walls). Such mapping would provide better assumptions for a numerical model which would calculate the mass of stone used in walls. Initially, it was expected to merge or add the new features to the existent national vector layer's 'built barriers' from the CROTIS 2.0 database. However, the numbers of inaccuracies and the differences of the two methodologies (the CROTIS layer was based on aerophotogrammetry from the 1980s) caused the layers to be incompatible; therefore, the full mapping process was carried out from the initial stages as it was assumed the process would take approximately the same time as modifying the CROTIS layer.

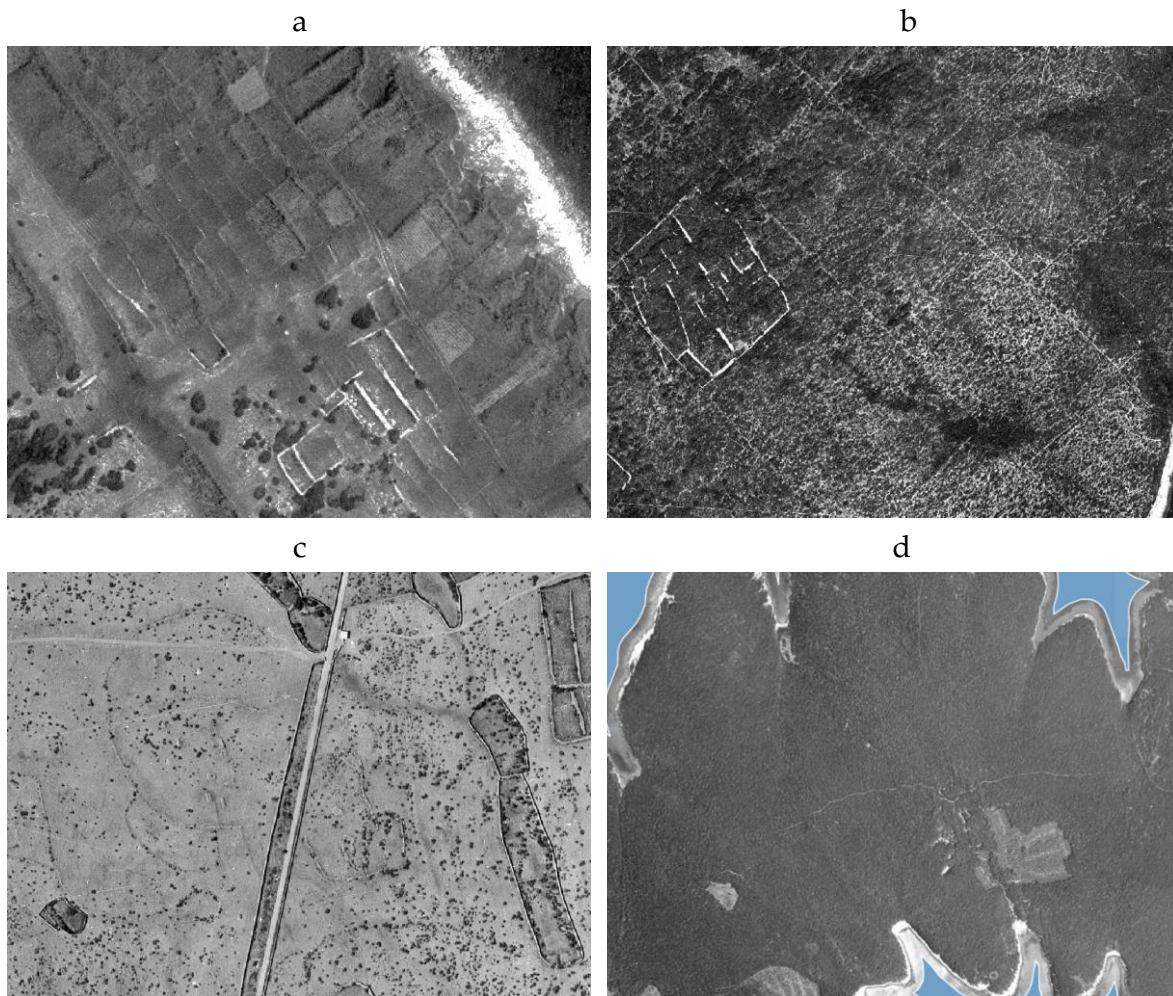


Figure 132. Ambiguities during mapping which require further verifications: a) The island of Male Srakane, much like the island of Susak, uses reed serves to decrease surface runoff, delineate parcels and protect the area from salt precipitation and wind. Based on the orthophotos, it is not possible to differentiate whether all visible lines are reed fences or overgrown dry stone walls. b) On the northern part of the island of Unije, regular orthogonal lines are recognisable, which would normally indicate pastoral enclosures, but the low thickness of the lines does not correspond to it. One probability is the 'fossilised' beginning of clearance of the new land (i.e. its measuring). c) Often, it is not clear whether the irregular, less-visible lines are older and degraded enclosures or geomorphic forms (Ustrine environs). d) Heavily under a forest canopy, some part of the region of Punta Križa showed only indications of pastoral enclosures, and some covered it completely. Later fieldwork did however show the existence of sparse and low walls.

4.2.2. Typology

Subsequent to the digitisation of the dry stone walls, two areas of the archipelago were part of the classification process (i.e. determination of their type [retaining wall, free-standing wall, pathway, clearance wall]) within the Attribute table in GIS. The island of

Ilovik (Figure 133) and the Merag environs were taken as case studies for the application of the typological mapping. The recognition of different wall types was attempted from the interpretation of DOF53 and from the available topographic symbology from HOK. Different types of the walls correspond to the different types and methodology of the 2nd-level model of inventory of dry stone walls proposed by Šraj (2019, 305).

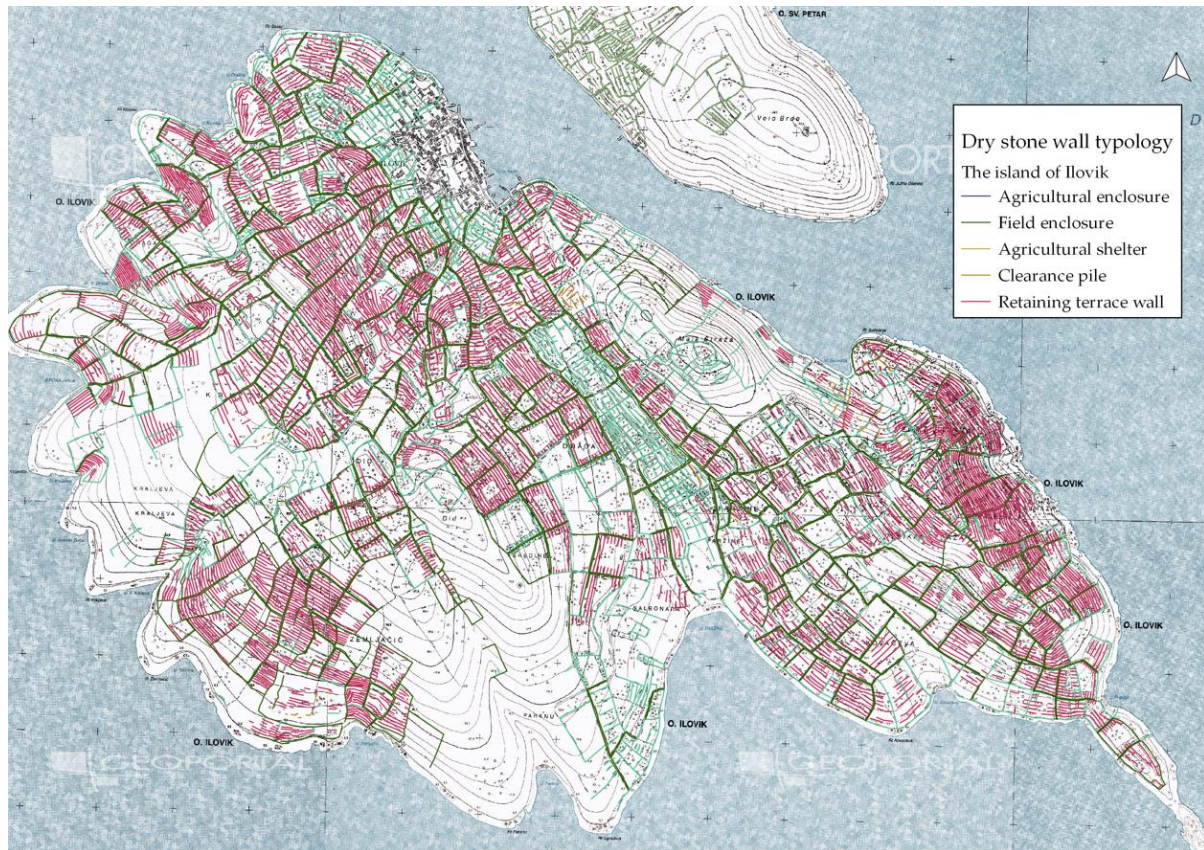


Figure 133. The dry stone walls of the island of Ilovik were assigned a typology based on the DOF53 and HOK interpretation. Basemap: HOK, typology elaborated by Tanja Kremenčić

4.4. Quantitative analysis of the dry stone walls

Quantitative analyses consider the length, density and ratio between the total study area and the one occupied by the mapped elements. The research area corresponds to 508.26 km². This value was obtained after the subtraction of the islands of Susak (3.77 km²), Zeča (2.55 km²) and other smaller islands and islets, from the archipelago area, which would otherwise equal 514.58 km².

4.4.1. Length

The length of the mapped objects – the dry stone walls – was calculated in both metres and kilometres using the ‘Calculate geometry’ and the ‘Summary Statistics’ tools. The length of the dry stone walls of the Cres-Lošinj archipelago corresponds to 13,786.31 km, and the estimated length of the ‘CROTIS’ is 9,007.31 km. Therefore, only 32.98% of the walls were part of the previous inventory, corresponding to a 203% increase in walls with the mapping done in this study (Table 13).

Table 13. The difference between the 'CROTIS' layer values and mapping values

Islands	Study area (km ²) ¹¹⁰	Length CROTIS (km)	Length mapping (km)	Difference (%)	Change (increase) (%)
Cres (N)	288.92	2,856.77	8,869.53	32.21	210.47
Cres (S)	117.24	911.09	1,722.07	52.91	89.01
Lošinj (N)	52.81	303.13	1,068.20	28.38	252.39
Lošinj (S)	21.85	192.95	1,369.39	14.09	609.71
Unije	16.90	160.78	336.79	47.74	109.47
Ilovik	5.54	92.97	314.78	29.53	238.58
Vele Srakane	1.20	2.51	34.45	7.29	1272.51
Male Srakane	0.62	2.20	25.43	8.65	1055.91
Vele Orjule	1.07	8.03	5.17	155.32	-35.62
Male Orjule	0.34	2.03	4.93	41.18	142.86
Oruda	0.41	0.55	2.93	18.77	432.73
Palacol	0.05	0	0.34	/	/
Sveti Petar	0.98	9.66	22.58	42.78	133.75
Trstenik	0.33	1.55	8.81	17.59	468.39
Town of Mali Lošinj area	219.34	1,687.45	4,916.79	34.32	191.37
Town of Cres area	288.92	2,856.77	8,869.53	32.21	210.47
Study area	508.26	4,544.22	13,786.31	32.96	203.38

¹¹⁰ Island areas were retrieved from the Duplančić et al. (2004).

4.4.2. Density and intensity

Density is calculated as the ratio of the sum of the lengths of all dry stone walls to the land area or homogeneous physical/administrative land area (or, in this case, island area) where they are located. Density is generally expressed in m/ha or km/km². However, the density index does not portray the exact intensity or allow an exact comparison of the dry stone walling between areas, as it includes fluctuating scale ratios of the examined regions (Varotto and Ferrarese 2008, 40). For example, the density of the dry stone walls of the entire island of Lošinj varies greatly from the density of its southern part.

The category of 'Mapped area' is introduced and further put into a ratio with the study area to determine the prevalence of the dry stone walls and better specify the intensity of the dry stone walling. The 'Mapped area' category involves the area near the vectorised walls. By using the geoprocessing tool 'Generate tessellation', a grid was created composed of 1000-m² hexagons.¹¹¹ From the layer thus generated, the polygons that intersected dry stone walls were selected from the Attribute table using the 'Selection by attributes' tool. For each area, the hexagons were united to form a single polygon (using the 'Editing' and 'Merge' tools). The areal extension was calculated for each individual polygon formed and was then compared to the corresponding areal (island) unit. The feature classes of the administrative area and the mapped area were subsequently compared using the 'Tabulate intersection' function. The results show that the area in the near proximity of the dry stone walls equals 247.46 km², and it covers approximately half of the study area. It covers 51% of the Town of Cres (146.75 km²/288.92 km²) and 49% of the area of the Town of Mali Lošinj (100.71 km²/219.34 km²) (Table 14).

The density of the dry stone walls in relation to the entire area is 27.12 km/km², which is a median of the Town of Mali Lošinj walls density (22.42 km/km²), and Town of Cres (30.70 km/km²). The density of walls of the mapped area equals 55.71 km/km², the median of the Town of Cres intensity (60.44 km/km²) and the Town of Lošinj (48.82 km/km²) (Table 15).

¹¹¹ Šrajer used a similar method, using the 'Buffer' tool in GIS, with the width of the buffer zone of 100 m, using the 'built barrier' layer for calculation. The new layer enabled the territory in the near vicinity of the dry stone walls to be analysed. The size of 100 m was selected arbitrary – the author considered this figure was easily memorable and has some foundations in the 'experience of the place'; also, the walls should be visible within this distance (2019, 32).

Table 14. Ratios between the study area and the mapped area (Michela Trevisan and Tanja Kremenić) show the coverage of the areas with dry stone walls.

Islands	Study area (km ²)	Mapped area (km ²)	Ratio between the areas (%)
Cres (N)	288,92	146.75	51
Cres (S)	117.24	46.68	40
Lošinj (N)	52.81	23.54	45
Lošinj (S)	21.85	18.24	83
Ilovik	5.54	4.29	77
Unije	16.90	5.80	34
Vele Srakane	1.20	0.64	54
Vele Orjule	1.07	0.13	12
Sveti Petar	0.98	0.43	44
Male Srakane	0.62	0.50	81
Oruda	0.41	0.11	26
Male Orjule	0.34	0.14	41
Trstenik	0.33	0.20	59
Palacol	0.05	0.01	25
Town of Mali Lošinj area	219.34	100.71	46
Town of Cres area	288.92	146.75	51
Study area	508.26	247.47	49

Table 15. Ratios between the densities of dry stone walls in the study area and in the mapped area

Islands	Study area (km ²)	Archipelago density (km/km ²)	Mapped area density (km/km ²)	Difference (%)
Cres (north of Belej)	288.92	30.70	60.44	49.21
Cres (south of Belej)	117.24	14.69	36.90	60.19
Lošinj (north of Privlaka)	52.81	20.23	45.38	55.42
Lošinj (south of Privlaka)	21.85	62.69	75.10	16.52
Unije	16.90	19.93	58.07	65.68
Ilovik	5.54	56.87	73.38	22.50
Vele Srakane	1.20	28.78	53.83	46.54
Male Srakane	0.62	41.25	50.86	18.85
Vele Orjule	1.07	4.81	39.77	87.91
Male Orjule	0.34	14.64	35.21	58.42
Oruda	0.41	7.19	26.64	92.72
Palacol	0.05	6.65	34.00	80.44
Sveti Petar	0.98	23.13	52.51	55.95
Trstenik	0.33	26.18	44.05	40.57
Town of Mali Lošinj area	219.34	22.42	48.82	54.08
Town of Cres area	288.92	30.70	60.44	49.21
Study area	508.26	27.12	55.71	53.32

Table 16. The lengths of the Cres-Lošinj archipelago's dry stone walls based on DOF53 vectorisation and calculations of their density per island and islet (Michela Trevisan and Tanja Kremenčić)

Islands	Study area (km ²)	Length CROTIS (km)	Length mapping (km)	Difference (%)	Archipelago density (km/km ²)	Mapped area density (km/km ²)	Difference (%)
Cres (north of Belej)	288.92	2,856.77	8,869.53	32.21	30.70	60.44	49.21
Cres (south of Belej)	117.24	911.09	1,722.07	52.91	14.69	36.90	60.19
Lošinj (north of Privlaka)	52.81	303.13	1,068.20	28.38	20.23	45.38	55.42
Lošinj (south of Privlaka)	21.85	192.95	1,369.39	14.09	62.69	75.10	16.52
Unije	16.90	160.78	336.79	47.74	19.93	58.07	65.68
Ilovik	5.54	92.97	314.78	29.53	56.87	73.38	22.50
Vele Srakane	1.20	2.51	34.45	7.29	28.78	53.83	46.54
Male Srakane	0.62	2.20	25.43	8.65	41.25	50.86	18.85
Vele Orjule	1.07	8.03	5.17	155.32	4.81	39.77	87.91
Male Orjule	0.34	2.03	4.93	41.18	14.64	35.21	58.42
Oruda	0.41	0.55	2.93	18.77	7.19	26.64	92.72
Palacol	0.05	0	0.34	/	6.65	34.00	80.44
Sveti Petar	0.98	9.66	22.58	42.78	23.13	52.51	55.95
Trstenik	0.33	1.55	8.81	17.59	26.18	44.05	40.57
Town of Mali Lošinj area	219.34	1,687.45	4,916.79	34.32	22.42	48.82	54.08
Town of Cres area	288.92	2,856.77	8,869.53	32.21	30.70	60.44	49.21
Study area	508.26	4,544.22	13,786.31	32.96	27.12	55.71	53.32

4.5. Discussion – Applicative role of the mapping of dry stone walls

Since they have been part of scientific and professional research, the lengths of the walls have been present in newspaper titles – such as ‘Britain boasts a staggering 125,000 miles of dry stone walls’ (Henley 2009) or ‘New England Is Crisscrossed With Thousands of Miles of Stone Walls. That’s enough to circle the globe—four times’ (Kusmer 2018) – to emphasize the work done by human hands. Currently, comparisons between countries can be drawn from state inventories or estimations done by researchers. Müller’s estimations of the past and recent distribution of the field enclosures (2013a, 1:62–65) are particularly extensive and show the rate of their diminishment. According to his estimations, Ireland had over a million kilometres of walls in 1880, which reduced to 750,000 km by 2012,¹¹² France had 535,000 km in 1880 and 225,000 in 2013; Germany’s 523,000 km has been reduced to only 94,000 km; UK’s walls have been halved from 502,000 km to 251,000 km; Italy’s walls have decreased from 375,000 km to 158,000 km; and Greece’s have decreased from 334,000 km to 200,000 km. He estimated that Croatian dry stone walls reduced only by 20%, from 375,000 km to 300,000 km.

Besides Müller’s estimations, another estimation for Ireland is 400,000 km of walls (McAfee 2011). In the UK Countryside report, 174,000 km of walls were recorded in Great Britain, which represents a 1.1% decrease from 198,000 km in 1984 (Carey et al. 2008).¹¹³ In the United States, based on the fences survey in 1872, about 400,000 km (\approx 250,000 miles) of dry stone walls were estimated, with the largest portion being located in New England and adjacent New York (Thorson 2002; Oliver 1939). Thorson estimates that, today, there could be about 160,000 km (100,000 miles) of them remaining (Kusmer 2018).

The total length of the lines of the Croatian ‘CROTIS layer’ is 89,482 km, which can be considered as the lowest total dry stone wall length value in Croatia. A more accurate estimation of the prevalence of dry stone wall construction at the national level was quantified by Šrajer (2019). Based on the same ‘CROTIS layer’ and the extracted coefficients based on case studies, he estimated 200,000–300,000 km of walls in the Croatian Adriatic. This number corresponds to Müller’s abovementioned estimations. Eventual confirmation of this estimation would mean that Croatia is one of the leading countries in the world in terms of its dry stone wall length and density. Šrajer furthermore calculated, based on the suggested 100-m buffer zone, that the dry stone

¹¹² Another estimation for Ireland is 400,000 km of walls (McAfee 2011).

¹¹³ Results from Northern Ireland show only the total length of field boundaries (hedgerows, banks, dry stone walls). About 226,000 km of field boundaries were estimated in 2007 (Carey et al. 2008, 53).

walls cover 42.5% of the Croatian Adriatic territory. This, according to Šrajer, proves that dry stone walls are the most dominant anthropogenic element of the Adriatic Croatia (2019, 392).

In addition to the portrayal and emphasis of the extent of the transformed landscape and the work done by ancestors, the introduction of dry stone walls in the GIS could satisfy several needs in the spatial planning, cultural goods protection, precision farming and landscape interpretation domain. Even though UNESCO's protection does not include the protection of the walls themselves, the inclusion of the art of the dry stone walling placed in them in the 'cultural goods' category. Their exact location and condition provide a reliable estimate of renewal and maintenance costs, especially if accompanied by field assessments of their condition, which should be relevant when these structures form part of the cultural landscapes in Croatia.

The most apparent practical need of their inventory is connected to the implementation and controlling of the incentives of rural national policies. Dry stone walls were included in the national subventions within the rural policies in 2017. Nonetheless, to date, only boundary walls are part of this subvention; the retaining walls or clearance walls within the terraced enclosures are omitted (Croatian Ministry of Agriculture 2021). This is not an insignificant omission, as the terraced enclosures are functionally important for the karst agriculture and make up at least half of the dry stone wall landscape. Despite the public recommendation for their inclusion, it seems the Croatian Agency for Payments in Agriculture, Fisheries and Rural Development has neither the operational capacity for full record-keeping – which is not surprising considering the vastness and complexity of the dry stone wall heritage – nor enough funds needed to allocate their renewal.¹¹⁴ Therefore, creating a database, especially one which classifies dry stone walls based on their typology (retaining walls, boundary walls), could be a step towards their full inclusion in the subventions. In Croatia, most of the current inventories and movements of dry stone wall protection are civilian-led (Bodrožić et al. 2012).

The quantification of the dry stone walls can be particularly useful regarding terrace landscapes, as it can aid assessments of hydrogeological risk, reflect the extent of the 'built landscape' (Varotto and Ferrarese 2008, 40), and comparison with other areas. The density of dry stone walls was analysed by Šrajer and estimated as being within the range of 97 m/ha (on the mosaic landscapes on the island of Žut, which is part of the Kornati archipelago) to 3,010 m/ha (vineyards on Bucavac site, close to Primošten). The terraced slopes of Takala (close to Bakar) have a density of 1924 m/ha (2019, 392). In the

¹¹⁴ This information was retrieved from a conversation with the Agency's employee.

town of Cres olive grove area (Figure 143), which is one of the highest terracing intensity areas of the Cres-Lošinj archipelago, GIS vectorisation based on DOF53 revealed more than 2,605 km of dry stone walls within an area of 21.6 km², with a maximum density of 120 km/km² (or 1206.8 m/ha).

Not all the land organisational patterns are followed or can be interpreted from the dry stone walls. However, the detailed mapping of dry stone structures is a heuristic process, especially when compared to provisional estimations which could be provided by machine learning possibilities of computer-based automatic wall recognition. Mapping compels the cartographer to better notice new structures. The island of Zeča is an example of a common pasture where the land use was based on the mutual agreement, as was the right to annual grazing for a certain number of sheep. Multiple divisions among heirs led to situations where the right of a single owner to graze could no longer be expressed by the number of sheep heads but by fractions (even in their legs), as is the case of the island of Zeča. One user had the right to graze '5/24 of sheep' which means that every 24 years, an individual could graze five sheep. During this time, the renter is obliged to pay taxes for his share (Stražičić 1981, 4:211). Mapping has revealed a two-cell sheepfold and a lime kiln (Figure 134). Both are indicated by the absence of forest in their vicinity (the first area is used for grazing; the other is used for lime production) and by toponyms (*Mrgari, Stare mrgari, Japlenca*)¹¹⁵ on the maps from 1956 (Ujević 1956).

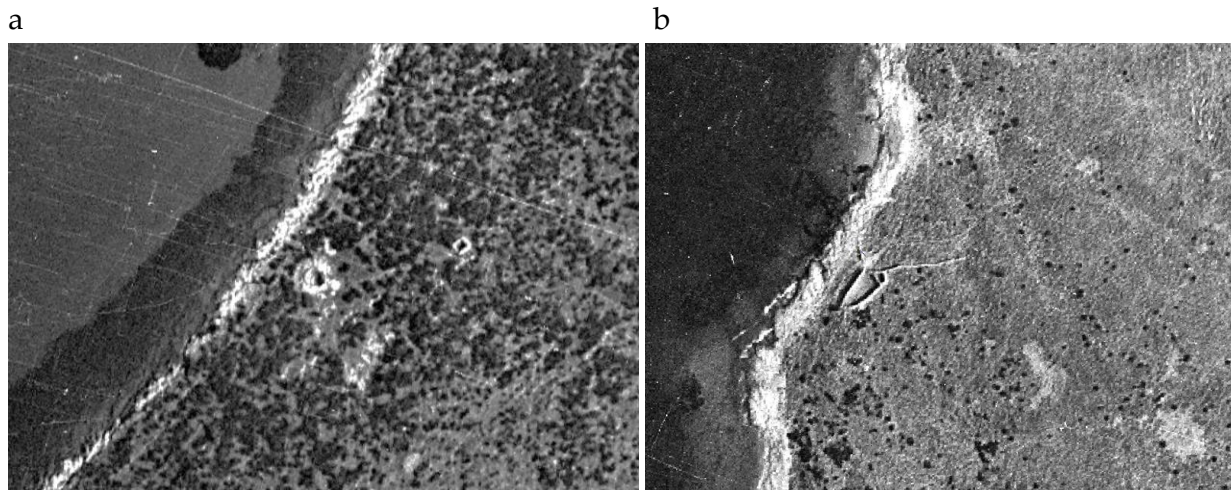


Figure 134. The only dry stone structures found on the island of Zeča: a) supposed burnt lime kiln and b) a two-cell sheepfold. Basemap: DOF53

Furthermore, mapping can assist the discovery of or the structures indicative of historical land use and/or new historical data. A cross-like pattern of dry stone walls was recognised between Merag and Cres settlements, close to the hillfort of Sveti Bartolomej.

¹¹⁵ Toponym *Japlenca* was not transcribed to HOK 1986.

These structures seem to have no apparent connection to the appurtenant landscapes. The lines of the 'cross-road' are 11 m wide, and their lengths are as follows: southern (230 m), western (75 m), northern (187 m) and eastern (135 m), where they are encompassed by other dry stone wall structures or dissipate into the field (Figure 135). On this same spot, ACM registers a 'pasture' without dry stone walls, while HOK registers some of the structures. During a field visit, the walls were discovered to be quite low (up to 40 cm tall), and cypress trees were planted along parts of these walls (Figure 136). The form of the walls would in the agricultural dry stone use fit into the *pridanci* (See chapter 5, *Lovreški*) or *vrstice* (See chapter 3, *Osuli*) category. However, here, they seem to have more of a signalling function than any other. Nearby pine trees were planted 90 years ago, but the cypresses seem to be younger than this.¹¹⁶ Therefore, based on the age of the trees, this construction might have been erected around the time of WWII. These two examples also emphasize other nuances – the importance of the cartographer's prior knowledge or expertise of the area and the object of mapping, for example.



Figure 135. Aerial imagery from 1953 indicating the existence of dry stone walls of an unknown function close to the Sveti Bartolomej hillfort. The black arrows point to the beginnings of the rays; the crimson dotted lines indicate their trajectories and lengths.

¹¹⁶ I thank Dubravko Matić for the information.

a



b



Figure 136. Field visit discovered the walls to be quite low – up to 40 cm, along parts of which cypress trees were planted (2021).

4.6. Conclusions

This chapter presented the methodological approach employed for the production and analysis of spatial data i.e. the vectorisation of the dry stone walls and other dry stone structures. It also capitalised on lessons which can be learnt even within a technical approach such as this one. The aims were to uncover, understand and create replicable mapping methods within current technological circumstances and to uncover the full extent of the human-induced changes in the area. Furthermore, the aim was to obtain sufficiently accurate data which might provide useful in subsequent scientific, professional work and spatial planning.

One of the most notable results is that the total length of the historically built dry stone walls of the Cres-Lošinj archipelago constructed until 1953 is 13,786.31 km. This length was obtained by the most precise mapping method currently available based on available cartographic data and technology. Nonetheless, due to methodological limitations such as relatively low quality of the monochromatic orthophoto imagery, the similarity of the dry stone walls to other linear structures and time restrictions which impeded a full field validation of all the structures, this result should be taken with a 3-5% error possibility. Another significant limitation to this approach has to do with the time invested, which hints at potentially high costs involved in gathering these data.

The total length calculated in this thesis reveals a noticeable change compared to the existing vector layer of 'CROTIS': only 32% of the actual dry stone walls were previously included in the official state vector layer. This difference equals to 203% increase, which further emphasises the inaccuracy of current official data.

From dry stone wall length value, further classes were obtained. A category of 'mapped area' indicates that 50% of the archipelago area has been covered by dry stone walls (i.e. the area in the near proximity of the dry stone walls equals 247.46 km²). Dry stone walls naturally cover 51% of the Town of Cres (146.75 km²/288.92 km²) and 49% of the area of the Town of Mali Lošinj (100.71 km²/219.34 km²), with regional varieties. This analysis corresponds to Šrajer's analysis using the 'Buffer' tool. Furthermore, the 'mapped area' category enabled a comparison and demonstration of the limitations of the density index in comparison to the intensity index. The latter is more adequate for revealing the magnitudes of terraces and enclosures and for the between-areas comparisons. The difference between these two indexes shows a 56% change (48.82% for the Town of Mali Lošinj, and 60% for the Town of Cres).

Dry stone walls are sparsely present only in the higher and noticeably agriculturally inhospitable areas which are distant from settlements (i.e. the Osoršćica hill on the island

of Lošinj and the *Križić* environs on the island of Cres). The areas of the highest walling densities are the terraces surrounding the town of Cres and on the island of Lošinj, south of Privlaka pass. Intense enclosures are also noted in the Belej environs (Figure 137).

Preliminary findings of the dry stone wall patterns close to the *Sveti Bartolomej* hillfort and observations of the dry stone structures of the island of Zeča confirm the importance of the ‘cartographer’s eye’ in detailed mapping procedures carried out to uncover new structures or historical indications,¹¹⁷ as opposed to provisional estimations based on sampling methods or the potential and probable future advances in machine learning and the possibilities of computer wall-recognition.

The vector layer of the dry stone walls created in this work can now be further overlapped with a breadth of other spatial data. For example, overlapping the vector layers with a habitat map of the Adriatic Croatia reveals that over 50% of the walls are within the habitat types of forests and shrubs, which highlights the neglect of the dry stone wall landscapes (Šrajer 2019, 341). A similar outcome was found for the Cres-Lošinj archipelago – the 2018 Land Cover Corine Data²³ was used as a basis for the calculation of dry stone walls that fall within urbanized areas and forest cover. Overall, urbanised areas occupy 2% of the territory (1.008 ha), while 37% of the dry stone walls are within the forest class (19,028 ha) (Trevisan 2021, 73).

Below is a list of suggestions for further research and spatial analyses based on new data. The latter were hoped to be achieved during this research project but were omitted due to the lengthy technical mapping procedure.

Suggestions for additional tools to be included in future work to obtain the full exactness of the distribution and length of the dry stone walls are as follows:

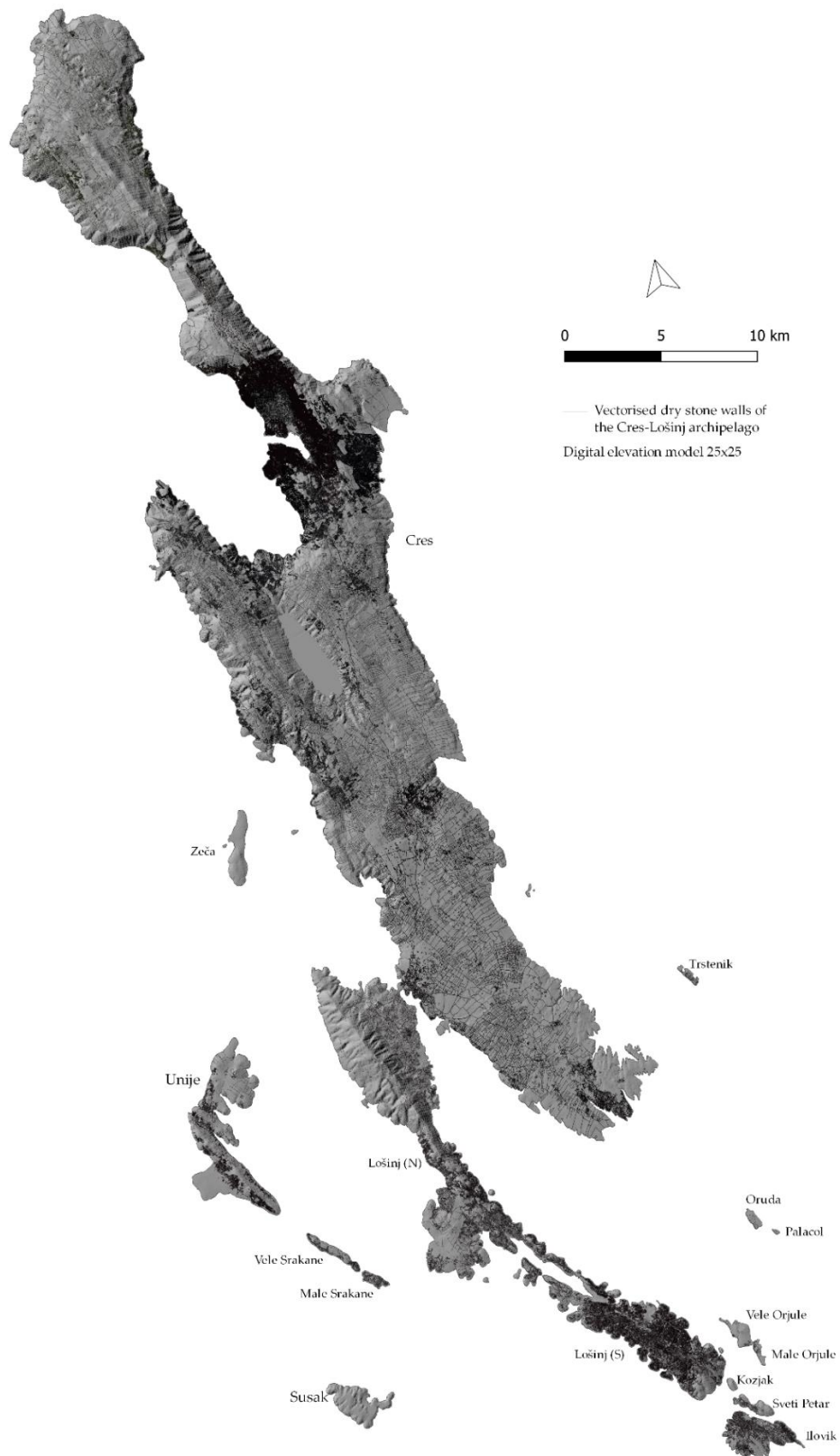
- include technologies of light detection and ranging (LiDAR) to determine the structures under high levels of vegetation, and
- create a template-based field assessment of the condition/state of the dry stone wall (i.e. the level of its degradation) and its use for dissemination among volunteers, as this might further aid assessments of the walls and enable participative mapping.

Suggestions for further spatial analyses are to:

¹¹⁷ This topic is expanded on in chapter 5.

- include analyses using the 'Buffer' tool with the 100-m distance to further analyse the prevalence of dry stone walls in the research area (Šrajer, 2019),
- overlap dry stone walls with digital elevation models to understand how much effort is needed to stabilise the steep slopes for terraces,
- differentiate and calculate the dry stone wall landscape units or dry stone wall landscape patterns and calculate their intensity index; also, calculate the intensity or density index for geographic-historical areas (*Tramuntana, Gerbin*), with landscape units from the landscape study (2015) and with administrative units (archipelago municipalities), and
- draw comparisons of quantitative data (length, intensity index) with international case study areas.

4.7. Maps of the Cres-Lošinj archipelago dry stone walls



*Figure 137. The distribution of the vectorised dry stone walls on the Cres-Lošinj archipelago
Area mapped: 508.26 km², DSW length – 13,786.31 km, DSW density – 55.71 km/km² (557.1 m/ha)*

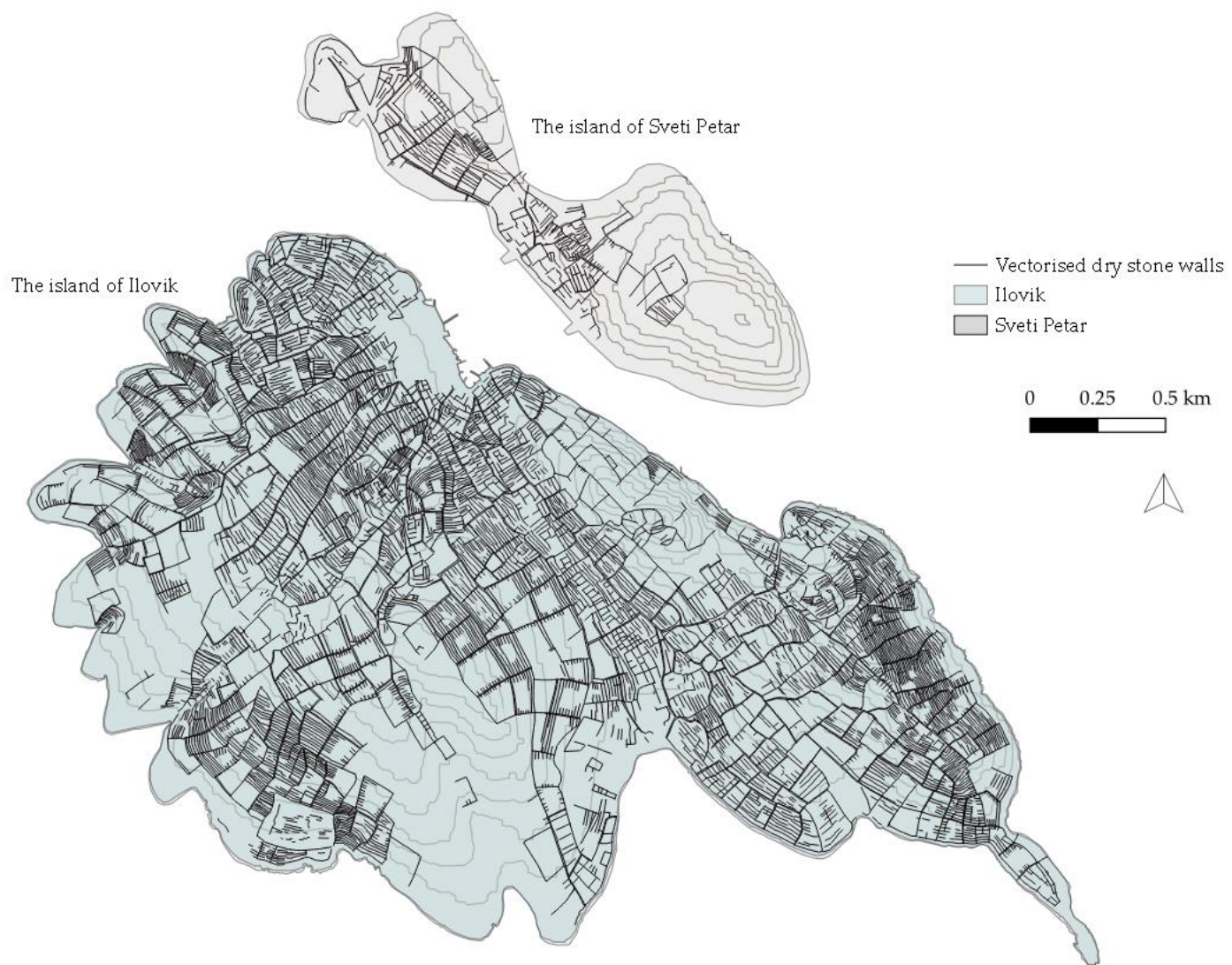


Figure 138. Vectorised dry stone walls on the islands of Ilovik and Sveti Petar
Area: 6.64 km², DSW length – 337.36 km, DSW density – 56.62 km/km² (566.2 m/ha)

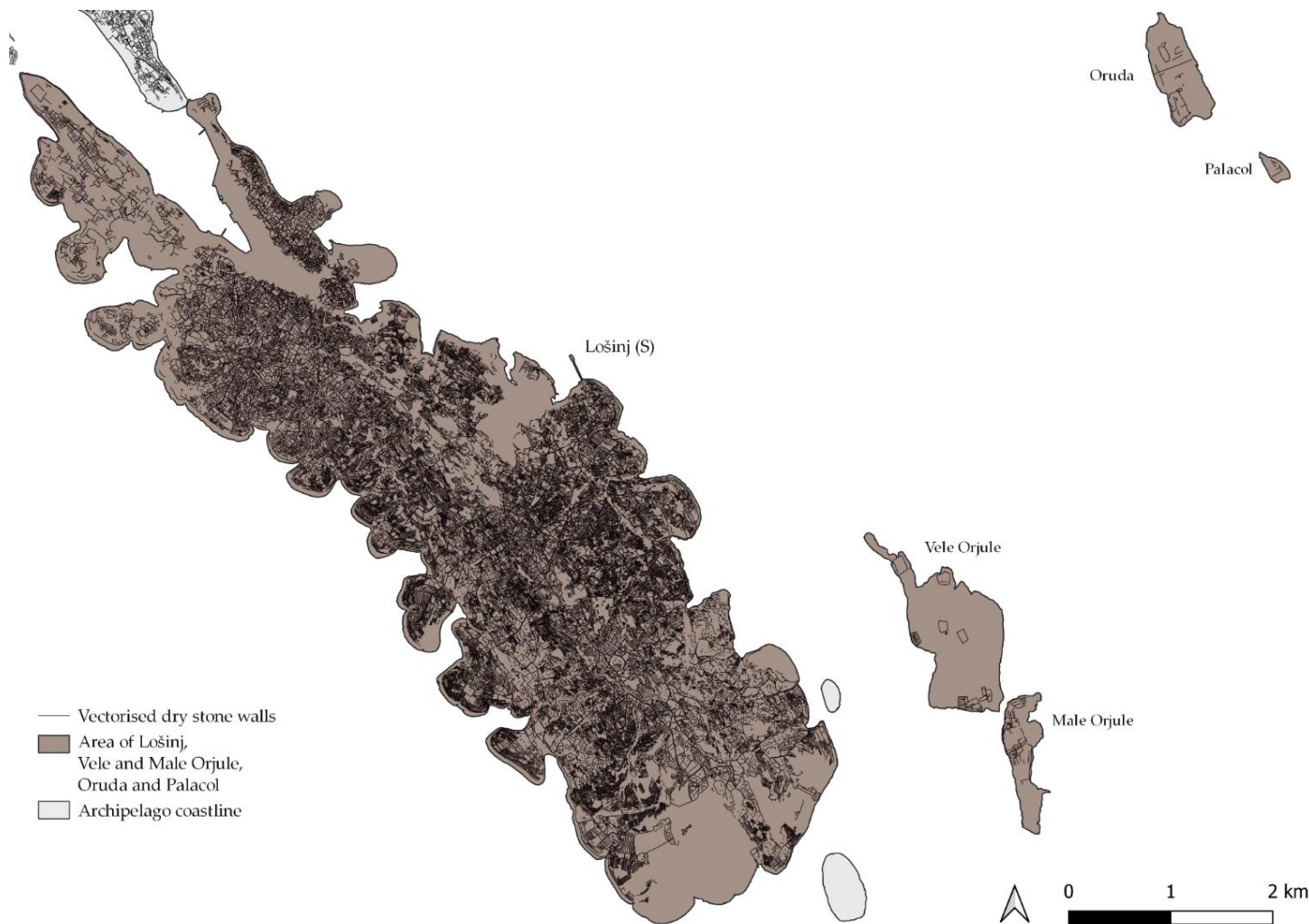


Figure 139. Distribution and occurrence of the vectorised dry stone walls of the islands of Lošinj (S), Vele and Male Orjule, Oruda and Palacol.

Lošinj (S) Area: 21.85 km², DSW length – 1,369.39 km, DSW density – 62.69 km/km² (626.9 m/ha)

Vele and Male Orjule Area: 1.4 km², DSW length – 10.1 km, DSW density – 7.21 km/km² (72.1 m/ha)

Oruda and Palacol Area: 0.46 km², DSW length – 3.27 km, DSW density – 7.12 km/km² (71.2 m/ha)

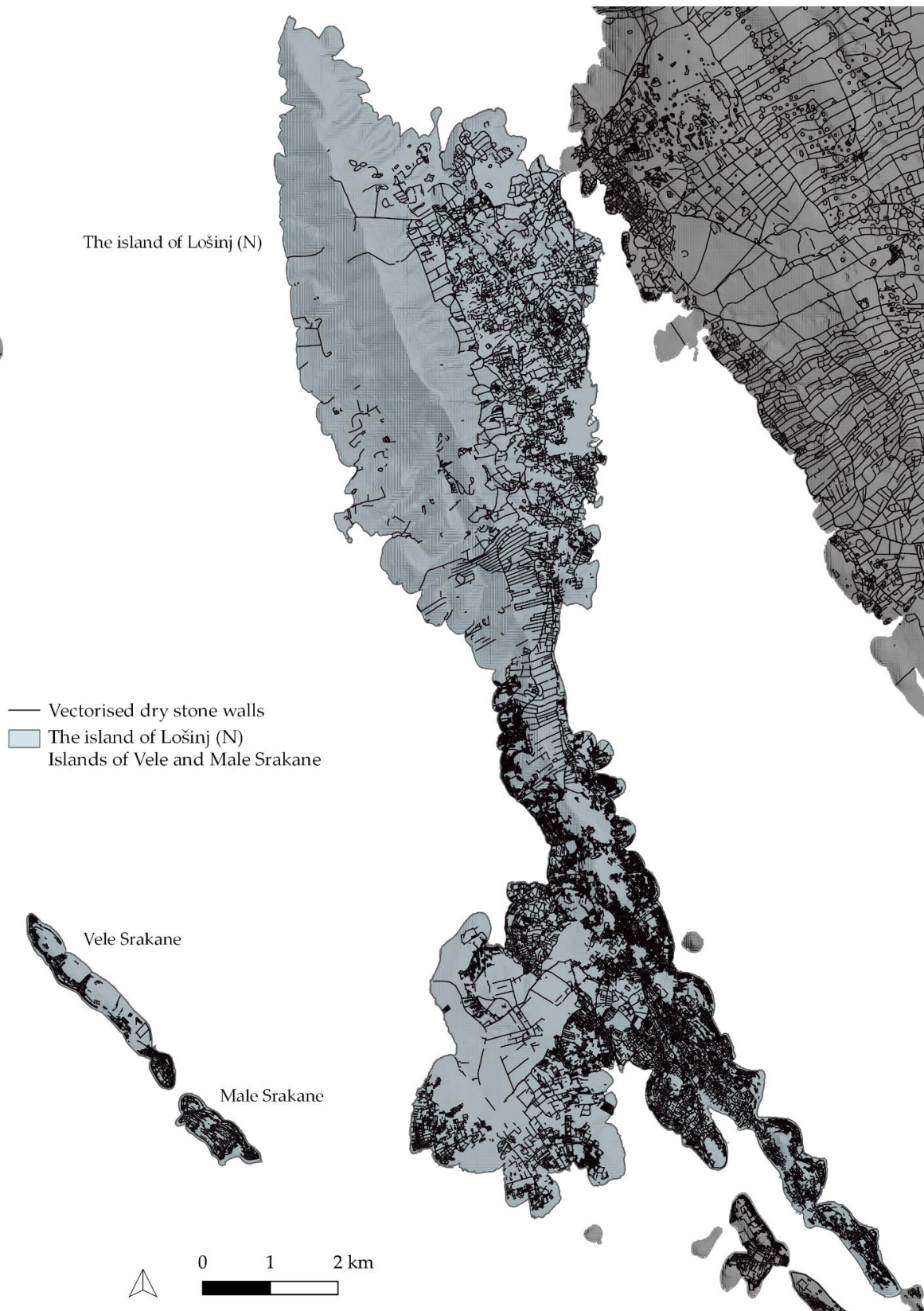


Figure 140. Vectorised dry stone walls in the region of the island of Lošinj (north of Privilaka) and the islands of Vele and Male Srakane

Lošinj (N) – Area: 52.81 km², Length: 1,068.20 km, Density: 20.23 km/km² (202.3 m/ha)

Srakane (Vele and Male) – Area: 1.79 km², Length: 59.88 km, Density: 33.26 km/km² (332.6 m/ha)

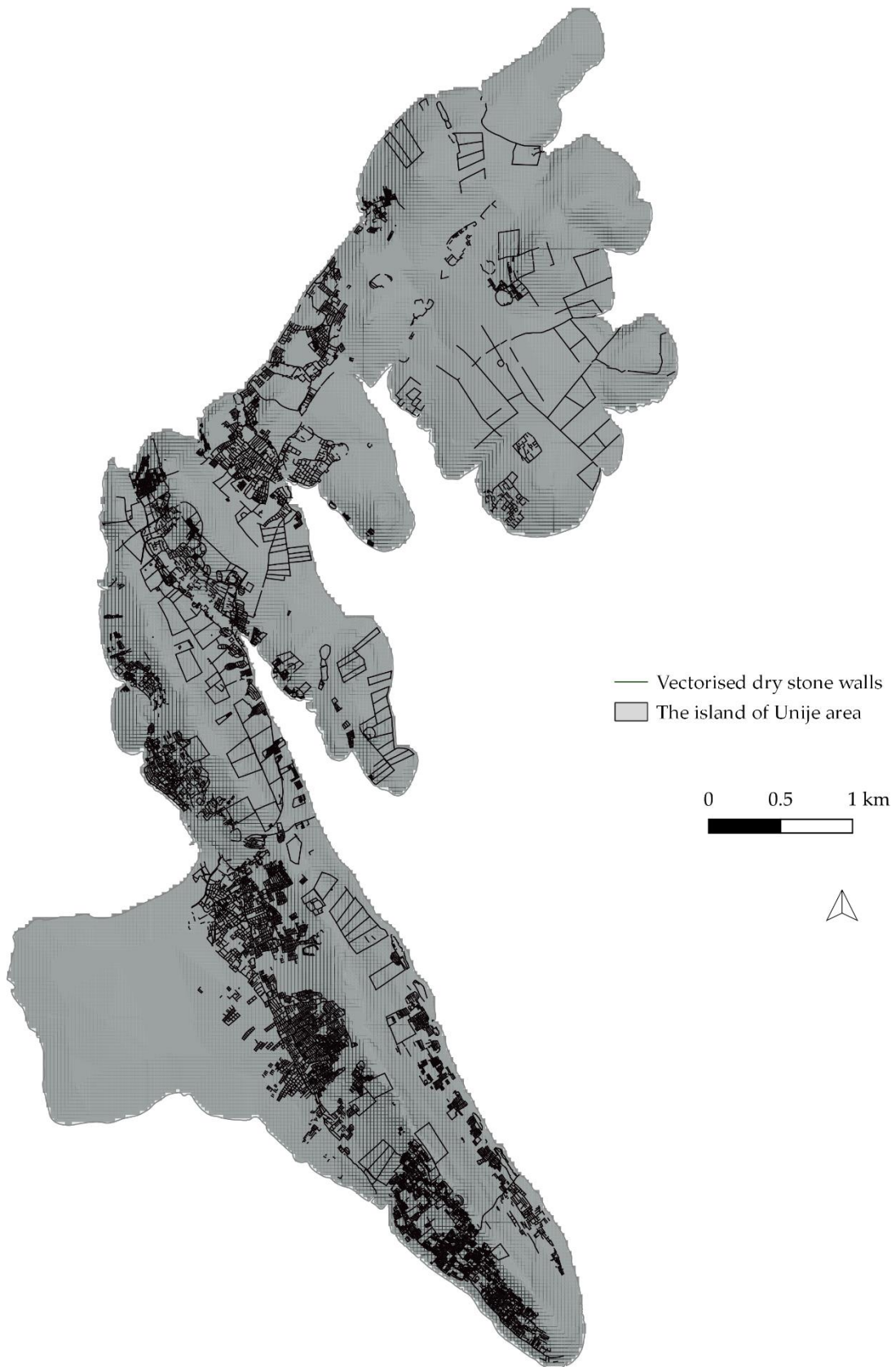


Figure 141. Vectorised dry stone walls on the island of Unije
Area: 16.87 km², Length: 336.79 km, Density: 19.93 km/km² (199.3 m/ha)

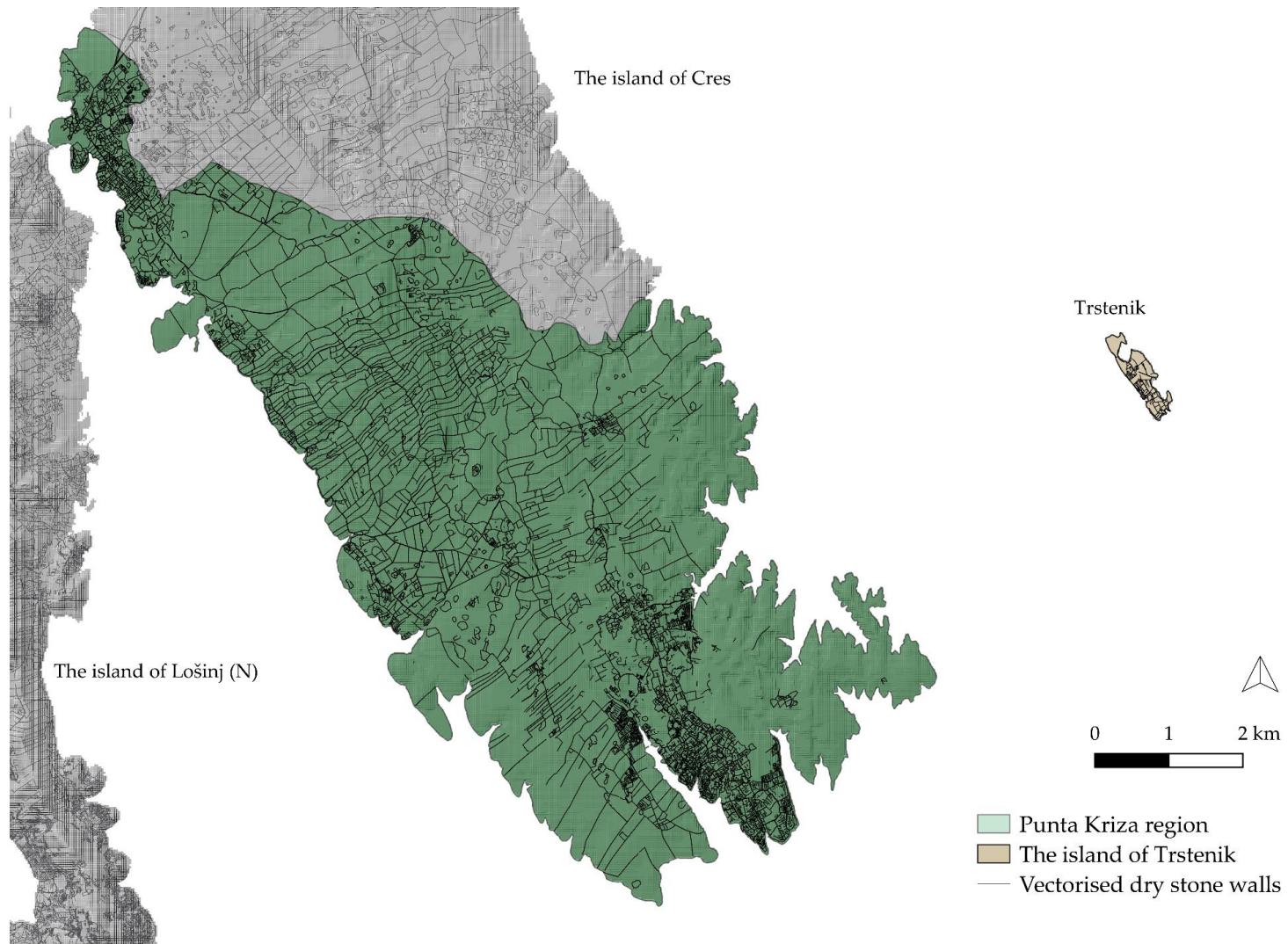


Figure 142. Vectorised dry stone walls in the region of Osor and Punta Križa (island of Cres) and on the island of Trstenik
Osor and Punta Križa – Area: 49.66 km², Length: 676.17 km, Density: 13.62 km/km² (136.2 m/ha)
Trstenik – Area: 0.33 km², Length: 8.81 km, Density: 26.18 km/km² (261.8 m/ha)

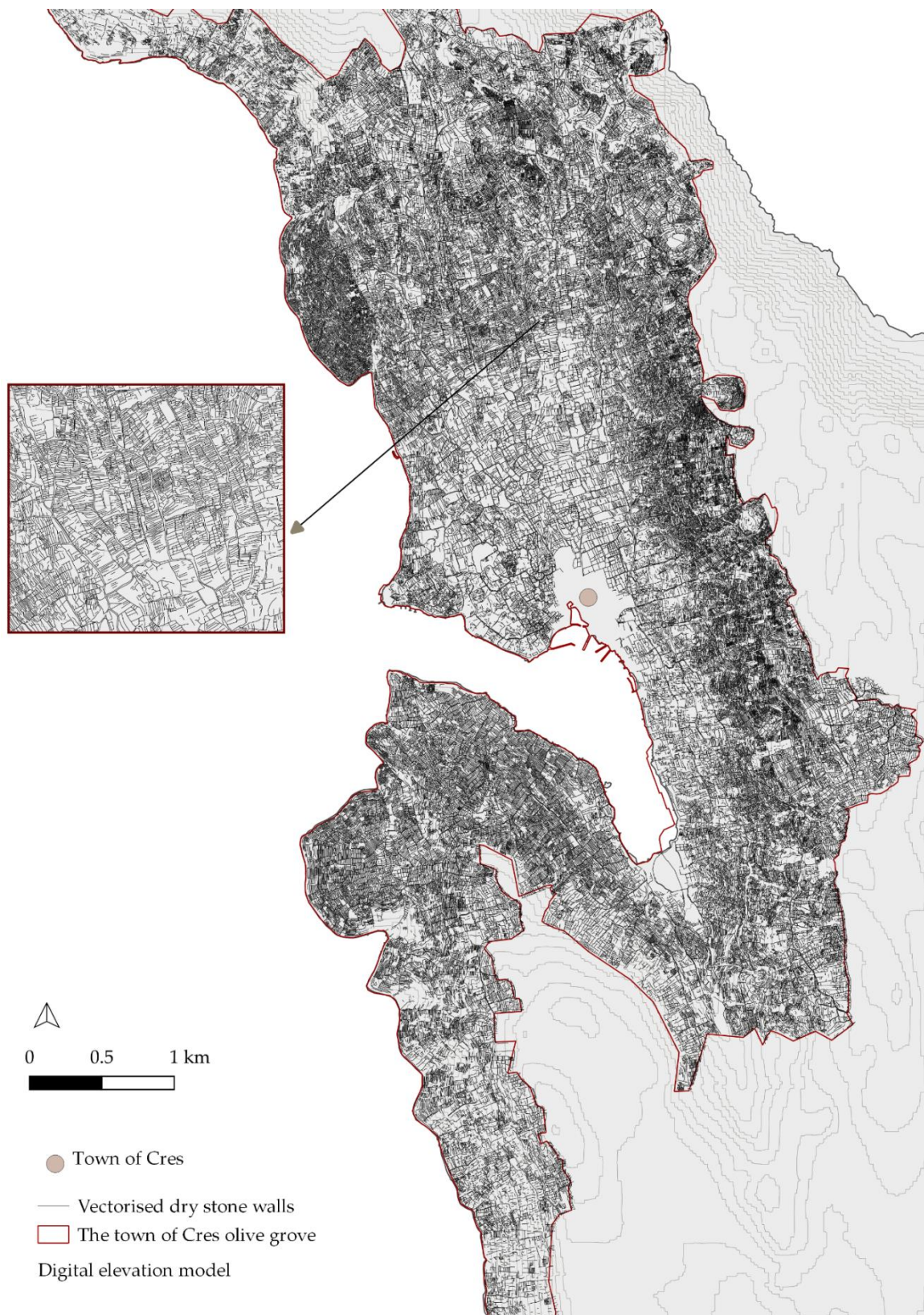


Figure 143. Vectorised dry stone walls in the town of Cres olive grove
 Area: 21.6 km², Length: 2,605.18 km, Density: 120.61 km/km² (1206.1 m/ha)



Figure 144. Vectorised dry stone walls of the Tramuntana landscape unit
 Area: 92.54 km², Length: 1,284.09 km, Density: 13.88 km/km² (138.8 m/ha)

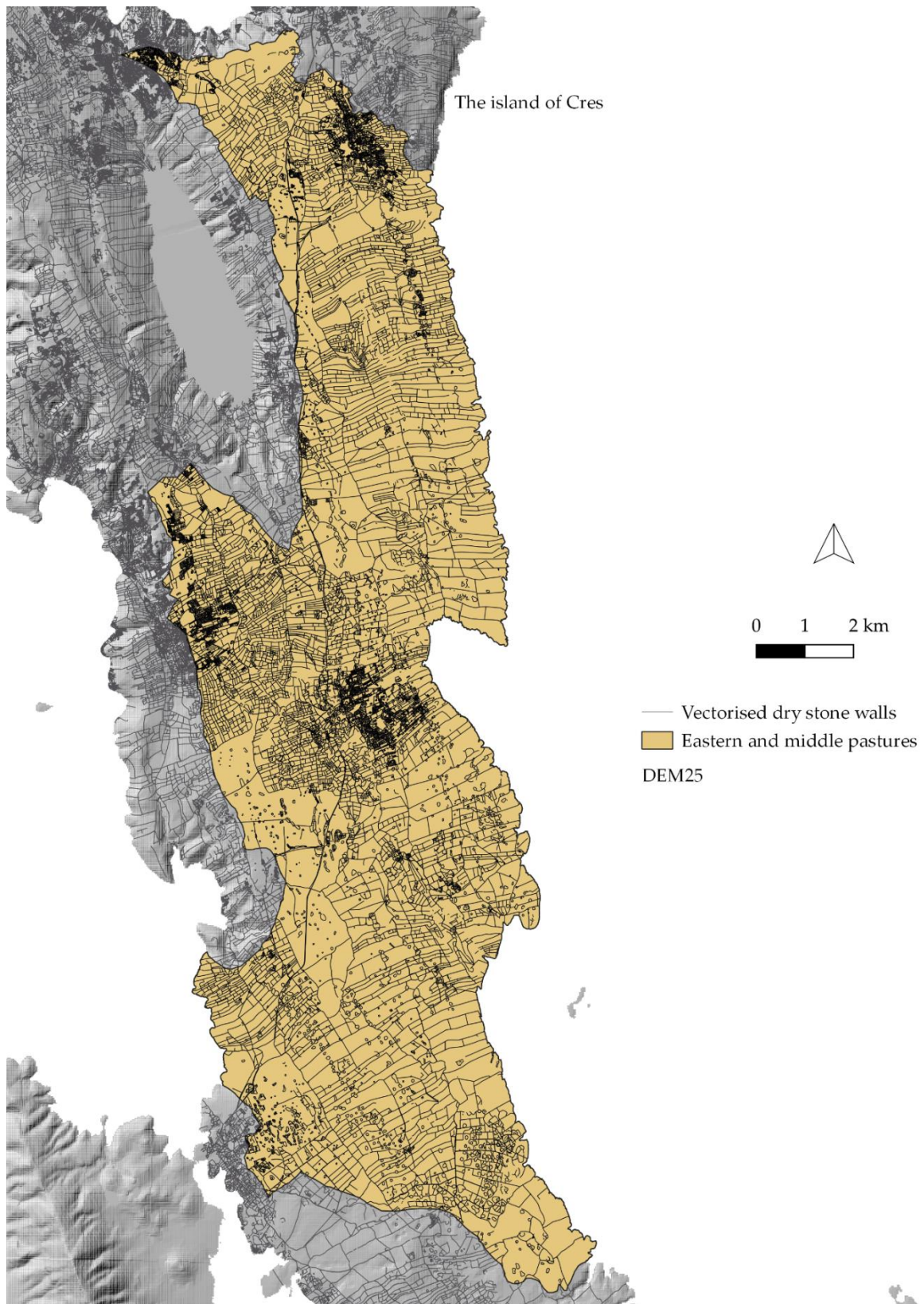
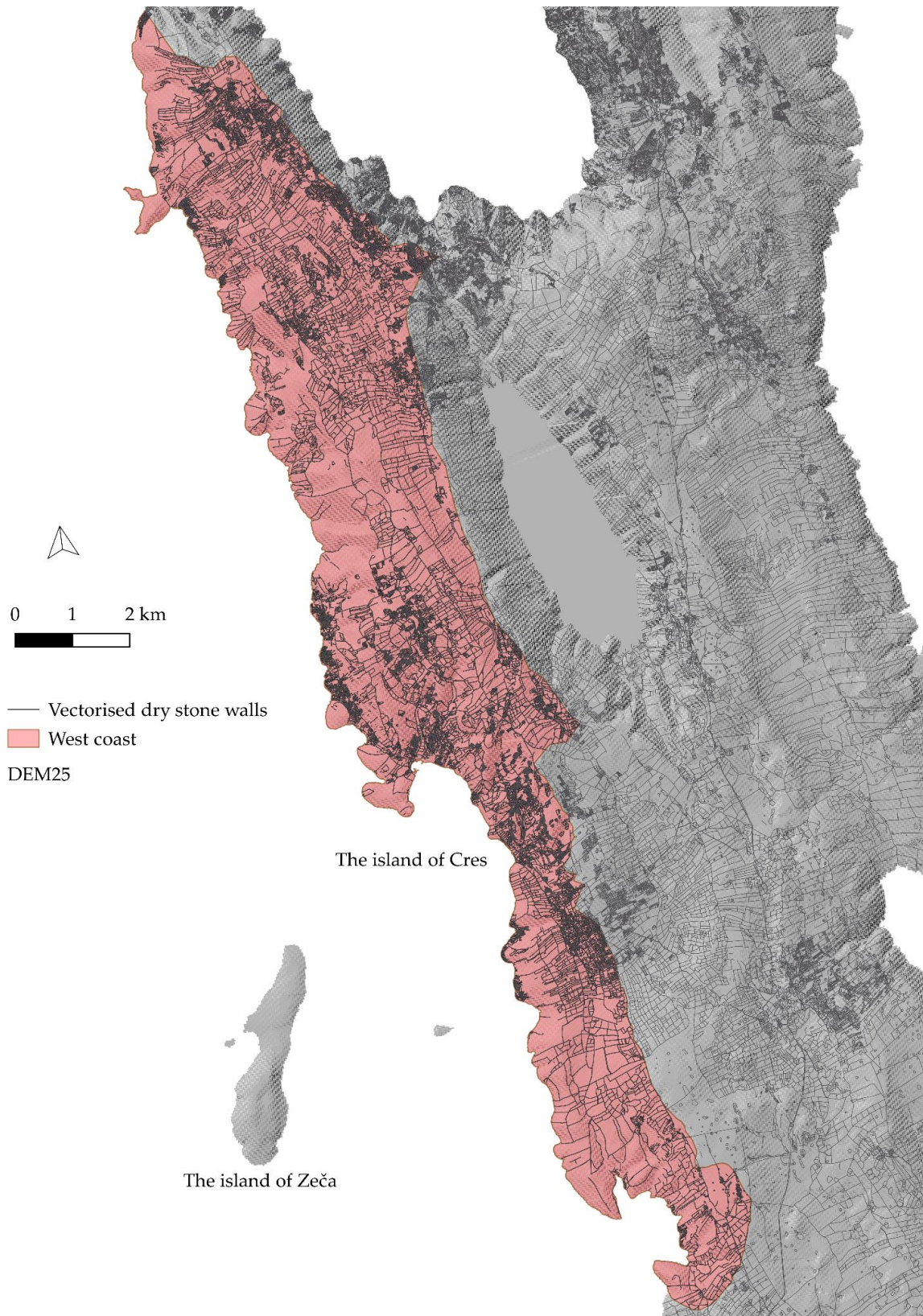


Figure 145. Vectorised dry stone walls in the eastern and middle pastures landscape unit (the island of Cres)

Area: 119.38 km², Length: 1,007.29 km, Density: 8.44 km/km² (84.37 m/ha)



*Figure 146. Vectorised dry stone walls in the west coast landscape area (the island of Cres)
 Area: 54.33 km², Length: 64.99 km, Density: 1.15 km/km² (11.54 m/ha)*

CHAPTER 5

DRY STONE WALL PATTERNS AND THE UNDERLYING HISTORICAL PROCESSES

'Pattern recognition is important to help us understand and relate to the world around us. We can develop a language of description and analysis to communicate relationships between different patterns, the processes that change the landscape and our aesthetic and emotional responses to them. How we perceive and understand patterns also depends very much on what we are looking for and why. For example, a cultural geographer, a farmer, a forester, a physical planner, an ecologist, an explorer, an archaeologist or an army general are likely to describe the pattern of a landscape based on their own knowledge, experiences and what it provides for them – its *affordances*, as we learn to call them' (Bell 2012, 3).

In this study, the *affordances* of the patterns formed by dry stone walls are their ability to convey or help people understand the historical processes which formed them. Providing information on the time depth of dry stone walls and dry stone wall landscapes is understood in this research as one of the main missing inputs, both in the case of the Cres-Lošinj archipelago and the Croatian Adriatic. Time depth is an important criterion not only for the subsequent implementation of the dry stone walls valuation model but also for evaluation and valorisation models in general. Since existing data are incomplete and dating methods are not always accurate or applicable, the attempt of the historical reconstruction is redirected to the use of indicators.

The aim of this chapter is to discern correlations between historical events and the chosen dry stone wall landscape patterns used as case studies from the Cres-Lošinj archipelago and draw typological conclusions. This part of the work aligns with one of the thesis objectives, 'O1: Clarify the historical-geographical formation and assess the capital stock of the dry stone walls of the case study area' and 'O2: Design replicable methods of mapping of the dry stone walls and their historical reconstruction', and one of its hypotheses, 'H2: Detailed mapping will generate new knowledge about the

historical formation and function of dry stone walls'. Here, a dry stone wall landscape pattern is considered the smallest area discernible that occurs in repetition and is identifiable by the spatial arrangement, design, and relationships of its corresponding parts (i.e. dry stone walls and structures) in a floor plan view.

The selection of the pattern case studies within the Cres-Lošinj archipelago was based on their distinctiveness, discernibility, and peculiarity, as well as the substantiation of their genesis in the local and international literature, archival sources, historical and current cadastral plans, and orthophotos.

The first part of the chapter reviews the dynamics of local and regional histories which have affected the dry stone wall landscapes' formation, outlines some of the methodological problems related to their historical reconstruction and highlights the importance of the historical interpretation of dry stone wall landscapes (subsections 5.1.–5.3.). The second part regards the results of the study, listed by the corresponding case studies (subsection 5.4.) and is endorsed by the chapters' discussion and conclusive notes (subsection 5.5.).

5.1. Major dynamics of the formation of dry stone walls in the landscape - (a)historical review

Samuels (1979) used the term 'authored landscapes' to emphasise that all landscapes bear the imprint of people's personal and collective authorships (Kolen, Renes, and Bosma 2016, 120). This is particularly true for dry stone wall landscapes, as many localities reveal differences between them, and the specificities of different farmers and artisans are apparent. However, Croatian dry stone wall landscapes, as well as those of other Mediterranean areas, are a result of circumstances beyond local personalities. These landscapes can be the result of short-term transformations or long, continuous building, rebuilding, and addition processes.

A large part of the dry stone wall landscapes observable today is the result of a constant, more or less intense, change and renewal, a never fully erased 'palimpsest'¹¹⁸ which carries bits of the past and incorporates it into new uses. Therefore, in most cases, the reconstruction of their histories should rely on an extensive transdisciplinary approach such as the landscape biography method.¹¹⁹ To reconstruct the dry stone wall history in a certain area means reconstructing the needs of the people at the specific moment. The slave-owning system of antiquity, feudal, and post-feudal estates, the extensive economy of early and underdeveloped capitalism, and the collectivist and planned economy of socialism influenced these landscapes each in its way.

5.1.1. Long-lasting continuous enclosing

It is assumed that the use of stones in dry stone structures was present even in the Palaeolithic era, but there is no archaeological evidence to support this (Kulušić 2004b). Enclosing and terracing have occurred at least since the neolithic age, and dry stone wall fencing for livestock and agricultural purposes has occurred since the arrival and affirmation of Proto-Illyrian and 'Illyrian' communities of the Bronze and Iron Ages

¹¹⁸ A concept first used by D. Crawford (1953). In addition to being used in landscape archaeology, it is today understood as an accumulation of physically-expressed events which provide a theoretical framework based on human and physical geography and anthropology (Harrison et al. 2004).

¹¹⁹ The landscape biography method has been developed as an interface by which the disciplines of ecohistory, historical geography, landscape archaeology, landscape ecology, geography, cultural anthropology and ethnology can combine their hillforts in reconstructing the often idiosyncratic social and environmental contexts that indicate land exploitation systems (Kolen, Renes, and Bosma 2016, 121).

(2400–150 BC) in the Croatian Adriatic region. This has been proven by various archaeological studies (Gams 1991; Marijanović 2017b; Moore and Menđušić 2019) with whom the first large findings of dry stone wall construction are associated. Their economy was mainly based on livestock management (Glamuzina and Fuerst-Bjeliš 2015, 42) observed in dry stone wall enclosures surrounding the many *tumuli* (mounds of stones raised over a graveyard) in the region.

Orthogonal dry stone wall patterns are characteristic of ancient Greek (*khora*) and ancient Roman (*ager*) agricultural land (Suić 1956; 2003, 160–67). The Stari Grad plain on the island of Hvar is a great and unique example of the preservation of plots divided by a network of dry stone walls formed by the Greeks 2400 years ago. This plain represents a rare case of the best-preserved ancient cadastre in the Mediterranean and Europe (Čavić 2017). The Middle Ages were the time of feudal systems marked by large open pastures lined by dry stone walls (See: Kulušić 2004, pp. 75–76), the intensive use of agricultural land in and around settlements, and the establishment of a network of settlements and roads. However, landscapes of medieval feudal organisation and prehistoric remains of hillfort structures represent only a part of Croatia's total cultural dry stone wall landscape. The second period of the Venetian rule (1409–1797) was characterised by the economic doctrine of physiocracy, which continued even during the short French rule in the early 19th century. This period consisted of attempts to improve the generally poor state of agricultural production. Therefore, many of the current olive groves and vineyards of the Cres-Lošinj archipelago are the remnants of this period. The second half of the 19th and the beginning of the 20th century were characterised by viticulture conjuncture and wine production and significant population growth. The subsequent collapse of the economy was soon followed by a crisis and emigration. The first three-quarters of the 20th century were characterised by insufficient success in the revitalisation of viticulture, and the land reform after the World War I led to a peak in emigration (Stražičić 1997). In some cases, many of the mentioned manifestations of dry stone walling can be traced to only one locality (e.g. the Cres case study or the case studies of similar coastal ancient towns). However, a large part of the current landscapes is also the result of short-term landscape transformations.

5.1.2. Short-term transformations

Kale argues that the most prominent Croatian dry stone wall landscapes (agricultural terraces and orthogonal enclosures) have been triggered by the same globalisation process that continues pressuring them today; and that these landscapes are, in fact,

quite recent and were formed because of short-lived (and, thus, intense) transformations in the environment (Kale 2010, 455). They were guided by the external large-scale environmental and socio-political events of which the Adriatic region was part. These events are primarily related to an increase in prosperity and population in general,¹²⁰ as well as an increase in the population of these islands¹²¹ and very favourable conditions in viticulture (See also: Bonardi 2019, pp. 9–14). Such favourable conditions were caused by the pandemics of grapevine diseases that first hit the leading regions of France and Italy, ease of international sale through established Austro-Hungarian trade links and the empire's large market, and to the partial transfer of land ownership from large landlords, the state, or communes to the wider population (Kale 2006; Kraljević 1994; Kulušić 2006; Trogrlić 1980; Žuvela-Doda 2008). As the phylloxera pandemic started decimating the winegrowing regions of France, Italy, and Spain in the second half of the 19th century and the first half of the 20th century, Croatian territory provided a new area for vine growing, which led local farmers to strenuously extract what little soil was left, even in the farthest rockeries:

'In our country, the most complex dry stone wall structures were erected in the period of only two generations (Kale 1998: 79). It is not accidental that the beginning of the golden age of the Croatian dry stone wall took place during the first years after the new favourable legislation that allowed ownership of land¹²² in the mid-1870s. In the agricultural sector, this is the period of the arrival of phylloxera in Europe, with higher Western European wine demand from countries that had not yet been affected by this disease, to the years when phylloxera finally arrived in these areas and caused rural demographic decay. The coastal cultural landscape before and after these agrarian divisions is like two landscape worlds' (Kale 2012, 258).

The favourable conditions in viticulture in coastal Croatia lasted from 1870 until 1890. This period experienced a collapse after 1890, attribute to political causes as well. For example, the so-called 'Wine Clause' of 1891¹²³ between the Austro-Hungarian Empire and Italy allowed Italy to export wine to the Austro-Hungarian Monarchy with a

¹²⁰ Historical chapters on dry stone walls in the Mediterranean usually refer to the end of the 19th century as a period of expansion of arable land and terraces due to increased population and prosperity (Barbera et al. 2015, 239, 315). Certain papers precise spatial analysis of this expansion: case studies of the valley of Brenta river in Italy (Chemin and Varotto 2008; Perco and Varotto 2004) and Dalmatia (Čuka et al. 2017).

¹²¹ During Austro-Hungarian rule, censuses became frequent, reporting an almost two-fold increase in population over a period of 100 years (1815–1910) (Stražičić 1997, 73).

¹²² Liberation from feudal relations.

¹²³ Annulled in 1904.

minimum customs duty. With this agreement, the internal Austro-Hungarian market was no longer a profitable market for Dalmatian products. Furthermore, because of the lack of stimulation from Austria towards Dalmatian winegrowers, attempts to cultivate vineyards on American rootstock progressed slowly.

It should also be emphasised that during the 19th century Croatia, while it was part of the Austro-Hungarian Monarchy, experienced a significant rise in population. Dalmatia and Istria, regions under the Austrian part of the Monarchy (and the ones from which emigration was the highest), were not densely populated but were considered agriculturally overpopulated because of the pronounced unfavourable land structure, especially along the coast and on the islands, where the emigration started (Antić 1995; Bonardi 2019; Čuka et al. 2017; Kraljević 1994).¹²⁴ This contrast is also why this demographic decline and land abandonment are so pronounced and still vivid in the second-hand recollections of the older local population.

The introduction of new phylloxera-resistant vines in the first half of the 20th century again brought about certain transformations in the landscape, due to the increase of the soil depth required for tillage and new stone that had to be deposited in dry stone walls (Gams 1991, 84). However, some of the soils of these new lands did not prove to be suitable for vines, which caused the final vine-growing collapse in the interwar period (Jelaska et al. 1954, 44).¹²⁵ Even in the second half of the 20th century, which was characterised by a demographic decline, some areas were subject to new land reclamation and are praised today as part of the national identity (e.g. Primošten vineyards).

Bearing in mind the abovementioned generalised historical reconstruction of the Croatian Adriatic region, it needs to be deciphered whether current general explanations of these landscapes can be applied within the local histories of Cres and Lošinj using comparative methods.

¹²⁴ This is not an exhaustive list of all the authors who have written about the wine conjuncture. Those listed are some of those relevant for this region.

¹²⁵ This course of events is representative of one of the following case studies; see sub-section '5.4.3. The *Lovreški* vineyards'.

5.2. Importance of the historical interpretation

Dry stone walls' manifestation in the landscape, due to their aesthetic value and increasing 'natural' outlook, produces a certain anticipation for their long-term history, nostalgia, and sustainable and ecological formation (Kale 2019). This is noted especially in the public discourse (Puljak 2014, 40) but also within other professional and scientific studies. According to Kale, getting lost in this ahistorical context might discourage scientific research and impeach conservation efforts: 'If a certain good is constantly being represented as eternal, then its conservation is, in principle, superfluous' (2010, 454).

The fact that the technique of dry stone walling and terracing is proven to originate from the Neolithic Age (Bonardi and Varotto 2016, 36) might have influenced the perception that all dry stonework is prehistoric. For example, it has long been considered that the people of the Neolithic period used dry stone shelters (*kućice, bunje*) as permanent residential solutions, though this was finally brought into question by Kale. Based on all ethnographic data, he noted that there were no such buildings on archaeological sites that would prove their residential use (since they did not have sufficient proportions and architectural solutions needed for living). Thus, they are attributed to the agricultural and animal husbandry temporary sheltering solutions. Even the most complex structures (multi-chamber structures with inner hallways) have been dated into the end of the 19th century (Kale 1998, 79–80).

The Primošten vineyards are a dry stone wall-delimited area of 18 ha which, in 2003, became a graphic background for Croatian postage stamps (*Figure 147*). Therefore, they are perceived as an important Croatian dry stone wall heritage archetype. However, their formation was a result of a by-order implementation of a geodetic design in 1947 during the period of communist collectivisation. At this time, Primošten vine growers were 'the executors of an order', who had to 'pull out of their hats the locations where they would plant the vine for the new state winery' (Kale 2006, 85). The cultivation of grapevines in the wider area of Primošten dates back to the 8th century BC, and this recent land reclamation was indeed achieved by mirroring the surrounding area of older origin. Ultimately, though, the protection and recognition regarded only the post-1947 formed landscape (UNESCO World Heritage Centre 2007).



Figure 147. Primošten vineyards, which became a graphic background for Croatian postage stamps in 2003 (Hrvatska pošta (Croatian Post) 2003)

Another myth regarding historical interpretation that has been proven false is the exaggeration of the ecological aspect of the dry stone walling (Kale 2019, 92). These large-scale landscape transformations can be deemed harmonious and sustainable only with the passage of time and the sustainable use of the current communities. However, it should be taken into consideration that in their origins, they were compelled by enabling the economically efficient monoculture (vines or olives), thus significantly impacting the previous ecosystem. Because the vast majority of extremely steep slopes, remote areas, and uninhabited islets have never been cultivated again, it can be affirmed that labour-intensive terrace construction and maintenance were only possible under extraordinary socioeconomic conditions.

Within this discourse, it should be emphasised that crediting these structures with timelessness does not necessarily mean that each of the constructions withstood the rigours of time from the initial date of stone-placing. This matter also refers to the potential of restoration of the dry stone wall constructions in the same place as previous ones, resembling the previous (or surrounding one) in style, shape, and construction (Puljak 2014, 42).

The aim for the historical and environmental exactness of landscapes' formation, even if they are very recent, does not suggest segregating certain landscapes from the umbrella term of heritage. Indeed, the recentness of a certain dry stone wall landscape formation might enhance such landscapes' heritage value since they are more relatable to present communities than those from the Greek or Roman past. This is because relatedness and belonging, in a valorisation sense, might rival the antiquity of a historic artifact. The

concept of landscape heritage matured into celebrating the continuously evolving environment and the community's perception of it (Council of Europe 2000; Gambi 1973; Sereni 1961). Along the Croatian coast, dry stone wall heritage reconstructions have been fuelled by imminent threats of their devastation. The fear of the loss of something the local community is related to – namely, the dry stone wall shelters (*kažuni*) in Vodnjanština and the dry stone bridge on the river of Krupa (*Kudin most*) (Kale 2016, 167–68) – initiated efforts to preserve them, resulting in formal protection. Furthermore, exact historical interpretations and understandings of the broader socioeconomic context serve as reminders that dry stone wall landscapes transcend the boundaries of local or national heritage, or, as Kale writes, 'Croatian dry stone walls are European dry stone walls, built with Croatian hands' (Kale 2019, 93).

5.3. Challenges and clues concerning research on the history of dry stone wall landscapes

There are a few underlying difficulties in the dating of the dry stone walls. Firstly, landscape transformation and the concomitant dry stone walling is poorly substantiated within historical sources. The genesis of cultural landscapes remains a key issue in many geographical studies (Jansen-Verbeke and McKercher 2013, 242), although research has generated new insights into landscape history in the last three decades (Kolen, Renes, and Bosma 2016, 121). This is also the case for the dating of dry stone wall landscapes (Gadot et al. 2016, 397–98; Šrajter 2019, 380; S. Turner, Bolòs, and Kinnaird 2018, 1–3). The lingering historical uncertainty causes considerable frustration, especially since it seems logical that the diversity¹²⁶ and dense distribution¹²⁷ of this vernacular architecture would provide a more prolific and reliable 'key' to clarifying their formation. This is especially the case considering that dry stone walling and terracing are techniques have been present for millennia (Caulfield, O'Donnell, and Mitchell 1997).¹²⁸ One of the main reasons is the fact that landscape transformation and the enclosures of dry stone walls were secondary incidental products of socioeconomic conditions and, therefore, are not a predominant part of historical written sources (Scaramellini 2008, 10–11). Specifically in

¹²⁶ See chapter 3 - Revealing the dry stone wall heritage of the Cres-Lošinj archipelago.

¹²⁷ See chapter 4 - Mapping the dry stone walls of the Cres-Lošinj archipelago.

¹²⁸ In Ireland, dry stone walls constitute the only prehistoric retaining or boundary feature that is still used (Feehan 2003; in Collier 2013, 142).

the case of karst environment, such is the Cres-Lošinj archipelago, archaeological prospection which investigates historical landscapes (N. Doneus, Doneus, and Ettinger-Starčić 2017, 762).

Secondly, the current dating methods are either not completely accurate or are largely unavailable. Physical methods such as radiocarbon and luminescence dating are not always applicable. For radiocarbon dating to be possible, the material must once have been part of a living organism (i.e. stone and sherds of ceramics cannot be directly dated by this method unless there is some organic material embedded in them or left as a residue). This type of dating has been regularly used in archaeology (Casanova et al. 2020; Caulfield, O'Donnell, and Mitchell 1997, 14) despite certain obstacles, such as contamination and the reservoir effect. In the case of the dry stone walls, the use of this kind of dating would depend on whether organic material has been present in its lacunas (and for how long). Optically stimulated luminescence (OSL) dating depends on the presence of quartz or feldspar minerals in the stone (S. Turner, Bolòs, and Kinnaird 2018, 927). Both methods are costly and invasive (i.e. they involve the decomposition of the analysed structure and imply the need to deconstruct and reconstruct a wall (Šrajer 2019, 238, 404). Nevertheless, both can be applied to terrace sediments (Bevan et al. 2013; Ballesteros-Arias and Criado-Boado 2009; Gadot et al. 2016).

Lichenometry is another dating method that involves lichen measurements and their growth rate. It is a fairly inexpensive relative dating method that is conceptually simple and quickly implemented (Jomelli et al. 2007). The dry stone walls harbour high levels of lichens cover,¹²⁹ and, on the Cres-Lošinj archipelago, they are found in humid areas (Figure 148). They tend to grow at a slow and regular rate; some grow only 1 mm per year.¹³⁰ Still, other factors may cause various levels of inaccuracy. For instance, it takes years for the lichen to start growing after the construction of the wall, various exposures and micro-climate can intervene with this average growth, and a wall can sometimes be built with stones that already had lichens growing on them (Nylund 2006).

¹²⁹ Stone and concrete walls were associated with increased lichen cover compared with rocky walls, perhaps because they were erected in open areas, whereas natural rocky walls occurred in woody areas (Manenti 2014, 1886, 1888).

¹³⁰ The amount of lichen can be measured and then calculated to see how long it has been growing. It is mainly measured from a centre point to the outside edge. These centimetres can be multiplied by five to get the latest date on which the wall could have been built. This is how it has been assumed that the 'golden age' for stone walls was from 1775–1825 (Nylund 2006).



Figure 148. Lichens on a dry stone wall close to the village of Predošćica (2021)

Light detection and ranging (LiDAR) datasets have been used over the course of the last two decades in examining cultural and historical landscape features, especially in highly forested regions. LiDAR allows for such high-resolution imaging of the ground surface, and it often provides an overwhelming amount of data to interpret (K. M. Johnson and Ouimet 2018, 33). It has proven useful in determining the chronological order of cultivation and enclosing of sheepfolds (Bradford et al. 2020, 31). Unfortunately, in Croatia there are no publicly available LiDAR images on the level of the entire country. The use of LiDAR technology is restricted to certain sites of great interest (such as national parks) or at the request of private companies.

Early applications of the ground-penetrating radar (GPR) took place from the 1960s to the 1980s and were developed for the electromagnetic detection of objects up to several meters below the ground's surface.¹³¹ It has been used to measure soil quality and has obvious potential for archaeological excavations following GPR imaging (Ristić et al. 2020). On the archipelago, Doneus et al., while exploring the case study of a Roman villa on the island of Sveti Petar, using the method of airborne laser bathymetry (ALB) detected submerged walls (2013).

¹³¹ These early applications coined the now widely used name ground-penetrating radar, or the abbreviation GPR. This abbreviation is still widely used, even though modern subsurface radars have developed much wider applications deserving of the more accurate name surface-penetrating radar (Daniels 2004) or subsurface interface radar (SIR) (Ivashov et al. 2021, 1).

The settlements can serve as the indicators of older enclosing and dry stone walling due to the need for an immediate agricultural surrounding. However, the historical reconstruction of landscape-making can also be addressed by other indicators observable from the fieldwork and from cartographic data:

a) The constructive form of a dry stone wall

- Single walls are usually more recent than double walls. If they are not constantly repaired, they are rarely older than 150 years (Kulušić 2004b, 66).

- Low double walls (*barbakani*) are indications of past or present grapevine cultivation. The higher density of such walls within larger plots indicates newer vineyards (i.e. those constructed after the destruction of old vineyards with phylloxera). Older walls (those erected before phylloxera) are of a lower density and are usually located on the more favourable sunny sides of slopes (Kulušić 2004b, 66).

- According to Kulušić, the thickness of irregular, carelessly built dry stone (single, double, or multiple) walls is a good indicator of the relative age of the cultivated area: 'if they are surrounded by thinner walls, they are a sign of the continuation of the agrarian 'pause', when the arable land from the Quaternary deposits began to spread by clearing to unfavourable limestone (surrounding) land' (2004b, 67).

b) Toponyms – considered as part of the linguistic landscape, are indicators of the historical land use and the location of objects. Geographical names such as Novina,¹³² designate 'a newly cultivated area' and, in many cases, they may relate to the viticulture of the late 19th century. Toponyms Vela straža, Mala straža, Straža and Grač(c)jšće, and Gradišće can indicate a prehistoric hillfort.

c) Soils – Since dolomite soils are generally more apt for cultivation than other soils, the earlier dry stone walling probably commenced in areas with dolomite soils (Šrajer 2019, 80).

d) Pine forests – Their presence points to deliberate protection from strong winds and the restoration of forests' cover of the barren, overgrazed land (Jardas 1964, 137). Such pine forests are today found in the *ex-komunada* Orlec and Vrana, *komunadica* of Stivan, south of Lubenice. These were afforested during the Austrian or Italian rule. However, today's pine forests may also indicate previous vineyard plantations destroyed by the

¹³² Croatian for a new phenomenon, a new way of doing, a change that replaces something that precedes it (HJP n.d.).

grapevine disease. Such examples can be found in Punta Križa, around Jadrišćica and Bokinić Bay (Stražičić 1981, 4:205).

e) Other structures and objects present in the area include the following:

- The presence of *vaške* – An indicator of the vine-growing area, either in the time of vine favourable economic conditions or in their American-rootstock aftermath.

- The presence or absence of chapels and small churches – E.g. there is an absence of chapels/small churches on part of Veliki Bucavac constructed during the communist collectivisation (Kale 2019, 91). In contrast, the older rural regions have a high density of Romanic and Gothic churches – there are 175 medieval churches within an area of over 500 km² built over two hundred years, between the 13th and 15th centuries – specifically, 100 in the Town of Cres administrative unit (Solis 2014) and 75 in Mali Lošinj (Dlačić 2016, 105–6).

f) Demographic oscillations – The increase in the population during the 19th century caused denser and more systematic parcellation. This is noticeable in the pastoral dry stone wall landscapes (Kulušić 1999, 56), which have been divided into a regular shape that overwrites earlier irregular shapes¹³³ (Figure 149).

g) Dry stone wall landscape patterns – There are certain regularities which have been identified: regular rectangular patterns indicate systematic transformations in most cases.

In the case of this research, a detailed analysis of the latter indicator – that is, the dry stone wall landscape pattern (DSWP) recognition – will be applied to recognise characteristic dry stone wall landscape patterns and try to ascribe them to a historical period.

¹³³ This distinction was made to differentiate from the rectangular regular shapes of the Greek and Roman era.



Figure 149. Visible differences between older (disintegrated) and the newer dry stone boundaries are indicative of the irregular shape of the older enclosures in comparison to the newer regular pastoral enclosures (Konfin area, north of Srem). Base map: DOF5 2014/16. Source: (DGU 2021)

5.4. Case studies

The following case study areas were selected to reflect the long historical stratigraphy of the Cres-Lošinj archipelago (from the Bronze Age to the second half of the 21st century). These areas also show the variability in the form, density, occurrence of the dry stone walls, as well as current and past agricultural functions.

5.4.1. The prehistoric hillfort cultures

Prehistoric hillforts and fortified hilltop settlements were not initially anticipated to be the object of dry stone wall pattern research for two reasons: they occur more as point objects, rather than polygons. Furthermore, they are of different, more massive, dry stone construction than other structures. They do, however, fit into the category of 'individual enclosures', as individuated by Andlar, Šrajer, and Trojanović (2018, 763), and they have been previously addressed as 'hillfort landscapes' (Andlar 2012, 37–38).

Prehistoric hillforts, locally known as *gradine*,¹³⁴ represent a group of archaeological sites that still have an important position in the landscape of the archipelago. In this study, they drew attention during the vectorisation of dry stone walls. Available imagery both from 1953 and after 2011 are very helpful in their detection and, thus, are suggested as an additional important archaeological source for the Cres-Lošinj archipelago, as was initiated by Šiljeg (2006). Another important aspect is that including hillforts in this chapter of pattern recognition covers all the archipelago's historical eras of the archipelago. Moreover, the inclusion of the hillforts means including the very beginnings of the dry stone technique and adding archaeological value to the landscape at large. Since these hillforts can be found on almost every island of the Cres-Lošinj archipelago, the entirety of this 'fortified landscape' has been taken as a case study (*Figure 150*).

Traditionally, the eastern Adriatic hillforts were considered remains of fortified settlements. However, the great variability in their size and shape, the kind and extent of their enclosing structures, as well as the kind and quantity of material findings have been used as evidence for functional variability. Hillforts may have served as surveillance stations, refugia, cattle corrals, elite residences, or ritual foci (Forenbaher and Sikanjić 2006, 467). Marchesetti, Mirosavljević (1955; 1973; 1956; 1974), and Stražičić (1981, 4:106–13) registered 59 sites (Čučković 2017, Appendix), most of which belong to

¹³⁴ *Gradina* is an augmentative for *grad*, which means a fortified settlement in Croatian language.

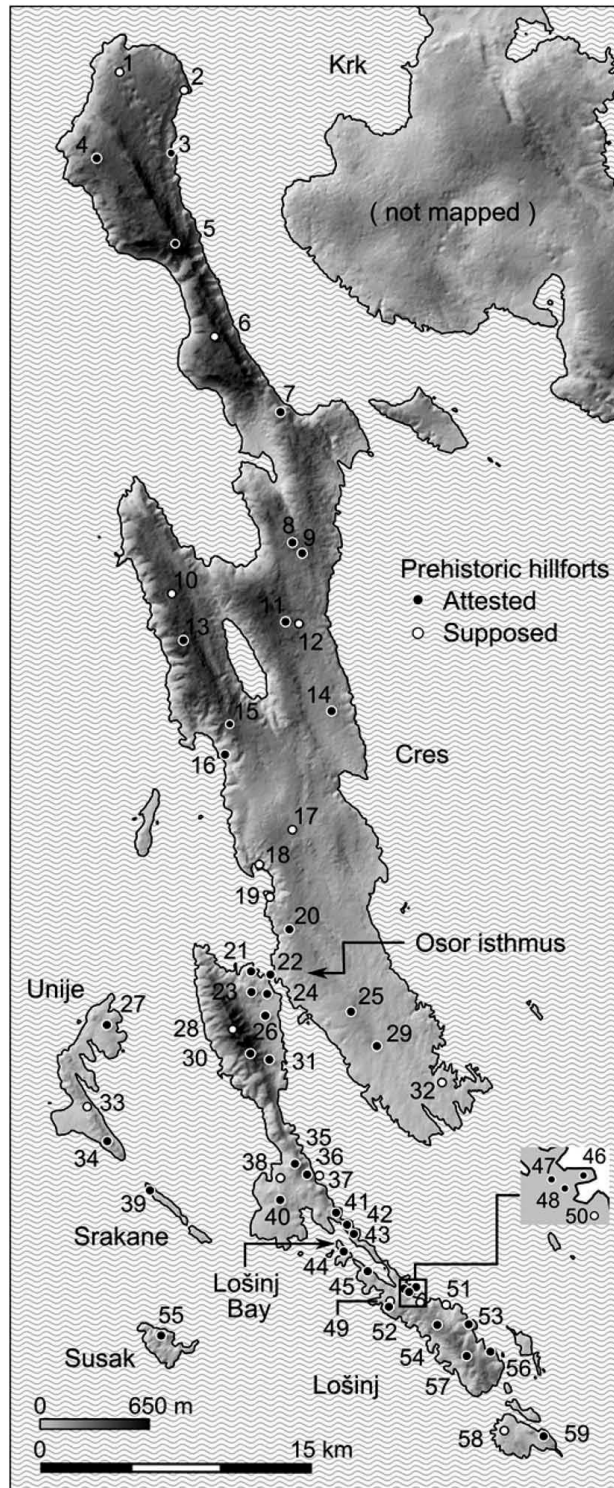


Figure 150. The prehistoric sites of the Cres-Lošinj archipelago based on the findings of Marchesetti, Mirosavljević, and Stražičić. Even though the archipelago's hillforts are described on the map as 'attested' or 'supposed', none of the hillforts have been part of a systematic archaeological prospection.¹³⁵ On this map, taken from Čučković (2017, 533), one hillfort close to Punta Križa is missing (between locations 25 and 29), which was later described by Starac (2011, 24).

¹³⁵ I thank Nives Doneus for the conversation.

the Bronze and Iron Ages (approx. 1600–900 BC) (Ćus-Rukonić and Glogović 1988, 495–96).

5.4.1.a Historical background

Oldest traces of dry stone walls are ascribed to the Neolithic age since such structures have been found in Göbekli Tepe (?) (Hughton 2011), Pokrovnik near Drniš (Croatia) (Marijanović 2017a) and Eneolithic settlements (Zucchi 2010, 13). Other important findings of dry stone construction are associated with communities of the Bronze and Iron Ages (2400–150 BC) which left behind many tumuli and hillfort sites along the entire eastern Adriatic coast (Chapman, Shiel, and Batović 1987; Faber 2000), with some findings of the hillforts dating back even to the Chalcolithic (or Copper) Age.¹³⁶

On the Cres-Lošinj archipelago, a lasting mark of the massive dry stone structures was left by the recognisable group of people and culturally specific group who inhabited these islands in the middle Bronze Age (1600–1400 BC). This ethnic group, whose name is not yet known (Zucchi 2010, 13), inhabited the area between the Gulf of Trieste in the north and the central Dalmatian islands in the south. They are sometimes addressed as the ‘people of the hillfort culture’¹³⁷ or the Bronze Age population. What is known is that they were the first to leave a lasting mark in the landscapes of Cres and Lošinj – for example, hillforts, settlements, and observatories bounded by dry stone walls, sometimes of cyclopean proportions¹³⁸ (Starac 2011, 21–22).

This anonymous population of the Bronze Age was conquered and assimilated by another group of people. For many years, they were assumed to be part of the Liburnians,¹³⁹ who inhabited this area from the 11th century BC. Their arrival represents the entry of this territory into the Iron Age, during which a number of the Bronze Age hillforts still remained in use.

¹³⁶ I thank Ranko Starac for this information.

¹³⁷ Author's free translation of the original: ‘*pripadnicima kaštelijske kulture*’.

¹³⁸ For example, the hillfort Garmožaj (close to the cairn of Vela straža on Punta Križa) has stone blocks of crushed limestone of 1,5 × 1 m in size (Starac 2011, 22).

¹³⁹ There is an ongoing dispute even on this matter, as it is possible that these people are also unanimous heterogenous people as ‘the Kvarner territory was neither an integral part of the “body” of the Liburnian group, nor was it its “marginal northern” part, although it was to be exclusively presented as such for centuries’ and that ‘we can talk about a separate cultural group on the territory of the Northern Adriatic – i.e. the *Kvarner group* of the Late Bronze and Early Iron Ages’ (Kavur 2014, 165).

Data recorded by ancient writers testifies to the Liburnian supremacy (thalassocracy) in the Adriatic; due to their seaward orientation, economy based on trade, regular fights and neighbourly disputes over borders, and access to water, hillforts needed to be maintained. Hillforts were placed in the area between the river Raša (Arsia flumen) in the north (border with the Histri) and river Krka (Titius flumen) in the south (border with the Dalmatae). The Liburnian area included these islands as well, as mentioned by the ancient writers who mentioned that 'Absirtide',¹⁴⁰ the ancient name of the Cres-Lošinj archipelago, was part of the Liburnian dominion (Zaninović 1988, 43–45). Liburnians had distinctive traits and were the first people identified on these islands. Due to their similarities with the broader 'Illyrian' and Adriatic territories (Batović 2005, 6), they were and still are commonly attributed to the Illyrian ethnic complex. However, research in recent decades shows that the term 'Illyrians' must be understood as a mixture of heterogeneous, albeit related, ethnic communities that have not fully merged into a single ethnic entity and which did not have the same origin (Stipčević 1989, 16).¹⁴¹ Since the Liburnian people never left behind any writings of their own, their historical records have relied on the writings of others, material findings, mortuary archaeology, and so on. Thus, these ramparts are important sources of knowledge of these people's (and the proto-Liburnian people's) identity and culture.

It is peculiar that half of the hillforts can be found on the relatively small island of Lošinj. Specifically, there are 30 sites in an area of 74 km², which translates to less than 3 km² of exclusive space per site. Their seemingly unnecessary great dimensions also had a functional role and a self-interested role – it is how people's wealth, strength, or status was demonstrated (Bourdieu 1994, 160–61; in Čučković 2017, 529). The most plausible cause is the key position of the island for maritime travel along the eastern Adriatic coast and the 'costly signalling theory', i.e. the expense invested in a message, especially when intended to communicate the social or economic status of an individual or a community. Therefore, '[a]driatic hillforts and specifically those of the island of Lošinj could then be understood as a series of overstatements of presumably sparse settlements of small islands, overstatements repeated over a considerable period, resulting in a network of conspicuous strongholds' (Čučković 2017, 541). Finally, prehistoric landscapes must

¹⁴⁰ The legend of how the archipelago obtained the name Apsyrtides and the town Osor (*Apsorus*) was named after *Absyrtus*, the Greek hero and the main character of the mythical stories of Argonauts, has no scientific foundation.

¹⁴¹ The ethnonym Illyrians served as a reference to patriots in Croatian history to the ancient peoples of the South Slavic area. A clear example of this is the Croatian National Revival (1835–1848), which took place during the 'Illyrian movement'. Using the Illyrian name as unique and neutral was chosen to seek unity among different peoples (Perić 2002, 35–70). This discussion is part of post-modern, post-structuralist works (Dzino 2008).

have featured extensive dry stone constructions such as field boundaries and various pastoral facilities, but these remain poorly documented due to various challenges: the need and tradition to recycle the stone material, the fact that there is no systematic archaeological exploration of prehistory (except for Osor (N. Doneus, Doneus, and Ettinger-Starčić 2017) and the many works of Blečić-Kavur (2014; 2015), and the inability to date the dry stone walls (without organic or archaeological materials).

5.4.1.b Dry stone wall pattern recognition

The pattern of the hillforts is identifiable through the remnants of their defensive structures. They are of wide, round or ellipsoidal shape from the aerial perspective (Figure 151, Figure 152). Their shape was conditioned by the shape of the hill's contour lines and their function. Some of them still have multiple visible rings of ramparts along the top two or three main relief contours (isohypses) (e.g. Sveti Bartolomej, Pukonjina (Figure 153), Maslovnik/Krunica, and Bulbin) or additional circular inner areas (e.g. Vela Straža [in Punta Križa],¹⁴² as seen from the NW angle in Figure 154). Vela Straža (PT) and Gračišće (close to Belej) have a slightly irregular, rectangular shape.

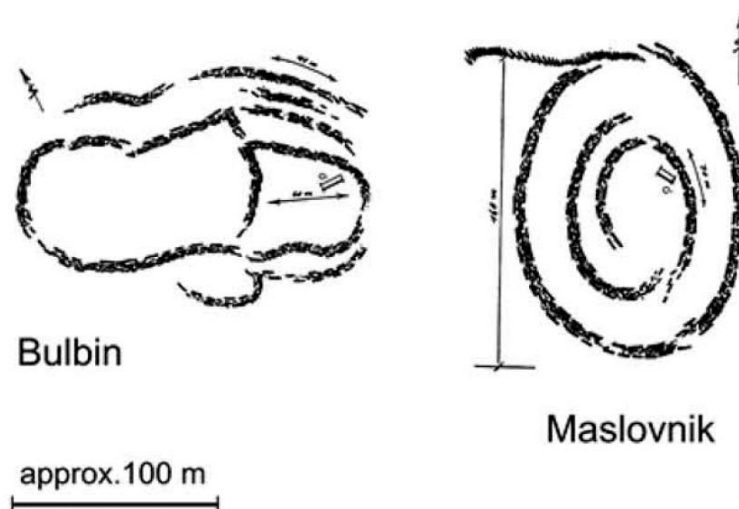


Figure 151. Common ellipsoidal shape of the outer ramparts: Ground plan by Miroslavljević (1974)

¹⁴² Other hillforts on the archipelago go by the name 'Vela straža', with the literal meaning of 'Great lookout', or 'Mala straža' ('Small lookout'), or just 'Straža', suggesting its function. The one referred to in text is the one located in the Punta Križa region. According to Starac (2011, 22), it would be more accurate to name it 'Garmožaj hillfort', since there is no actual hillfort on the peak 'Vela straža' (only a cairn).

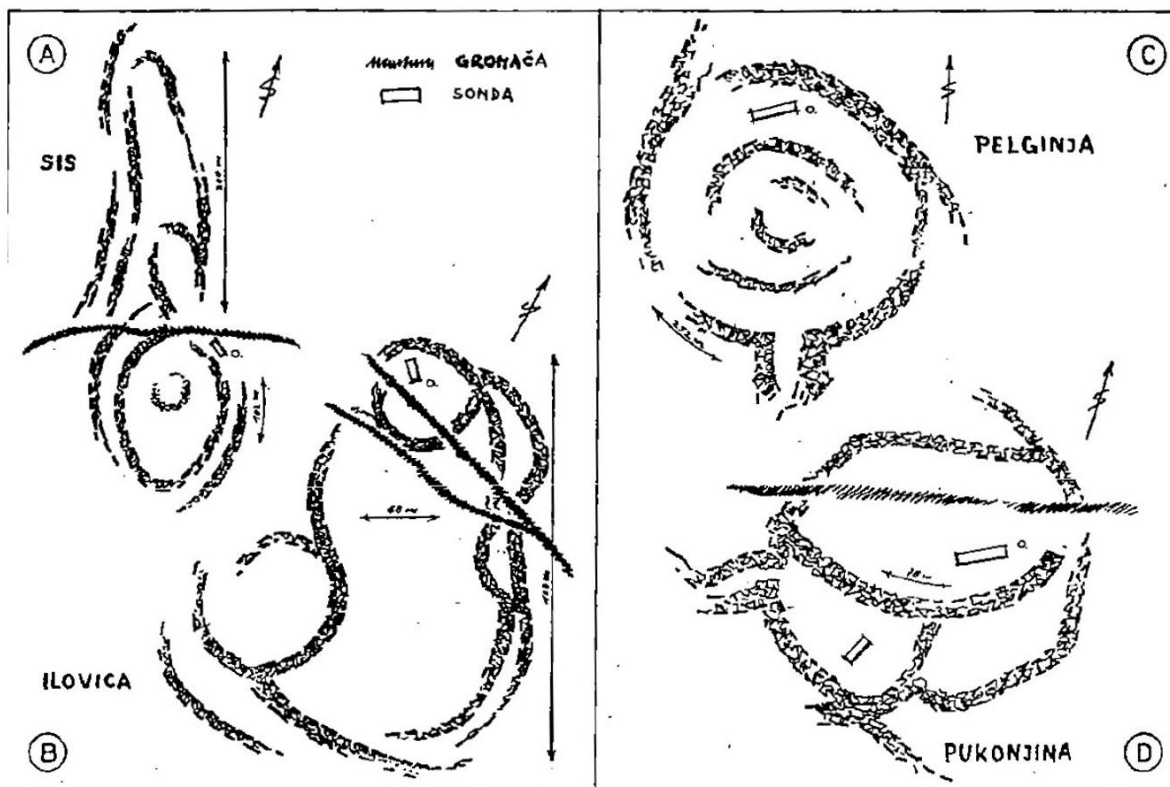


Figure 152. Hillforts of Sis, Ilovica, Pelginja, and Pukonjina, according to Mirosavljević's drawings (Stražičić 1981, 4:110). Gromača is a dry stone wall; sonda is an archaeological probe.



Figure 153. The hillfort of Pukonjina; only one additional rampart remains (2021)

The dimensions of their enclosed areas vary from 0.5–3 ha, with a mean value of 1.3 ha (Čučković 2017, 534). In the field, they are hardly recognisable and mostly resemble agricultural elongated clearance walls (*menici*). Another clue is the burial mounds or cairns – *tumuli* (Figure 154) – which also appear as clearance piles but are built conically. Their bases have a diameter of 10–15 m, and their heights reach 1–3 m (Stražičić 1981, 4:109). Without archaeological excavations, it is almost impossible to confirm if their function is agricultural (clearance stones) or burial.

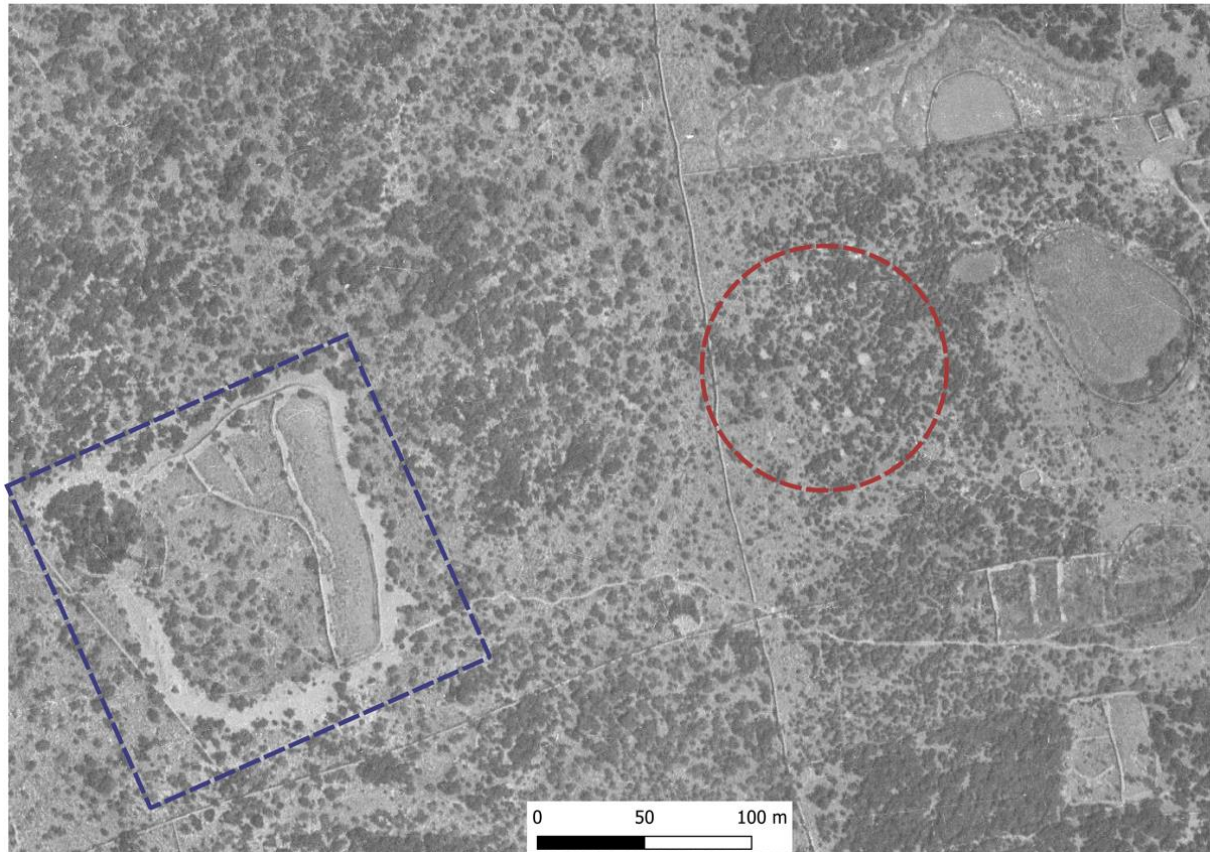


Figure 154. Prehistoric fort of Vela straža/Garmožaj (marked in blue), close to a shepherds' dwelling in Garmožaj (Punta Križa area). Forts are recognisable by their massive, now disintegrated dry stone ramparts. They are also recognisable by *tumuli* (marked in red). Dimensions: 128 m × 114 m, area: 12,620 m². Basemap: DOF53 (DGU, 2021). North is up.

The patterns of prehistoric hillforts may be compromised in some of the places due to the removal or relocation of sections of their ramparts. Island inhabitants used the rampart stones to build new dry stone walls for agricultural purposes. Such regroupings have largely changed the original constructions i.e. via the removal of a clear trace of the basic shape of the outer contour (Miroslavljević 1973, 76). Original traces may also be compromised by the karst topography and their location on the edge of a steep slope (Figure 157). Lošinj forts are even more imperceptible, as most of the island area has been transformed into terraced vineyards and olive groves (Figure 155).

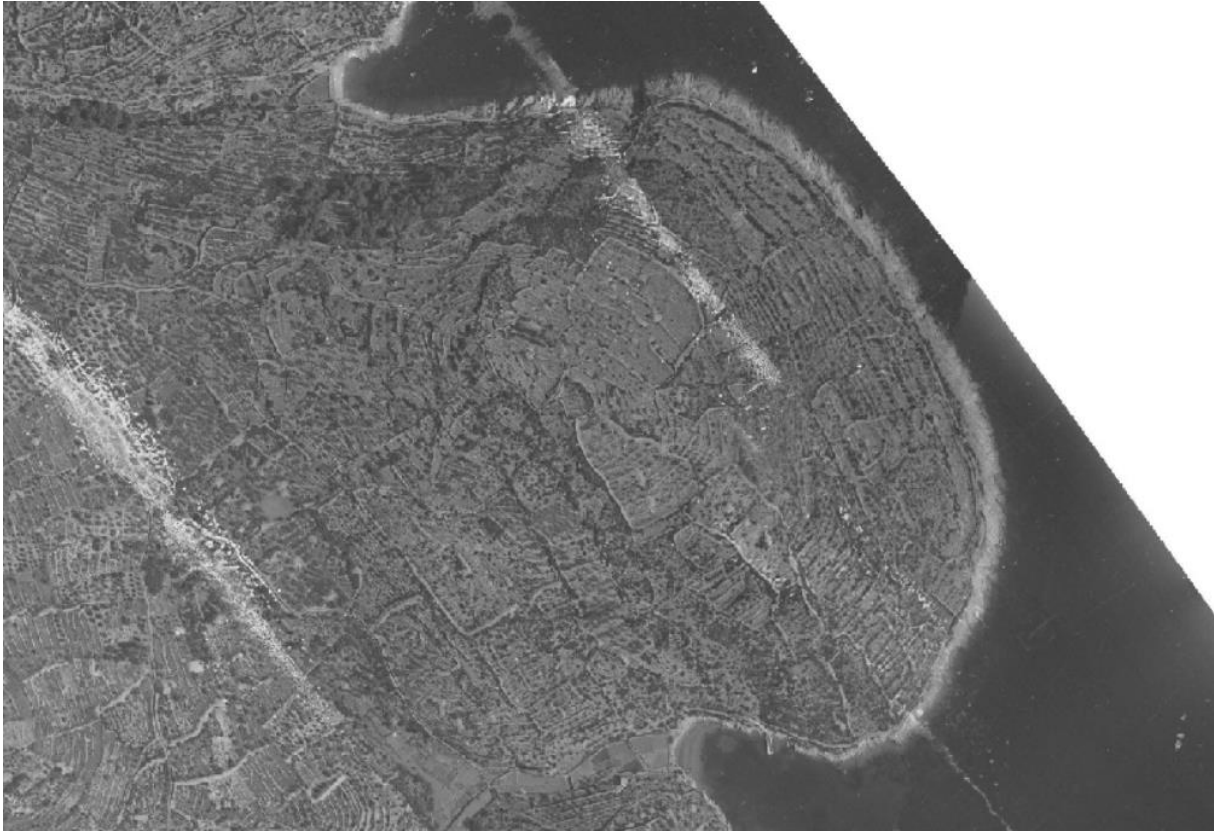


Figure 155. An example of an imperceptible prehistoric hillfort (Bulbin, island of Lošinj), which has been turned into terraced agricultural land. Basemap: DOF53 (DGU, 2021). North is up.

During the cartographic interpretation, another hillfort was recognised and assumed based on its shape (Figure 156). This hillfort is not yet part of the recorded archaeological topography (Ćus-Rukonić 1982, 12; Čučković 2017, 533). It was later recognised by Starac, who was led there after encountering ‘a school example of a spacious necropolis with numerous stone mounds of various sizes’ (2011, 24). According to Starac, this hillfort was a settlement, likely from the Bronze Age based on the multitude of burial mounds and shards of pottery.¹⁴³

¹⁴³ I thank Ranko Starac for the additional insights.

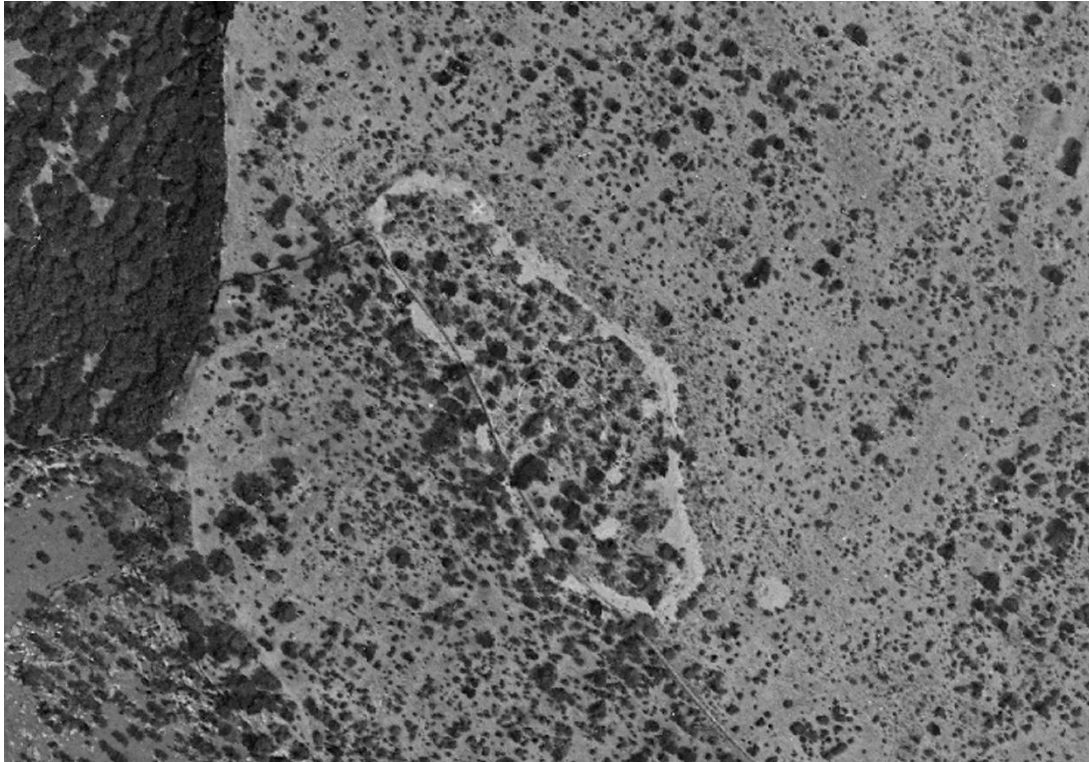


Figure 156. A nameless hillfort NW of the dwelling Murtovník (Punta Križa). New dry stone walls were built upon the rampart lines as part of the pasture border, probably using the existing stone material. Approximate dimensions: 172 m × 100 m, area: 12,500 m². Basemap: DOF53 (DGU, 2021). North is up.

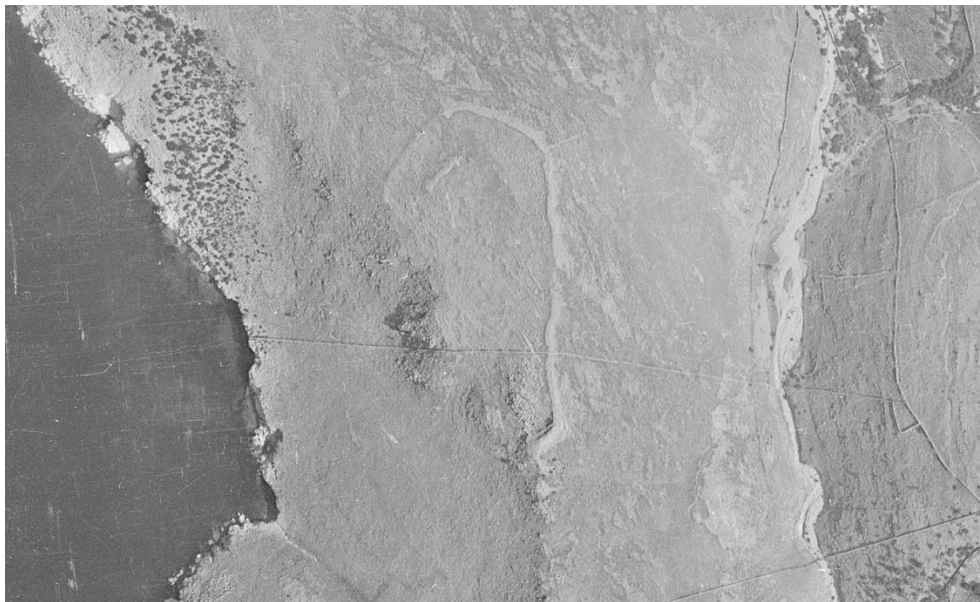


Figure 157. Hillfort Kuš (not attested), SW of Ustrine. This hillfort is an example of the missing contour western contour, which is due to the natural protection provided by the escarpment. Also, the western part of the rampart might have undergone erosion. Šiljeg (2006) attributes this hillfort to the Byzantine Empire (late antique period). Approximate dimensions: 265 × 90 m, area: 19,000 m². Basemap: DOF53 (DGU, 2021). North is up.

5.4.2. The town of Cres olive grove area¹⁴⁴

The research area of the town of Cres case study was defined based on a discernible network of densely distributed dry stone walls, as recognised from the aerial imagery from 1953. Thus, they encompass the full extent of the historically cultivated area (21 km²), including currently overgrown parcels within the Cres karst valley and the eastern slopes of the outer bays (Figure 158). Today, the area accommodates approximately 250,000 olive trees and 1500 sheep, amounting to 90% and 10% of the island's totals, respectively (OTRA 2017, 23).

The lithological base of the island consists mainly of carbonate rocks (limestones and dolomites), forming pronounced karst topography of scarce cultivable soil. This condition is why the main agricultural site of the island has been located in the semi-submerged dolina surrounding the town of Cres. In total, 2205 inhabitants are registered in the town of Cres (DZS 2022),¹⁴⁵ as are 181 registered businesses (family farms, crafts) dealing with agriculture (APPRRR 2021). However, this number does not include families benefiting exclusively from farming, as agriculture in Cres today is only an economic activity ancillary to tourism. Historically, this area and its immediate surroundings were representative of Mediterranean polyculture (subsistence crops in addition to olive groves and vineyards) in its, with a significant prevalence of market-oriented olive groves and vineyards, respectively. After the vine disease at the turn of the 20th century, it became almost an olive grove monoculture area and, after the 1950s, an agropastoral area.

¹⁴⁴ This paragraph explains in more detail the multifunctionality of this case study, as it was part of the article (T. Kremenić, Andlar, and Varotto 2021) and will be relevant for the final chapter of the thesis (Towards valorisation of the dry stone wall heritage).

¹⁴⁵ The number of actual and permanent inhabitants is, in fact, smaller. Many people retain the address of their residence on the islands to achieve certain financial benefits related to transportation.

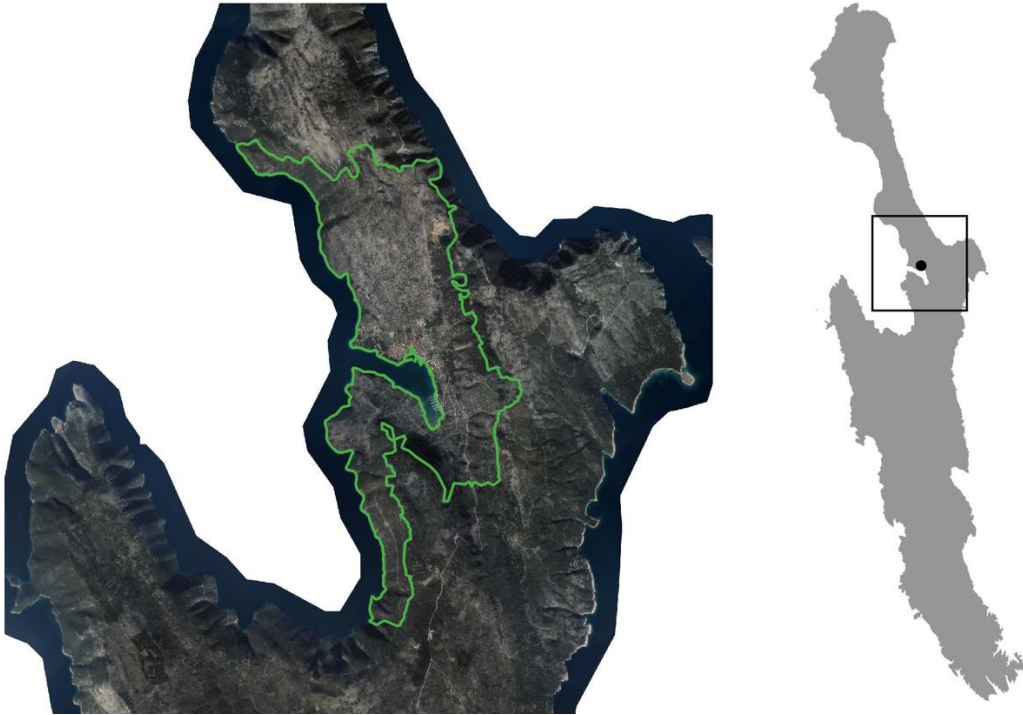


Figure 158. Outline of the town of Cres's agricultural area and its location within the island of Cres. Base map: DOF 2014/16 WMS



Figure 159. Olive groves and the karst valley surrounding the town and the Bay of Cres (Goran Andlar 2019)

5.4.2.a Historical background

The town of Cres has a long and lasting history dating back to prehistoric times, and it has been a constantly inhabited settlement since antiquity. Since the demise of the town of Osor in the 15th century and until the 19th century, it performed the role of the main administrative centre of the archipelago.

Traces of the late Bronze Age settlement have been archaeologically determined in the Piskel area (Ćus-Rukonić 2014, 13). Its ancient roots have been confirmed in its medieval town centre (Ettinger-Starčić and Ćus-Rukonić 2015, 11–12). Cres was a Roman Empire *municipium*, known as Crexi/Crepsa at the time. Based on the numbers of amphorae that were exported from Istria and the Kvarner islands, mainly to the Po Valley (Degrassi 1956), Cres was probably a centre of oil and wine production in Roman times. Roman rule created the basis on which the Cres economy relied on olive and vine growing, which developed in later times (Stražičić 1981, 4:120). Nonetheless, it is assumed that most of the dry stone wall enclosing and cultivation activities that happened in what we know today as the Cres olive grove occurred in modern history.

Reconstructing the formation of the Cres olive grove involved the verification of the unpublished manuscripts of Cres citizen and agriculturer Josip Kremenčić (2013).¹⁴⁶ It concerns the novelty of the hypothesis of a historical formation of the Cres olive grove, which he advocates as a systematic and strategic step in the production and marketing of olive oil during the second Venetian rule (1409–1797) and which was constructed within only 300 years between the 16th and 19th centuries. He further divided the formation of this area into three sub-periods for which he calculated corresponding percentages of land transformation by investigating the number of oil processing facilities registered by the Cres convent priests (Vlahović 1995, 101–12). The starting years of the transformation of the area (approximately around the 1550s) were established based on the request of Cres noble Petrisso de Petris, who obtained permission from the municipal authorities to graft wild olives with tame varieties in 1504 (Hugues 1900, 23–25). Other indicators for such a hypothesis are the following:

- Before the 1500s, there was remarkably little mention of olive groves or olive oil production. From the regulations of the Cres-Osor Statute (*Lo Statuto dell' Isola di Cherso ed Ossero* (Margetić [1441] 2012)) from 1441, it can be noticed that in the

¹⁴⁶ The year 2013 was considered, as it was found to be the manuscript's last entry date. Unfortunately, Josip Kremenčić's text was only posthumously submitted to the author of this thesis. Therefore, the accuracy of his assumptions had to be determined by literature analysis.

Medieval period, the economy relied on vine cultivation and sheep breeding, with very little mention of olive groves.¹⁴⁷ The provision which deals with the protection of fences (*'ograde'*, which probably denotes the dry stone walls) primarily refers to the fences which safeguard vineyards, gardens, grain, and ponds ([1441] 2012, 1253).

- At the end of the 15th and beginning of 16th century, olive grove purchase reports started increasing: As Vlahović (1995, 101–2) reports from the monastery archives documents, in the years of 1387, 1395, 1436, 1441, 1443, 1447, 1472, 1479, and 1489 (which testify to the purchase, selling, exchange, or inheritance of goods), there are mentions only of arable land, vineyards, gardens, pastures, and forests in Cres. There is no mention of olive trees. Only in 1496 and, later, in 1499 did he find mentions of land with olive trees in the area between the Cres monastery and the *Piskel* bay.
- Important early information about the cultivation of olives on the island of Cres comes from 1504 from the 'Book of Councils of the Municipality of Cres' which states that a Cres noble, Petrisso de Petris, received permission from the municipal authorities to graft wild olives with tame varieties. Four years later, he requested permission to graft another 20 olive trees (Hugues 1900, 24).
- Olive oil reserves were founded only in 1550 (Hugues 1900, 23–25);
- As part of the Venetian Republic, Cres was probably affected by the Venetian doge request of 1565 made by the Venetian doge Jeronim Priolus to the Brač prince Frano Dandolo, which includes a demand to 'transform every available Dalmatian surface into an olive grove': 'You must know that this city of ours (Venice) must import oil from foreign countries to supply its population. Therefore, we decided to do everything necessary to produce and import from our region as much oil as possible' (Krnčević 2007, 35).
- An increasing number of oil processing facilities were built between 1600 and 1900, including three mills in 1668, seven in 1698, 11 in 1795 (a year in which 11 private individuals unsuccessfully requested permission from the municipality to build new oil mills), and 24 in 1868 (Vlahović 1995, 107).

¹⁴⁷ The same can be found in the Starigrad Plain historical analysis from Čavić (2017, 38). Olive trees are mentioned very little, and olive oil seems to be used only for personal use. However, this might be due to the fact that communal statutes were mainly focused on their provisions on the viticulture, as this was the most profitable activity (Šrajer 2019, 123).

- In 1770, Alberto Fortis admired the people of Cres who ‘shaped the surroundings of their town into a garden to a considerable height’ ([1771] 2014, 141) and stated that the work of clearing the stones is done continuously. He mentioned that Cres olive oil, which is considered to be of the highest quality in the countries of the Venetian Republic, is the richest product on the island. According to him, Cres produced between 3000 and 3500 barrels (or 230 tons) of oil ([1771] 2014, 59–60), as well as wine, which is produced with only a few barrels of surplus and cannot be compared in terms of quality ([1771] 2014, 143).
- After the fall of the Venetian Republic in 1797, Venetian nobles fled from the island, and the people took power and ruled for one year. One of the decisions made by the people’s council was to clear the then-sylvo-pastoral area of Punta Grassa and allow the Cres farmers to reclaim it for agricultural purposes (Lemessi 1979, 443). This suggests that most of the area closer to the town was already used. This area was later denoted in the Austrian cadastre as a zone of vineyards with olive trees and is today discerned as one of the steepest narrow regular terraces within the olive grove.
- In 1798, the Austrian government-imposed taxes on olive oil exported from the town of Cres (Lemessi 1979, 518).
- The number of inhabitants increased from 2000 in 1553 (Vlahović 1995, 84) to 2474 in 1750, 2856 in 1850, 2911 in 1797 (Stražičić 1980, 127), 3289 in 1818, 4872 in 1855, 6034 in 1890, and 6375 in 1912.
- Austrian cadastral maps indicate almost a full reclamation of area and the significant prevalence of olive groves in 1821¹⁴⁸ (45% of the site is olive grove monoculture cultivations, with olive trees present in the arable land and vineyards while being less prominent in pastures). Pastures (20%) and vineyards (20%) are the next most represented types of land use. Overall, 90% of the research area was already agriculturally active (Figure 160).
- In 1853, the municipality had 24 oil mills in Cres, built by many joint co-owners (Lemessi 1979, IV p. 358). The yearly yield of these mills was 2000 barrels¹⁴⁹ (Lemessi 1979, 356).

¹⁴⁸ Archivio in nota ‘Archivio Di Stato Di Trieste - Progetto Divenire - Documento: 114 b 28: Mappa Catastale Del Comune Di Cherso Foglio XXVIII, Sezione XXVIII (1821 - 1837)’ n.d.)

¹⁴⁹ Cres olive growers have not produced this much oil, even in their most fertile years, in the last three decades.

- In 1891, Hirc reported that the town of Cres was 'surrounded by an enormous forest of olive trees' and that most of the olive oil barrels in the bay of Rijeka were supplied by the town of Cres (1891, 301).
- In 1900, Cavallini reported about 1288 ha of olive groves and 300,000 trees. Production decreased and amounted to 700 kg of olives (or 70 kg of oil) per 1 ha. He attributed this decrease to a lack of pruning (which is peculiar, considering that 130 years earlier, Fortis praised Cres farmers especially for this agrotechnical measure). The total production in the municipality of Cres was 900 tons of olives, or 90 tons of oil (Cavallini 1900, 37, 40, 43).
- Pozzo-Balbi mentions 'a million trees' in 1934 around the town of Cres (1934, 33). This number is certainly exaggerated, but it testifies again to the prevalence of olive trees.

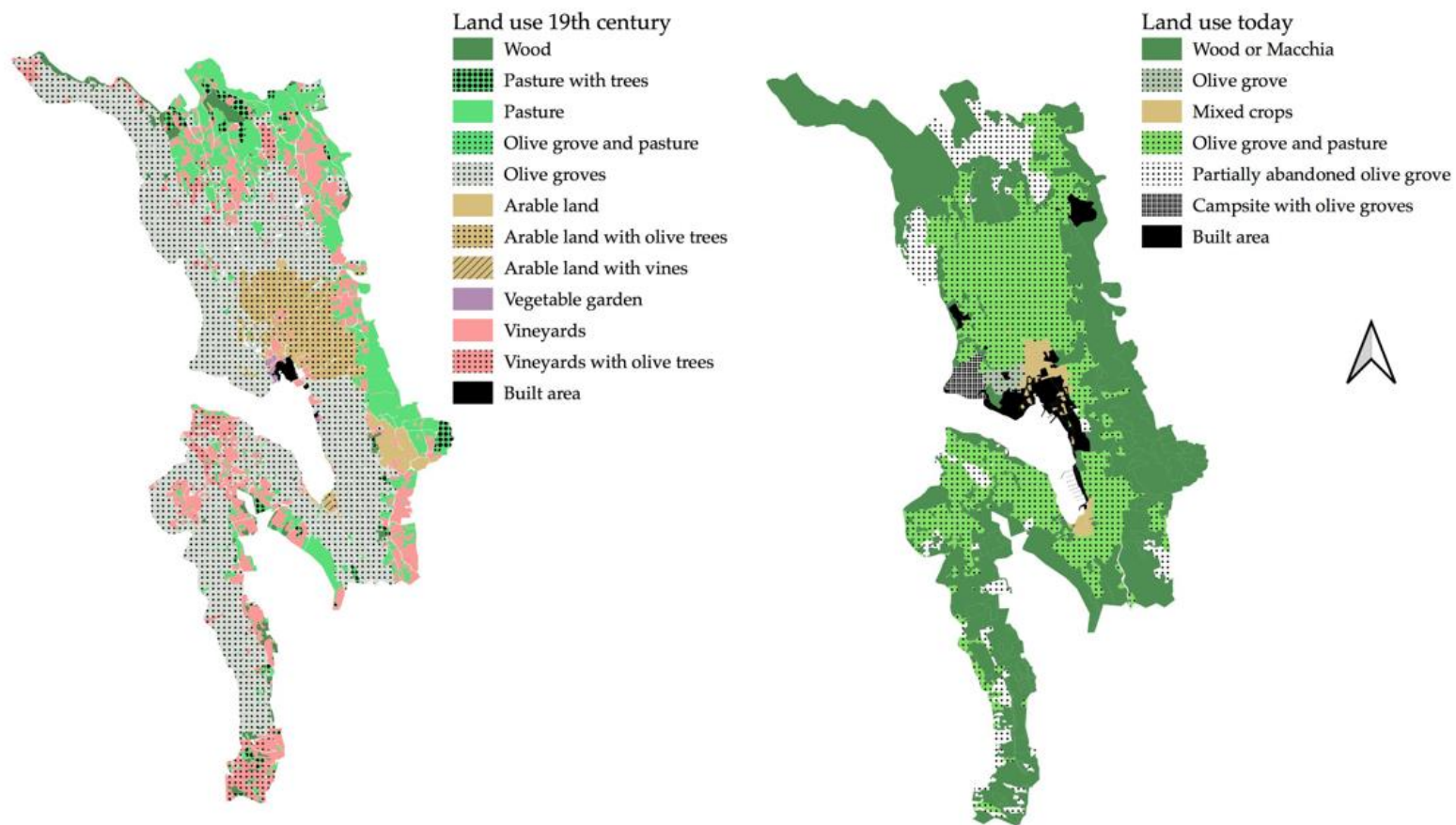


Figure 160. Comparison of the land use in the period 1821–1837 and 2016. GIS elaboration was based on a cartographic analysis of Austrian cadastral maps, digital orthophoto imagery from 2016, and ARKOD land registry (Goran Andlar and Tanja Kremenić, 2021)

What is not seen on the Austrian cadastre is that the dry stone wall terraces surrounding the town of Cres were also used for the plantation of Dalmatian chrysanthemum (*Tanacetum cinerariifolium*). This is another short-lived culture which brought significant wealth to the local inhabitants, especially during WWII (Rossi 1926, 92–94). Emphasis has been put on the whereabouts and prevalence of either the olive trees or vineyards to clarify which culture might have driven more land reclamation. Naturally, every piece of land has been used in order to exploit its maximum capacity; therefore, many plots have had both of the cultures cultivated.

In summary, the landscape associated with the town of Cres is a patchwork of centuries-long enclosures of the land. The vineyards and olive groves determined the spread of dry stone wall enclosures, which have probably been most extensively spread in modern history during the vine conjuncture.



Figure 161. A rare high-quality photograph taken at the beginning of the 20th century. In addition to the paths that lead from the town to the olive grove parcels, regular orthogonal patterns of arable crop land close to the town are discernible. Today, this ground is mostly used for new house construction. (D. Rendulić - Agencija za fotodokumentaciju Zagreb, 1960s)

5.4.2.b Dry stone wall pattern recognition

GIS vectorisation revealed more than 2605 km of dry stone walls in 1953 within an area of 21.6 km², with a high density of 120 km/km² (or 1206.8 m/ha). A large part of the Cres olive grove follows a particular spatial design identifiable by the base and consecutive units of *graja* (Figure 162). According to J. Kremenić, a *graja* (from Croatian v. *ograditi*: to enclose) is a parcel enclosed on the sides by elongated dry stone clearance walls (*menici*), intersected with terraces and retaining walls (*barbakani*) and interconnected with a network of dry stone wall lined pathways (*klananci*). During land reclamation, one family had the right to transform pastoral or agriculturally inactive land into an agricultural plot. Upon reclaiming one plot, they had the right to request another one.¹⁵⁰

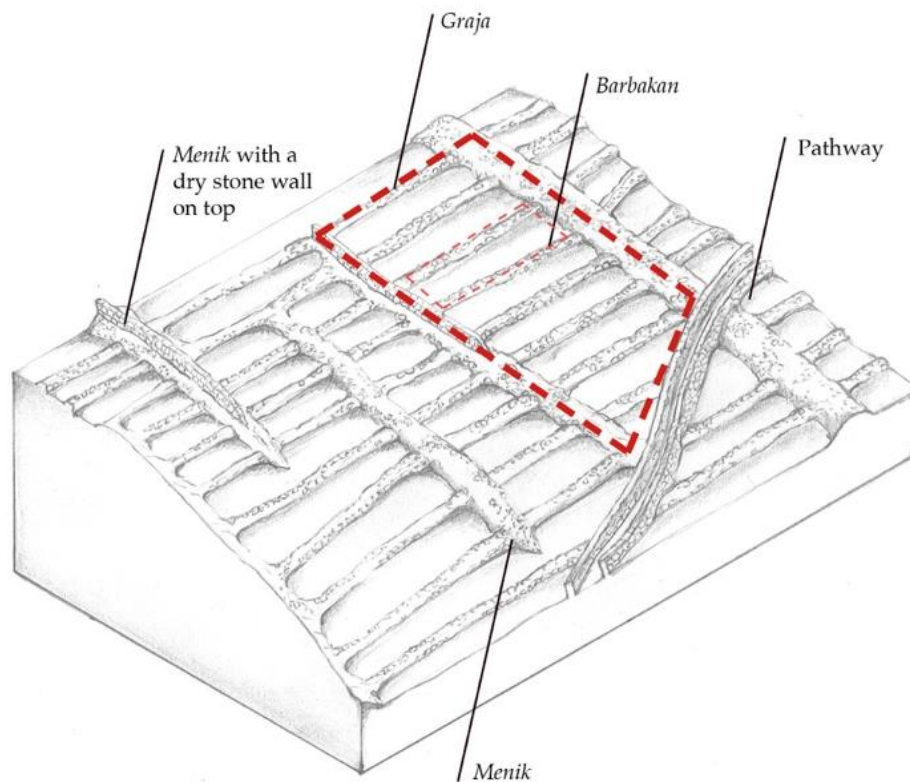


Figure 162. The main components of an agricultural plot within the Cres olive grove, according to J. Kremenić, called *graja* (elaborated by Andlar and Kremenić, based on the drawing of Anita Trojanović)

Stražičić states that the vineyards of the town of Cres area are noticeable from the 'gromacine' (probably implying *menici*, T.K.) on the upper hills (1981, 4:204). However, this cannot be the rule since *gromacine* or *menici* can be found in most of the area. *Graje* are not the only agricultural unit. The typology starts from main types – in this case, crop

¹⁵⁰ Similarities are noted for the island of Ilovik. See paragraph: 4.6.4. The island of Ilovik.

karst enclosures and terraces – while further subtypes are distinguished on a structural basis.

Crop enclosures are defined as a dry stone wall-lined plot found in rocky karst areas with scarce or absent soil. Cultivation in such areas was determined by the removal of stones and their stacking in walls and clearance walls, thus creating small, fragmented patches of soil for crop growing. In the area of the town of Cres, they are located on flattened or mildly sloped areas where terracing was not present. Recognised types are regular enclosures with variations of regular patterns of inner dry stone wall structures; irregular enclosures with regular patterns of inner walls and retaining walls; irregular to regular enclosures surrounded by elongated clearance walls and containing inner clearance walls; and irregular enclosures with irregular patterns of inner stone walls and clearance walls (Figure 163).

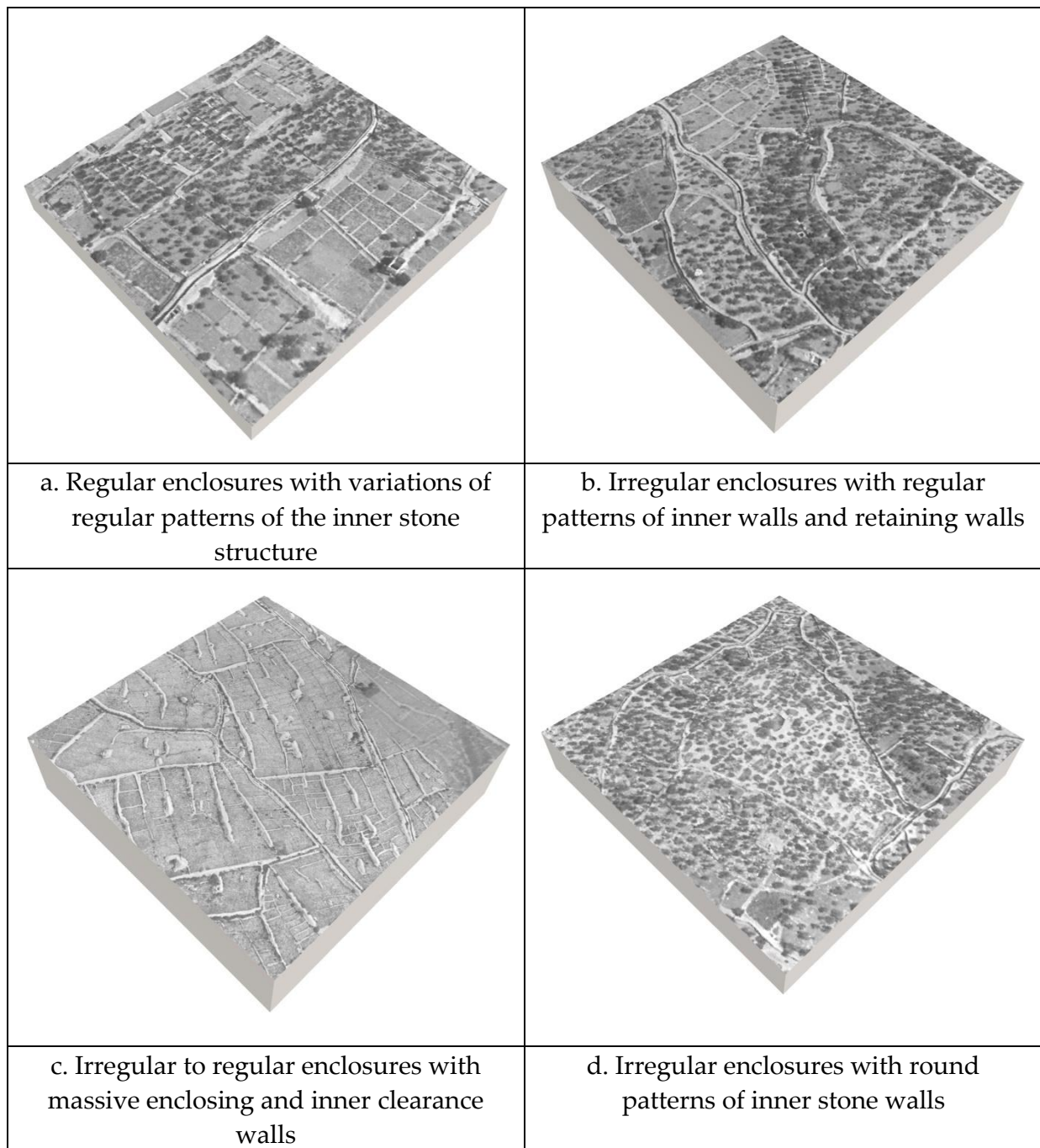


Figure 163. Types of karst enclosures found in the Cres olive grove. This visual elaboration is based on 1953 digital orthophotos and the digital elevation model (25 × 25 m) (Goran Anđlar and Tanja Kremenčić, 2021)

The first subtype is the regular enclosure (Figure 163a). This type can be found in the area immediately to the east of the town of Cres (Figure 161). Most of the enclosures are irregular with a regular inner structure (Figure 163b); occasional massive enclosures and inner clearance walls can also be found (Figure 163c). A rare and particular pattern is the one of *vrčići* (lit. ‘little gardens’), in which most of the area is covered in very low dry stone wall. They contain a round surface of soil within which only one olive tree is

cultivated (Figure 163d).¹⁵¹ The outer structure is irregular, but the inner soil-intended area is characterised by certain regularity (round shape) (Figure 164).¹⁵²

Dry stone wall terraces are defined as flattened plots on inclined terrain for agricultural, silvicultural, or pastoral use. The following types of step terraces are recognised: a) step terraces with regular to curved patterns and narrow terraces, with or without minor enclosing clearance walls; b) step terraces regularly enclosed with vertical enclosing stone clearance walls; c) step terraces regularly enclosed with massive vertical enclosing walls and inner stone clearance walls; and d) step terraces irregularly enclosed with spontaneous patterns of massive stone clearance walls (Figure 165).



Figure 164. A rare and particular pattern is the one of vrtiči, in which most of the area is covered by a very low dry stone wall. Single olive trees are cultivated on round soil surfaces (Goran Andlar, 2016)

¹⁵¹ The location of the figure of the pattern in Figure 160-d has recently been erased due to the new housing infrastructure, but similar patterns can also be found 150 m north of it.

¹⁵² Apart from the great amount of stone, according to what was found by Sergio Gnesda (an independent researcher and enthusiast on the topic of the dry stone walls in the region), this cultivation technique was planned to retain moisture in the soil (private correspondence).

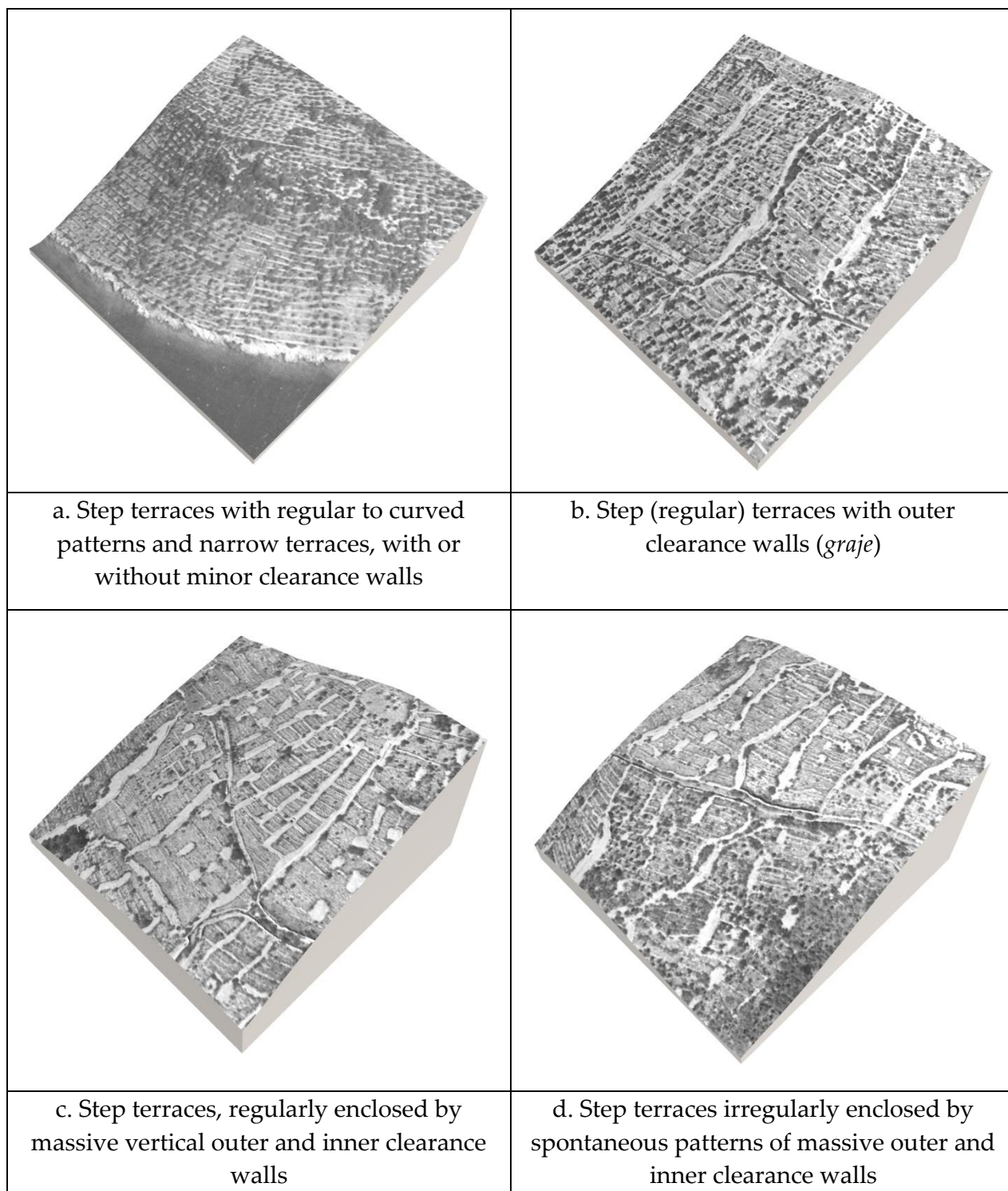


Figure 165. Dry stone wall karst terraces representative of the Cres olive grove. The visual elaboration is based on aerial imagery from 1953 and the digital elevation model (25 × 25 m) (Goran Andlar and Tanja Kremenić, 2021)

Step (regular) terraces are the most common ones in the town of Cres area (Figure 165b). These terraces are lined with dry stone clearance walls following the slope. Inner clearance walls are also common, as depicted in Figure 165c. Usually, the clearance walls are denser the higher the slope is. With the increase of the energy of relief, the

irregularity of the clearance wall pattern also grows, leading to the type of terrace shown in Figure 165d. It can be noticed that most of these patterns are different only in their (ir)regularity; they are common in that they are all lined with stone clearance walls, which corresponds to the logic of *graje*. Step terraces with regular to curved patterns (Figure 165a) are typical in the Croatian area, but relatively uncommon in the Cres olive grove. The most prominent example is the one from the slopes below the church of Saint Salvador (toponyms: *Mlada Gavza*, *Paskalova Dražica*). The division of the cadastral parcels in this area is particular. All of them are of a similar area (between 400 and 600 m²), and they are all of a regular rectangular form, belonging to many different Cres inhabitants, suggesting this area was part of an organised reclamation.

The noted patterns and their connection to the relief suggest that the Cres farmers always aspired to the regularity of the patterns – most of the plain and more accessible land is of regular form. Even though the existence of the Roman grid in the area near the town of Cres has been mentioned in the literature (Stepinac Fabijanić 1999), it has not been confirmed. The theory may be plausible due to the Romans' centuries-long presence in the region, Cres's status as a Roman town (*Crexi*), and the regularity of the immediate plain area (between *Kurinina* and *Poje*).

By analysing the dry stone wall patterns, it is possible to understand the influence of relief, hydro-geological and climatic conditions, and crops intended. Such factors may serve as valuable indicators of their dating. The diversity of the recognised patterns found in this 21-km² area is a result of centuries-long parcel-by-parcel land reclamation. Such activity occurred mostly under Venetian and Austrian rule, driven by olive oil and wine production, but had to be adapted to the topography and lithology of the area.

5.4.3. The Lovreški vineyards and the post-phylloxera attempts of recovery

The agricultural area called *Lovreški* is adjacent to the small village of Loznati, 4 km eastward from the town of Cres. It spreads from the localities of Antonski and Pregon to the eastern coast. It is a completely derelict landscape, with vegetation camouflaging a very dense and orthogonal dry stone wall system.

More precisely, the term '*Lovreški*' is only one of the toponyms of this area and denotes an area close to the dilapidated church of St. Lawrence and mark, which is an archaeological site with remains of a *villa rustica* (Ettinger-Starčić and Ćus-Rukonić 2015, 9). From the town of Cres-centered point of view, the toponym '*Lovreški*' comprises other localities as well: Travnic, Obratin, Vrčuh, Stara banja, Grožuja, Brstovica, Osup, Homutići, and Arcić. The latter, larger area, is part of this study. Functionally, *Lovreški* is part of the Cres agricultural area, as it was used principally by Cres farmers. However, it is considered as a separate landscape unit for reasons to be explained further in the text. The border between the two regions can be seen in their dry stone wall pattern (Figure 167).

The *Lovreški* area has a dense network of dry stone walls. For instance, within one area of 5.25 km², 711.8 km of dry stone walls have been mapped. This translates to an overall density of the dry stone walls of 135 km/km² (Figure 166), which is denser than in the Cres olive grove. Unlike in Cres, cultivation was quick, integral, massive, and organised in *Lovreški*, as it was driven by the need to regrow the vineyards lost to downy mildew (*Peronosporaceae*) and phylloxera (*Phylloxera vastatrix*) in the town of Cres area. Thus, a vast area of relatively gentle slopes above the eastern coast of Cres has been completely transformed in terms of its landscape and turned into the largest complex of terraces on the island of Cres (Stražičić 1981, 4:204–5).



Figure 166. The dry stone walls of the Lovreški area. Over 711.8 km of walls stand in an area of 525 ha, with an overall density of 135 km/km². Vectorisation in GIS by Michela Trevisan and Tanja Kremenić. North is up. Base map DOF 2014 (DGU 2019)

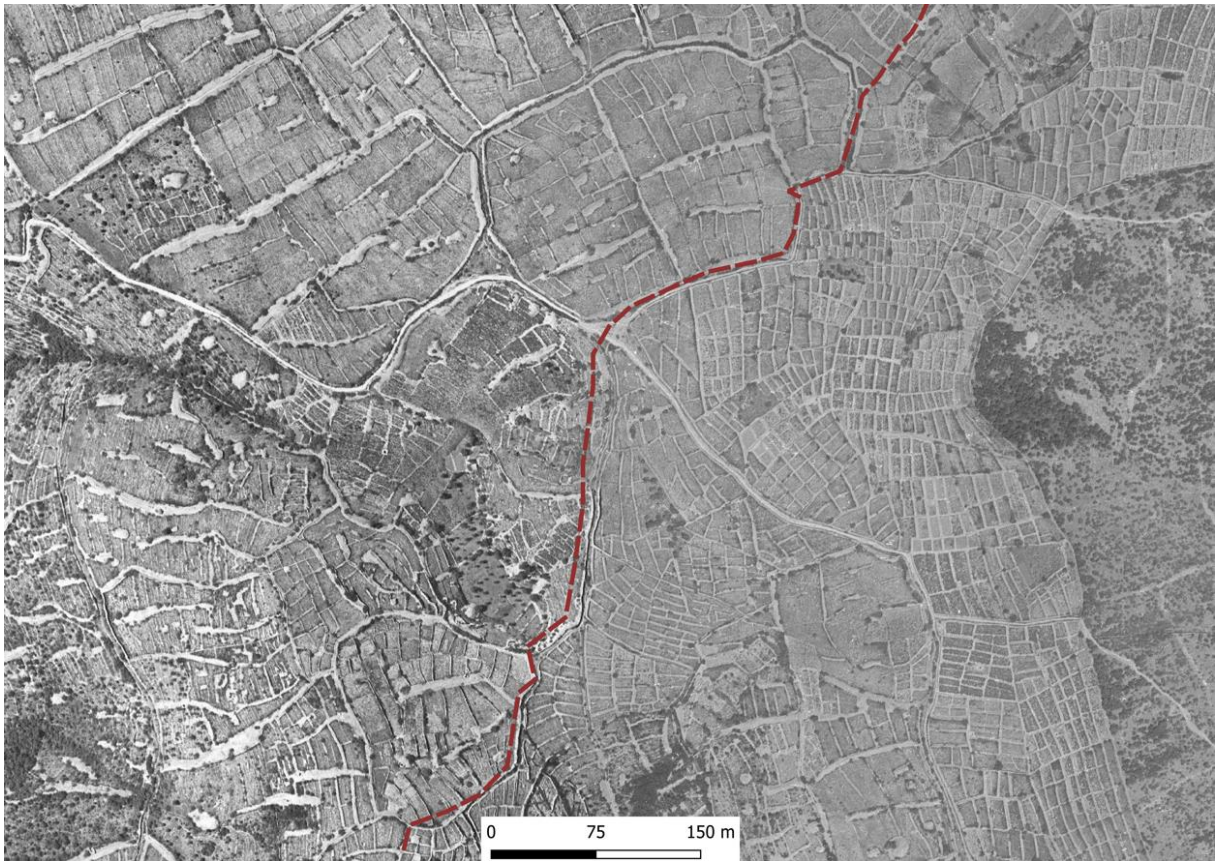


Figure 167. The border (marked in red) between two dry stone wall landscape patterns and two different socioeconomic circumstances and historical periods. The town of Cres olive grove is on the left, and the Lovreški 'vineyards' are on the right. Basemap: DOF53 (DGU, 2021)

5.4.3.a Historical background

Most of the Dalmatian's dry stone wall landscape is a result of the favourable ephemeral conditions in viticulture which occurred in this region between 1870 and 1890. These conditions were due to the pandemics of grapevine diseases which hit the leading vine regions of France and Italy in 1865. In that period, Cres farmers started planting more vines in the middle of olive tree terraces and marginal areas of the immediate agricultural area (in *Betkaf, Kuric, Vrh, Obratin, Marcinjev, Zapernat*, and, in the area of *Lovreški, Stari del, Gornji Arcić, Stara Banja* and *Kruščica*). Such vines were all planted on European rootstock and, therefore, were lost to the grapevine diseases.¹⁵³

¹⁵³ In 1900, Cavallini wrote of how the Cres citizens were in great misery. He stated that it was not only the phylloxera that had destroyed their vineyards, but it was also their own fault because they were so immersed in wine production that they had neglected their olive groves and, thus, had 'neither wine nor oil nor money in their homes' (1900, 9).

Lovreški was not formed during the profitable viticulture era. It was designed and agriculturally reclaimed mostly in the first quarter of the 20th century. To mitigate the damage caused by the grapevine disease, the Cres municipality provided more than 500 ha of the pastoral and forest area of the shepherd's dwelling in *Lovreški* to the Cres citizens willing to cultivate vines (Stražičić 1981, 4:205). The exact years during which the landscape transformation took place are still not clear, but it can be assumed that most of this campaign was accomplished at the beginning of the Italian rule.¹⁵⁴ Technical documents (geodetic plans) of the *Lovreški* transformation are still kept in the cadastral office in Cres. The earliest date indicating the geodetic design and trigonometric surveying is October 27, 1925 (Figure 168), with later additions and modifications of the document in 1928 and 1930. Unfortunately, no accompanying documentation or cover letter can be found, thus making it unclear whether the dry stone walling and cultivation were already in process. The assigning of the parcels on the terrain (staking out) had probably already been accomplished.¹⁵⁵ This parcellation is still visible in the current cadastral plan. The area of the parcels varies, but most of them are between 3000 and 3500 m² (called *děli*).¹⁵⁶

The investment of the impoverished Cres farmer was not easy. For every new crop, a farmer had to pay the municipality a yearly rent; clear, dig, and cultivate land, and walk uphill for hours away from home. For the first yield of vine grafted on American rootstock (*Rupestris du lot*), a farmer had to wait three years. If the farmer was lucky, they would need to bring 50- to 80-kg bags of yield back to the town of Cres. Some would put these bags on donkeys or mules. As Rossi writes in his memoirs:

'Almost all the vineyards at that time¹⁵⁷ were in the valley of Saint Lawrence or *Lovreški*. That land was exposed to the sun all day so the grapes got a golden colour, in dialect called *cekin*¹⁵⁸. These fields were a two-hour walk across the hills that surrounded the city. (...) Instead of the road, pack animals were used to transmit the crops, and it was

¹⁵⁴ The Cres-Lošinj archipelago became part of the Kingdom of Italy from WWI until WWII (1919–1943), when Italy annexed the Austrian Littoral according to the Treaty of London and later Treaty of Rapallo.

¹⁵⁵ I thank Marino Filipas from the cadastral office in Cres for his assistance with the archival search.

¹⁵⁶ J. Kremenić's manuscript.

¹⁵⁷ Rossi never stated in his work to what past time he refers, other than these were his childhood memories. Therefore, it can be assumed that the action took place in the first half of the 20th century.

¹⁵⁸ From the Italian word *zecchino*, meaning gold coin.

often difficult to walk under the sun, first uphill, then downhill and vice versa, all the way to the other sea, to Kvarnerić' (Rossi 1926, 78).¹⁵⁹

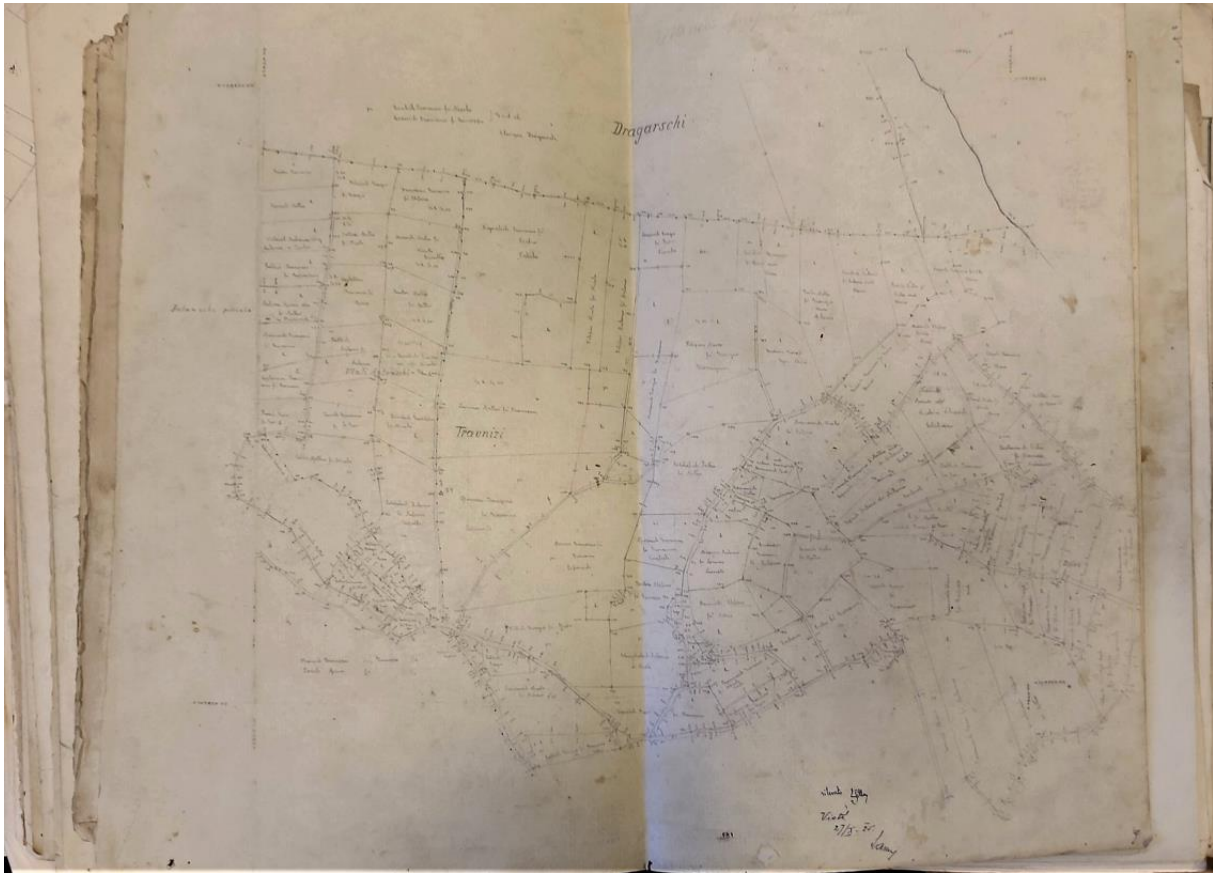


Figure 168. One of the cadastral plans of the geodetic survey from 1925 for the Lovreški area (northern part) taken from the archives of the cadastral office in Cres

From 525 ha of the designated territory, 105 ha are left in their original pasture-forest (20%). By the 1930s, 20% of the vineyards had already been abandoned due to their unprofitability,¹⁶⁰ owing to the major decline of viticulture and production in the area of *Lovreški* in the years just before World War II. Therefore, from the 420 ha of vine growing designated area (without the area under the dry stonework and without the abandoned land), the total area used for planting vines was about 153 ha, with 1,530,000 total vines in its best years. It can be noticed that only 191 ha (and later only 153 ha) from the designated 420 ha were, in fact, used for vine-growing, which is very indicative of the needed effort invested (Table 17).

Besides their patterns, two areas – the Cres olive grove and *Lovreški* vineyards – represent different current realities. While the olive grove is in active use, the plantations

¹⁵⁹ Author's free translation.

¹⁶⁰ From the unpublished manuscripts of Josip Kremenčić.

of *Lovreški* cannot even be found. Land use is recognised in its indicators, such as *vaške* (from Italian: *vasche*), which are reservoirs for water and pesticides. Certain parcels from this site are now being used as pastures by the inhabitants of Loznati.¹⁶¹ Here the reforestation phase has already surpassed the garrigue and turned into a mixed forest, enabling the foraging of sheep. The only recent changes to the landscapes are the already common perforations of gravel roads.

During the field visits in 2020 and 2021, it was observed that a large part of the dry stone walls and the dry stone wall-lined pathways are still well-preserved, therefore providing a basis for the potential natural reintroduction of terraced agriculture crops after vegetation clearing (Figure 169).



Figure 169. The area of *Lovreški* is heavily under vegetation, but the dry stone walls and the capstones are still in place (2020).

¹⁶¹ The current village name, Loznati, comes from word *loza* (Croatian for vine). On the Austro-Hungarian cadastre maps from 1821, this site has been named *San Lorenzo sotto le vigne* (from Italian, literally: Saint Lawrence under the vines).

Table 17. Vine growing statistics from the Lovreški area, from J. Kremenčić (n.d) manuscripts. Each percentage is to be read while taking into account the previous (above the bolded line) as 100%

Lovreški area	ha	%
The whole vine-growing designated area	525	100
Left as pasture-forest	105	20
Fragmented and lined by the DSW	420	80
Fragmented but remained uncultivated	126	30
Overall cleared and cultivated area	294	
Percentage of the DSW (within the cleared and cultivated area)	103	35
Remaining land for the cultivation of vines	191	65
Land abandoned due to unprofitability	38	20
Land used at the time of peak wine production	153	

5.4.3.b Dry stone wall pattern recognition

Lovreški has the most homogeneous pattern, as it is a mosaic composed of the consecutive repetition of rectangular parcels with inner divisions with very low dry stonework. These low dry stone walls, locally known as *pridānci* (N pl, *pridānek*, N sg.), are another specificity of this area. They are the smallest form of the dry stone walls, constructed of only one line of stones, which serve the purpose of soil retention (Figure 170, Figure 171).

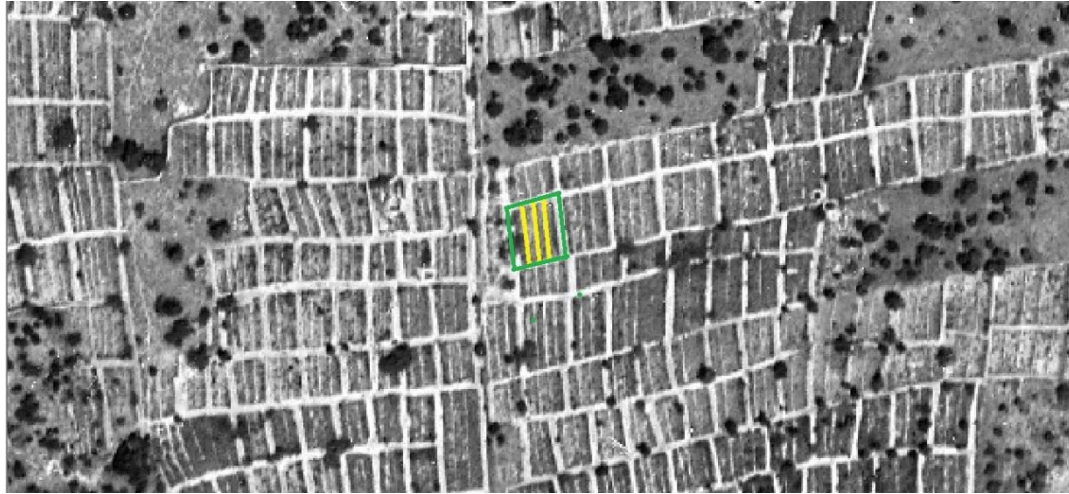


Figure 170. Pridanci, a characteristic of the Lovreški area (2020), are marked in yellow. Basemap: DOF53 (DGU, 2021)



Figure 171. The Lovreški pattern consists of double dry stone walls which enclose a regular, rectangular area. The soil within is further stabilised by smaller dry stone structures (Pridanci), a line of transversely stacked stones. Remnants of a dry stone shelter (kućica) are seen at the bottom (2021).



Figure 172. Consecutive repetition of the Lovreški pattern, the only area which is not yet fully covered by the canopy (2021)

It shares similarities with the Cres case study area for the plot division logic, with the interesting differences: the absence of clearance walls and the occurrence of only one type of pattern. A difference can also be found in their names – in the town of Cres, area plots bear the name *graje*, while the *Lovreški* parcels are divided into *deli* (Chakavian *del*: a part [of something]), even though *deli* would refer more to the cadastral, rather than dry stone wall division.

Also, the logic of the pathways differs. In the olive grove of the town of Cres, a structural connection is visible in a network of pathways extending in a semi-concentric web from the town centre. Here, the dry stone-lined pathways extend transversely to the slope (all of them are directed N-S), while the W-E communication is based on the use of *barbakani*. In this case, the term *barbakani* refers to wide and massive double walls.¹⁶²

¹⁶² I thank Tone Žic for the conversation.

5.4.4. The island of Ilovik

The island of Ilovik is one of the smaller islands within the Cres-Lošinj archipelago, comprising an area of 5.51 km² (Duplančić Leder, Ujević, and Čala 2004, 13). It is located at the very south of the archipelago. In comparison to Cres and Lošinj, this island has an accentuated insularity. The homonymous only settlement on the island covers only 2% of the island's total area and is fully concentrated on the north-western part of the island. Here, \approx 315 km of dry stone walls have been mapped, resulting in the overall density of dry stone walls of 57 km/km². The island of Ilovik was here considered as a separate case study due to the prominence of its dry stone wall landscape patterns, even though it forms a functional whole with the neighbouring island of Sveti Petar (which has a similar DSWP) (Figure 173).

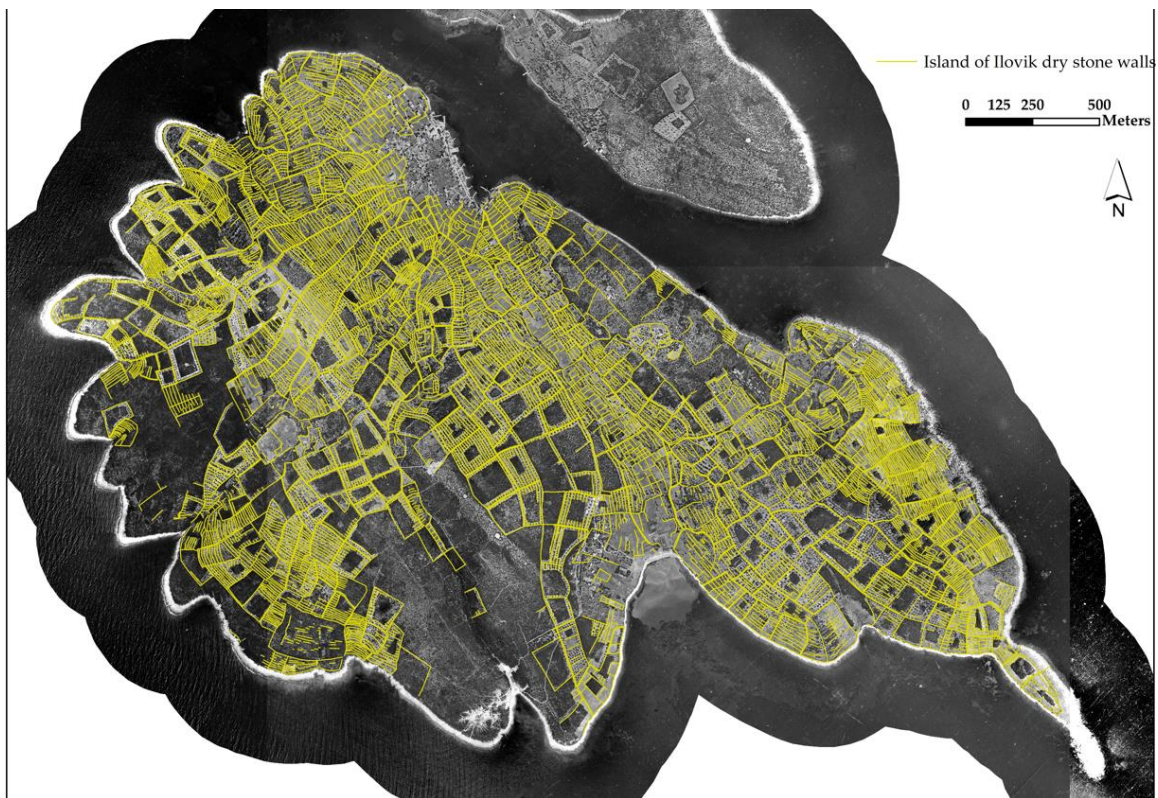


Figure 173. The dry stone walls and the dry stone wall landscape patterns of the island of Ilovik. Similar dry stone wall patterns are found on the island of Sveti Petar (upper part of the figure). Basemap: DOF53 (DGU, 2021), author's elaboration in GIS.

5.4.4.a Historical background

Both Ilovik and the neighbouring island of Sveti Petar have been important harbours since antiquity and relevant stations on the east Adriatic sailing route, owing to the island of Sveti Petar which provided sufficient shelter from northern winds (Ćus-Rukonić 2012, 397), and they remained so throughout the period of Venetian rule until 1797.¹⁶³ Nonetheless, most of the dry stone walling was built only in the last two centuries¹⁶⁴ (mostly in the 19th century). This is visible from the Austrian Cadastral Maps from 1821 ('Mappe Catastali Del Comune Di Lussingrande' 1821), which prove that at the time, most of the island was still a pasture (as was the entire island of Sveti Petar), with the arable land and vineyards located mostly around the settlement and along the central valley (*Draga*).

Two peculiarities can be noted. Firstly, in the first half of the 19th century, these cultivated lands were designated mostly for vines, with some sporadic olive trees ('*vigne olivate*'), which contrasts with today's domination of olive trees. Grapevine disease is one of the common causes of the spread of olive groves, but from the letters sent from the Ilovik farmers to newspapers '*Pučki prijatelj*' in 1901 and 1902, it can be noticed that olive groves were considered the island's main yield by its inhabitants (R.I. Prijatelj puka 1901). In one of the letter wrote for this paper, it was stated that the island of Ilovik 'could be called the island of olive trees, since wherever you look, you see olive trees, and the other ones way less' (Glas iz puka 1902). Secondly, from the ACM it can be observed that the cultivated parcels close to the settlement of Ilovik and along *Draga* follow a relatively regular pattern, but the ones in the northwest part of the island have inner patches of forest (Figure 174). This latter area may mark the beginning of this particular land reclamation *modus operandi*.

Pavoković describes the island of Ilovik's reclamation in the following manner. In the first half of the 19th century, the Church started to give its property to the Ilovik (or Veli Lošinj) citizens, selecting those who had already commenced the clearing of the land. Ilovik citizens then strategically occupied the new terrains in a manner that they would first clear the vegetation and build dry stone walls along the outer edge of the parcel. The dry stone walled outer margins suggested the (parcel) now belongs to them. After concluding the lease agreement with the Church, they would continue clearing the land towards the centre of the parcel. Many would take a new parcel without completely

¹⁶³ The cannal between Ilovik and Sveti Petar still provides a safe harbour during stronger winds.

¹⁶⁴ The Ilovik settlement was formed only in the late 18th century, mainly by the inhabitants of the island of Lošinj (Stražičić 1997, 82).

clearing the previous one. It is possible that the Church's willingness to lease the land attracted people and encouraged the emergence of the Ilovik settlement in its present form (Pavoković 2016, 79–80).

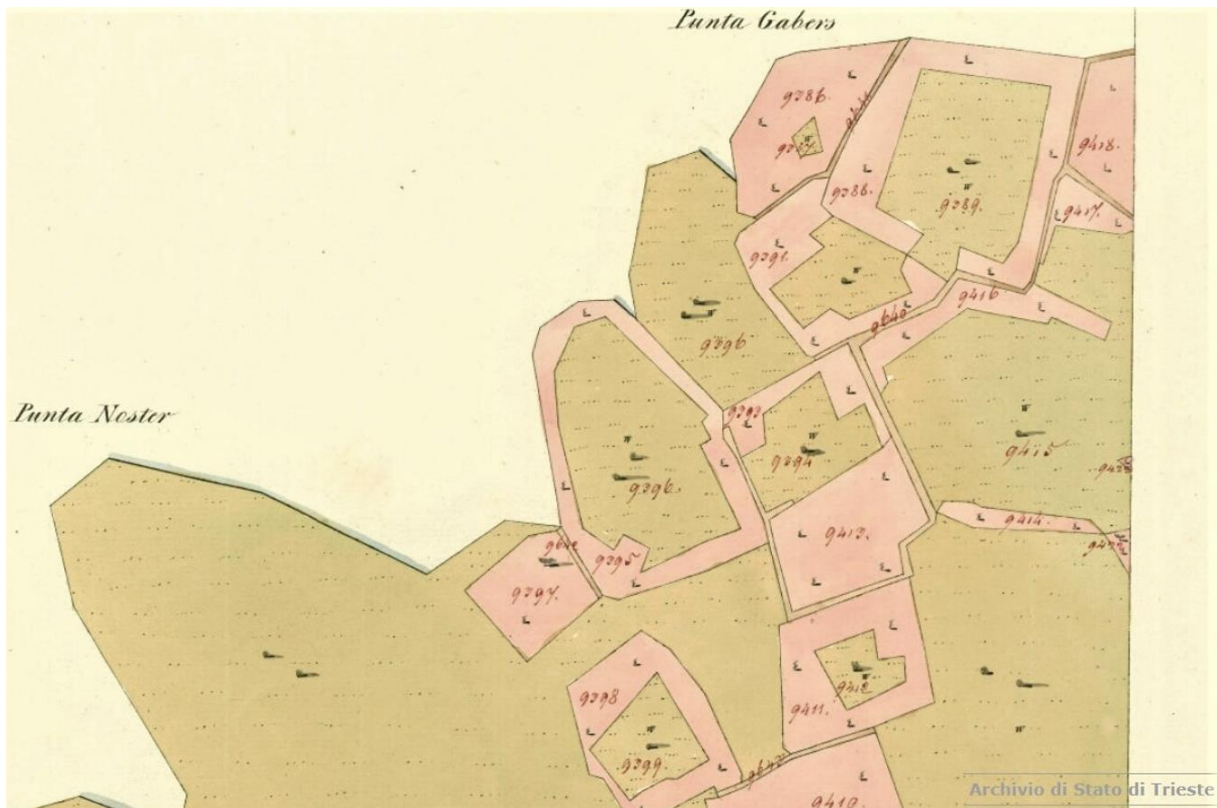


Figure 174. In the northwest part of the island, patches of inner forest of the parcels can already be discerned, suggesting this area as the first to undergo this kind of land reclamation *modus operandi* ('Mappa Catastale Del Comune Di Lussingrande Foglio XV, Sezione XVII' 1821)

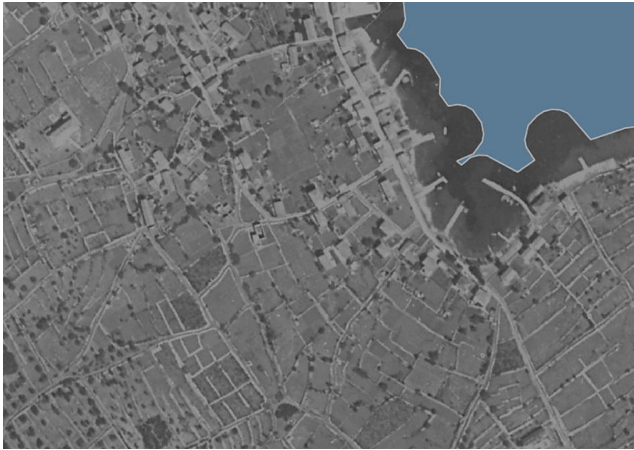
Most of the agricultural surfaces today serve as pastures, employing an extensive (low-input) agropastoral system. Unlike in the Cres olive grove, the olive oil production here is quite low, but on the other hand, the inhabitants of Ilovik produce relatively significant amounts of dairy products from goats and sheep¹⁶⁵ (Pavoković 2016, 232).

¹⁶⁵ The anthropogenic soil of the terraces, created by the Ilovik inhabitants over the last two centuries, provided better grazing ground, as can be seen by the size of the sheep – the same breed, Cres *pramenka*, is much larger and thicker on the island of Ilovik than on the island of Cres.

5.4.4.b Dry stone wall pattern recognition

The importance of the bird's-eye and cartographic perspectives in the case of the dry stone walls is especially evident for the case of the island of Ilovik. There are four main patterns present: 1) shallow and wide regular-pattern terraced fields in landscapes, 2) narrow step terraces, 3) enclosed regular-pattern step-terraced landscapes, and 4) enclosed regular-pattern step-terraced landscapes with forest patches. They all represent different crops (Figure 175).

The first pattern is located near the village and in the *Draga* valley and is used for vegetables and crops which require frequent and intensive care. Here, the double dry stone walls follow a regular grid with no (or very sparse) inner *barbakani* and *minjici*. Many auxiliary individual buildings, livestock sheds, threshing floors, and sheepfolds can be found, as the livestock on the island of Ilovik were always kept close to the houses. The second pattern is one of the singular vineyard terraces, located on the eastern slopes south of the peak Vela Straža (*Zaprikroj*). The rest of the island has also been enclosed into regular rectangular parcels – however, in this case, they enclose inner terraces and a small patch of forest (Figure 176).



a) 'enclosed terraced fields: wide regular patterns' (shallow terracing with mildly undulating bottoms)
Land use: mixed crops



b) 'narrow step terraces'
Land use: vineyards



c) 'regular-pattern step-terraced landscapes' with forest patches, grouped into dry stone rectangular enclosures
Land use: olive groves (historically mixed with vines)



d) 'regular-pattern step-terraced landscapes', grouped into dry stone rectangular enclosures
Land use: olive groves (historically mixed with vines)

Figure 175. Four main types of dry stone wall patterns on the island of Ilovik correspond to different types of land use. DOF53 (DGU, 2021)

The third pattern is the most particular. Its most prominent characteristic is the inner rectangular area of a forest. The area of these forest patches varies depending on the stage of parcel reclamation, which is why the areas with wider forest patches are more distant from the settlement. Even though the outer dry stone walls are parallel, there are no walls underneath the canopy, indicating that the found landscape is a work in progress.

Another unique feature is that each of the parcels was encompassed by pathways (Figure 27), which enabled every citizen of Ilovik to arrive at their parcel from their home without trespassing onto other private parcels. Even though the network of pathways is extensively distributed across the entire archipelago, this strict demand for the right of access was not present in other areas – access to land would be additionally enabled by stairs: *skalini*, *stalbice*,¹⁶⁶ or *vilazi* (beaten path, additionally marked with boundary stones (*osuli*)). Some of the Ilovik pathways lead directly to the sea, potentially with a drainage function. Managing livestock – as an explanation for this necessity – can be excluded: at least until 1962, all livestock was kept tied close to the owners' houses to prevent their forage on young and sprouting olive trees or vines (Pavoković 2016, 225). The structural features of the dry stone walls – their relatively short height and lack of walls enclosing the forest contours – indicate there was no need to build dry stone wall for livestock management.

¹⁶⁶ See paragraph 3.2.5.4. - Stone stairs.



Figure 176. Example of a parcel which has been recently restored (left) according to the historical condition; there are no dry stone walls underneath the canopy (2020).



Figure 177. Wide regular patterns of the Draga valley.¹⁶⁷ Due to its naturally more fertile soil, it was one of the first land reclamation sites (2021).

¹⁶⁷ *Draga* means valley in Croatian.



Figure 178. The current state of the Ilovik landscape with an emphasis on the 'active' northeastern part of the island; patterns 1, 3 and 4 are recognisable (2021).

Enclosed wood management is not a peculiarity; deciduous forests on the Adriatic karst were always a valuable and inherently endangered source of firewood, timber, and acorn. Andlar et al. (2018, 767–68) divided Croatian Adriatic dry stone wall sylvo-pastoral enclosures into two types: 1) organic patterns (dominant and characteristic precisely for the hinterland and mountainous areas of the Croatian Adriatic) and 2) rectangular patterns (with the most prominent example of managed forests on the neighbouring island of Olib) (Magaš and Faričić 2002, 50). Ilovik seems to fit the second category based on its shape, yet not entirely. These patches of forests do not represent a separate plot but a 'pocket' within one. These patterns have been found within the Cres-Lošinj archipelago only on the neighbouring island of Sveti Petar, islet Koludarc (in the Mali Lošinj bay). Similar patterns have been found in a few other places along the Croatian coast on the island of Drvenik, Vinišće and Marina environs (Andlar 2012, 74), and close to settlement Ljubljevo, Bosiljina (Šrajer 2019, 140). However, these patterns are ascribed to forest management, by which the forests were enclosed with dry stone walls, which is not the case for the island of Ilovik.

Other terraced areas, such as the landscapes of Cres and *Lovreški*, did not have reserved areas of wood since they could rely on other territories on the island.¹⁶⁸ Therefore, the

¹⁶⁸ The forests of Tramuntana and Punta Križa, located on the northern and southern part of the island of Cres, were exploited for this reason.

island's forest patches might be additionally connected to the island's accentuated insularity (i.e. its position (distance), size, and the necessity to rely on its own wood resources). Therefore, this landscape is indeed an unfinished case of land reclamation, which came to an abrupt stop before the beginning of a demographic decline of the mid-20th century, which can also be seen from the size of the forest patches, or rather vegetation residues.

5.4.5. Pere and the land reform of 1945

Pere is a toponym for the area located 2 km northeast of the town of Cres. Here, the dry stone wall patterns repeat the rectangular regularity similar to the *Lovreški* area, but with different dry stone walling. These walls belong to the post-WWII era. These parcels, again, are used by the few families from the town of Cres, even though all of them belong to the two wider cadastral units owned by the Republic of Croatia and managed by the Croatian forests.

5.4.5.a Historical background

Even though the period after WWII has been marked by an intense demographic decline (and, therefore, deagrarianisation (see: Stražičić 1980, 246)), it brought about new socioeconomic conditions and new changes to the agricultural land. The islands of Cres and Lošinj were formally ceded to Yugoslavia in 1947 through the Treaty of Paris. However, the influences of the new administration have been felt in many socioeconomic and political spheres since 1945. The first implementations of the well-known land reform (*Agrarna reforma*) can be traced to 1946. Its purpose was to change the ownership structure, mostly by the expropriation of large estates at the expense of grand landlords. On the islands, it mainly affected the clergy and the noble families of large land estates.¹⁶⁹ Specifically, the Church and the monasteries were left with a maximum of 30 ha of arable land and 30 ha of forests (Stražičić 1981, 4:247). An average of 5 ha of land was allocated to each hired worker of the feudal estate (*stân*).

Pere, or as it could be heard in conversations with the locals, *Titovo polje* (Tito's field, after Josip Broz Tito, the then Yugoslav president), is a result of the beginnings of the land reform on the island of Cres. The cadastral registration of the new users was never formally completed,¹⁷⁰ which means that Cres farmers who received a certain area of the plot for use were not formally added to the land register – the whole area is still statal, and due to the pine trees in the northern part of one of the cadastral units, it is managed by the Croatian Forests. Their names are, however, evidenced in the documentation in the cadastre of the city of Cres. Vines are visible from the land use as follows: 19.59 ha of vineyards, 0.18 ha of arable land, and 5.93 ha of pasture (State Geodetic Administration n.d.).

¹⁶⁹ The expropriation also affected the peasants who had estate areas above a certain maximum area. The surpluses were included in the land fund on which the cooperative economies were formed.

¹⁷⁰ I thank Marino Filipas from the Cres cadastral branch office for the conversation.



Figure 179. The parcellation of the Pere area within one cadastral unit (3685/1). Source: (DGU 2021a; 'Katastarske Čestice i Katastarske Općine - WMS' n.d.)



Figure 180. The further plantation of vines on relatively regular patterns followed after 1953 in the right cadastral unit (3835/1) on the Stari stan locality ('Katastarske Čestice i Katastarske Općine - WMS' n.d.; DGU 2019).

The parcellation of 'Tito's field' is dated in 1945 and 1946, as indicated by the cover letter of the hired Italian geodetic engineer (*Figure 181*).

Cherso, 14 dicembre 1946

Oggetto: frazionamento del territorio "Pere"

K. N. O. di

C H E R S O

Conforme l'incarico ricevuto ho esaurito la stima ed il frazionamento del territorio "Pere" con circa 40 ettari di superficie in 220 particelle .
Ogni particella comprende circa 1500 metri quadrati di superficie.

Il lavoro sul terreno e' stato esaurito nel corso di 17 giorni , senza osservare l'orario d' ufficio, con qualsiasi tempo, impiegandovi anche tutti i giorni festivi e domeniche.

Giornalmente dopo esaurito il lavoro sul terreno si procedeva con il concorso del dipendente impiegato Buntelich Antonio alla costruzione del piano di frazionamento che nel caso contrario avrebbe chiesto perlomeno altri dieci giorni di lavoro al tavolo; mi trovo così nella possibilità di trasmettere subito l'unito piano di frazionamento e relative strade costruite con sufficiente precisione in scala 1:2000. Nel piano i confini sono marcati in inchiostro nero mentre i singoli lotti in rosso.

Prima di procedere allo scrutinio dei 202 lotti si rende indispensabile di convocare il Presidente del Graskj e tutti i capi dipartimento i quali si sono interessati nell'oggetto per stabilire di comune accordo le condizioni di cessione.

Per poter sbrigare l'incarico ricevuto ho rinunciato alle ferie annuali di 15 giorni e per il soggiorno straordinario nella sede di quest'ufficio non posso conteggiare le spese di missione ,perché il dipartimento L.P. di Pisino ha accordato una permanenza a Cherso del tenore di 15 giorni per ogni mese .

Ho trovato però doveroso di farlo ,perché la mia permanenza nella sede dell'ufficio di Cherso durante il periodo 1. maggio 1945 inclusivo 30 settembre 1946 e' stata molto limitata e quindi per me consapevole dell'importanza dell'oggetto che risolve uno dei maggiori problemi nell'interesse degli agricoltori di Cherso e che unicamente in seguito alla caparbia ed opposizione di alcuni grandi possidenti non venne fatto nel passato.

Per ogni appezzamento gli agricoltori potranno coltivare in media 1000 piante di viti ; considerato l'ottimo terreno con abbondante humus e che finora veniva sfruttato soltanto col pascolo di ovini ,dando un reddito di sole 500.= lire annue, fra cinque anni ogni singolo appezzamento potrà produrre perlomeno cinque ettolitri di vino, che corrisponderebbe ad un complessivo di 1000. ettolitri senza calcolarvi il prodotto che si ricaverà dalla coltivazione del pomodoro, fagioli, patate, cipucci ecc. ecc.

Per l'esperienza acquisita durante la mia lunga permanenza nei distretti di Cherso e Lussino nel disbrigo di consili incarichi ,affermo che l'assegnamento del territorio di "Pere" agli agricoltori di Cherso e' da considerarsi l'opera di maggior importanza che sia stata fatta in un periodo di 30 anni in favore dell'economia rurale dell'isola.

Prego eccetto C.P. Distrettuale di comunicare al Dipartimento L.P. di Pisino ed al K.N.O. di Lussino l'opera svolta dallo scrivente nell'oggetto affinché possa giustificare il mio attuale soggiorno a Cherso.

Figure 181. A cover letter from the geodetic engineer employed for the parcellation of the Pere area as part of the execution of the Land reform of 1945. Source: Archives of the cadastral branch office in Cres.

The letter, entitled 'Parcellation of the Pere area' (*Frazionamento del territorio 'Pere'*), describes the scope of the project, the previous and planned land use, and the perceived importance:

'In accordance with the assignment received, I have carried out the estimate and the subdivision of the 'Pere' area, with about 40 hectares of surface, into 220 parcels. Each parcel comprises about 1500 square meters. The fieldwork was completed over the

course of 17 days, without observing office hours, (...), also taking place on holidays and Sundays. (...)

However, I found it only right to do so because my stay in the Cres office during the period between 1 May 1945 and 30 September 1946 was very limited, and therefore, I am aware of the importance of the task that solves one of the major problems in the interest of the farmers of Cres and that only due the stubbornness and opposition of some large landowners was not done in the past.

For each plot, farmers will be able to cultivate an average of 1000 vines. Considering the excellent soil with abundant humus, which until now was exploited only by grazing sheep, giving an income of only 500 lire, in five years, every single plot will be able to produce at least five hectolitres without calculating the product that will be obtained from the cultivation of tomatoes, beans, potatoes, cabbage, etc.¹⁷¹

5.4.5.b Dry stone wall pattern recognition

The dry stone wall enclosures of *Pere* are, in every sense, an indicator of its vine-intended production; all of them are constructed in the lower dry stone walls (*barbakani*) and have a very rectangular grid, with *vaške* in the middle of every parcel. However, the inner area of the rectangular enclosure changes according to the topography, turning from 'regular enclosures' to 'narrow step terraces'.¹⁷²

¹⁷¹ Author's free translation of the original: *'Conforme l'incarico ricevuto ho esaurito la stima ed il frazionamento del territorio 'Pere' con circa 40 ettari di superficie in 220 particelle. Ogni particella comprende circa 1500 metri quadrati di superficie. Il lavoro sul terreno è stato esaurito nel corso di 17 giorni, senza osservare l'orario d'ufficio, (...), impiegandovi anche tutti i giorni festivi e domeniche. (...) Ho trovato però doveroso di farlo, perché la mia permanenza nella sede dell'ufficio di Cherso durante il periodo 1. maggio 1945 inclusivo 30 settembre 1946 è stata molto limitata e quindi perene' consapevole dell'importanza dell'oggetto che risolve uno dei maggior problemi nell'interesse degli agricoltori di Cherso e che unicamente in seguito alla caparbia ed opposizione di alcuni grandi possidenti non venne fatto nel passato. Per ogni appezzamento gli agricoltori potranno coltivare in media 1000 piante di viti, considerato l'ottimo terreno con abbondante humus, e che finora veniva sfruttato soltanto col pascolo di ovini, dando un reddito di sole 500. = lire, fra cinque anni ogni singolo appezzamento potrà produrre perlomeno cinque ettoltri senza calcolarvi il prodotto che si ricaverà dalla coltivazione del pomodoro, fagioli, patate, capucci, ecc. (...)'*

¹⁷² The step terraces could not be captured on photograph since they are completely reforested.



1) 'regular rectangular enclosed fields'



2) 'enclosed step terraces'

Figure 182. Two main types of dry stone wall patterns in the Pere area



Figure 183. Abandoned vineyards in the area of Pere (2020)



Figure 184. New dry stone wall enclosures for vineyards on locality Stari stan (adjacent to Pere) built after 1953 (2020)

5.5. Dry stone wall landscape patterns as indicators of historical circumstances

Landscape patterns give a distinctiveness and sense of unity to an area (Bell 2012, 3). Different dry stone wall landscape patterns form heterogeneous dry stone wall landscapes, such as the town of Cres area. A dry stone wall homogeneous landscape area is formed by the repetition of a single pattern over a large area (e.g. *Lovreški*, a large part of Ilovik, *Pere*). Both types can be interwoven by networks of dry stone-lined pathways (linear features) and can have other types of patterns (polygon features) within the landscape unit they form (e.g. a forest remnant in *Lovreški*). While many of the basic pattern types described above could be applied to Croatian Adriatic landscapes (and vice versa), there are also examples where this is not applicable, as their occurrence is, to this thesis author's knowledge, restricted to the local scale (e.g. the Ilovik case study).

Environmental determinism commonly provides the primary bases for explaining the occurrence of the landscape patterns. This perspective revolves around the relative presence or, rather, the excess, of the available building material, which is observed in either lower dry stone walls (e.g. *Pere* and *Batajni*) or in the massive clearance walls (e.g. the slopes of the Cres olive grove). The different heights and densities of terraces area explained by distinctive local topography (Klimm 1935, 623–24) and the need to stabilise the slope. Further follow the general notions about (individual) human-caused factors in the formation of these pattern, the differences of the craft of the people who built them during different periods, adjusting the terraces to the needs of different crops, for instance.

Given the utilitarian purpose of the dry stone walls, all the previous factors are accurate and can be implied to be universal ones. However, they lack the possibilistic consideration of the concurrent socioeconomic events. Human economic relations, such as decisions about land management, concessions on feudal estates, and other political-economic influences, can dictate the land transformation process even more strongly than natural conditions. Therefore, both kinds of factors – natural and socioeconomic – are mutually constitutive for the pattern formation, changing only in terms of the grade of their effect.

One example is the systematic transformations, which are completely subordinated to planned geometry.¹⁷³ They can belong to various periods:

- antiquity (Greek or Roman centuriation),

¹⁷³ E.g. The centuriation of ancient Istria, Roman grid of the ager around Pula (Ivetić 2009, 129).

- the ephemeral favourable conditions in viticulture in the late 19th century
- the attempts of the vines' revival in the phylloxera aftermath at the beginning of the 20th century
- the land reform of 1945–1947

Čučković suggests that due to their size and the ruggedness of the neighbouring terrain, most of the Cres-Lošinj prehistoric hillforts could not have been important settlements (2017, 534). However, one should be careful with such potentially reductionist interpretations. A hillfort's shape is primarily determined by its topography, then by its function; however, the in-situ material findings (e.g. household or hearth ceramics point to a settlement) are the only form of proof which can determine a hillfort's function. Sometimes, the widespread terrace construction does not correlate with demographic oscillations (Gadot et al. 2016, 415).

5.6. Conclusions

This part of the study was intended to demonstrate the accompanying signs of specific economic changes observable in the dry stone wall landscape patterns. Case studies from the Cres-Lošinj archipelago demonstrated variability in their patterns, which is indeed correlated to the different space-time circumstances under which they were formed. Even though these cases were placed into causation with certain historical socioeconomic events – and even if similar conclusions have been made in the previous work (Kulušić 2004; Kale 2016) – using them as a *pars pro toto* is unwise. More research is needed to fully confine their typology to a particular period and location and avoid making easily defeasible claims. Nonetheless, they should be considered as strong indicators and a starting point for subsequent, more elaborate research questions. This method is recommended for replication along the Adriatic coast and the Mediterranean, as such interpretations can provide a framework for interpretation in other places and countries which were influenced by similar environmental circumstances and economic needs. The reverse process is valid as well – noticing important historical events and circumstances can direct the search for its corresponding landscape patterns, with the potential of creating a larger and comparable inventory of such patterns.

To further target historical stratigraphy and resolve the questions of the genesis of the dry stone wall cultural landscapes, it will be necessary to continue with the presented research processes in a more detailed manner while employing the following additional methods:

- a more detailed analysis of the Austrian cadastral maps and documentation
- more detailed ethnographic research involving the elderly population of the archipelago for less-investigated micro-regions (e.g. *Tramuntana*, *Gerbin*, Veli Lošinj area, Unije, middle and eastern pastures) to determine the extent of transformation of individual localities and individual structures and buildings
- the opening of one or more archaeological probes, which would include several types of structures in the directions of ancient parcelling (town of Cres) to determine possible structural changes
- where applicable, combined HLC and physical methods, such as radiocarbon dating (C-14) and luminescence profiling (OSL)
- technologies of LiDAR, which could be used to determine the structures under higher vegetation and the chronological order of enclosing
- geophysical sensing devices, such as GPR for subsurface detection and Airborne laser bathymetry (ALB) for detecting and recording submerged archaeological sites from the air (See: Doneus et al. 2013)

CHAPTER 6

TOWARDS VALORISATION OF THE DRY STONE WALL HERITAGE

'About a decade and a half ago, I entered a crisis regarding the sauntering among the dry stonework – suddenly, I realised that it was all abandoned ruins at various stages of decay. Archaeologists and historians are also dealing with dead cultures, but at least they dig up the skeletons while we are dealing with the corpses that are still disintegrating. It's a bit depressing to me. Some of them, with great effort, could still be revived, but only as zombies (...) as a monument of culture, resurrecting a local symbol of identity (which there isn't) and/or as a tourist bait, but never again in its full original function. Zombies, just acting to live. So, for a change, and for my spiritual recovery, I turned to the field and to something alive – the snakes, the birds, and the plants ...'

Berislav Horvatić, 2021¹⁷⁴

Advancing in the vein of Horvatić's deliberations; considering the major decline in the agricultural use of the territory and the visual disappearance of the dry stone heritage, some of the questions guiding this part of the study were as follows:

- What are the current values of the dry stone wall heritage relevant for the needs of the modern society?
- Are any of these values sufficient to instigate their safeguarding and renewal?
- How tangible are they (i.e. are they calculable or monetisable)?

¹⁷⁴ Berislav Horvatić, by formation with a PhD in physics, is an avid dry stone heritage researcher and an erudite. This text is from private correspondence. It has been translated by the author and published with B.H.'s permission.

Since the beginning of the thesis's conceptualisation, two major approaches have been considered: the place of the dry stone heritage within the EU's funding instruments and its place within the ecosystem services. Its place within the EU's funding instruments (i.e. within the calls for project proposals) was reviewed within various programmes: those targeting biodiversity, the environment and climate action (LIFE),¹⁷⁵ research and innovation (Horizon2020),¹⁷⁶ sustainable agriculture and engineering in the Mediterranean (PRIMA SRIA)¹⁷⁷ or within one of the pillars of INTERREG (European Territorial Co-operation), and the cultural heritage.¹⁷⁸ This part of the research initially had the aim to compare calls and see where the dry stone wall heritage can find its place within the EU budgeting and why they consider its validity for financing. This aim was later omitted, and work was refocused to examining the place of the Cres-Lošinj archipelago dry stone walls within the ecosystem services, as the latter demonstrates a greater possibility of more permanent value modelling than the politically driven changes of funding instruments.

A review of international literature was conducted to address the research questions from the beginning of this section, with a focus on studies on the values that arise from the dry stone structures and dry stone wall landscapes. More specifically, focus was placed on the values which are translated into 'services' provided by the ecosystem. This change in the research direction – and the lack of needed background formation of this thesis's author in environmental economics – envisaged training at the UK's Countryside and Community Research Institute (henceforth CCRI), at the University of Gloucestershire,¹⁷⁹ as part of the Erasmus+ Internship programme. A group of researchers and experts in environmental economics, directed by Prof John Powell, conducted a study with an 'ecosystems approach', designing and applying a conceptual model of dry stone wall heritage accounting.¹⁸⁰

¹⁷⁵ LIFE. n.d. *European Climate Infrastructure and Environment Executive Agency*. Accessed: July 09, 2019. https://cinea.ec.europa.eu/programmes/life_en.

¹⁷⁶ HORIZON2020. n.d. *European Commission*. Accessed: June 08, 2019. https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-2020_en.

¹⁷⁷ PRIMA-SRIA. n.d. *Horizon 2020*. Accessed: February 17, 2019. <https://prima-med.org/>.

¹⁷⁸ Interreg. n.d. *Interreg EU*. Accessed: February 05, 2022. <https://interreg.eu/>.

¹⁷⁹ Countryside and Community Research Institute n.d. *University of Gloucestershire*. Accessed: March 17, 2020. <http://www.ccri.ac.uk/>.

¹⁸⁰ Due to the synchronous breakout of the COVID-19 pandemic, the training at the CCRI was abruptly terminated 15 days after its beginning. Even though it was anticipated and hoped the training would be continued, it never was due to the immediate pandemic-related health issues and the subsequent

Albeit the training brevity, certain insights have been attained regarding the scientific and professional work done at the CCRI. In this chapter, their approach is reviewed, and its applicability in the context of the Cres-Lošinj archipelago is discussed for several reasons: a) modelling of the ecosystem services in Croatia is only at its beginning stages, b) the same has not been nor considered or applied for dry stone walls, and c) the modelling done in the UK follows a novel approach.

In this chapter, an introduction to the ecosystem services will be given, as well as a review of values and benefits arising from the dry stone walls (both acknowledged and assumed) (sub-section 6.1.), followed by values recognised on the scale of Cres-Lošinj archipelago and their current issues (sub-section 6.2.). A category of the cultural landscapes will be proposed based on one case study area to address the potentiality of the institutional dry stone heritage recognition and valorisation (sub-section 6.3.).

two-year-long travel restrictions and security measures. This situation required several adaptations to be made to the initial research project proposal's design, hypotheses, and objectives. The result of this redesigning process is seen in the current form and breadth of this PhD thesis.

6.1. Introduction to the ecosystem services

Ecosystem services (henceforth ES) are resources and processes of ecosystems that benefit humankind (B. L. Turner 2009, 107). The term of 'ecosystem services' has been attributed since at least 1981 (Mooney and Ehrlich 1997; in Potschin and Haines-Young 2016, 2) but has gained special attention after the publishing of the Ecosystems and Human Well-Being: Millennium Ecosystem Assessment (henceforth MEA) – a report which extensively assessed the extent of humans' impact on the environment. In it, the ES are divided into categories: 'provisioning services such as food, water, timber, and fibre; regulating services that affect climate, floods, disease, wastes, and water quality; cultural services that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling', emphasising that 'the human species, while buffered against environmental changes by culture and technology, is fundamentally dependent on the flow of ecosystem services.' ('Ecosystems and Human Well-Being: Millennium Ecosystem Assessment' 2005, v).

In the period after the MEA, the concept evolved, and these services are analysed through a series of valuation methods, mostly derived from environmental economics techniques. This approach was, and still is, critiqued for its emphasis on economic production and for assigning economic values to goods and/or ecosystem processes that may not be so easily monetised, like the sense of place and sense of identity (Blythe et al. 2020, 2; Small, Munday, and Durance 2017, 65). Another debatable aspect when ascribing values is the individual perception of ecosystem services – which is also increasingly recognised as context-dependent, spatially contingent, identity-bound, gendered, and age-specific factor which is influenced by the social and cultural worlds in which it is embedded (Chan et al. 2012; Martin-Lopez et al. 2012; Reyers et al. 2013). Another important issue is the premise that nature is valuable in relation to humans, and not *per se* or for other parts of the natural environment.

From the ecosystem services' categories listed above – provisioning, supporting, regulating, cultural – it can already be deduced their aim was mostly directed at natural resources (or natural capital). From this point, it was advanced to address the relationship between cultural heritage/cultural goods and the services they might provide (Powell et al. 2019). In the case of the dry stone wall heritage, services can be observed from the walls as separate objects and from the landscapes they form.

6.2. Value of the dry stone walls in the context of ecosystem services

Benefits from dry stone walls arise from the current level and quality of the stock (the asset), as well as from the functions they currently serve that enhance social welfare. It has been long agreed that the value of dry stone walls goes beyond their original function of providing new agricultural areas. If part of a terraced system, they provide hydrological functions like erosion control, stabilisation of slopes, prolongation of runoff times, and the possible reduction of surface runoff (Agnoletti et al. 2015). It has also been argued they play a strategic role in the conservation of biodiversity (Assandri et al. 2018; Manenti 2014; Collier 2013), the maintenance of local identity (Acovitsióti-Hameau 2008; Stepinac Fabijanić 2013), and biodiversity. They further contribute to the character of landscapes and local distinctiveness, how landscapes are experienced and perceived by people, and the senses of place and well-being (Powell et al. 2018, 6–7). They can also provide an understanding of historical and present land management.¹⁸¹ In addition to approaching them as landscapes, benefits can be observed from the dry stone walls themselves (individually). This is a detail to be looked at in the valuation models to avoid double counting (i.e. counting the value of the dry stone walls more than once).

6.2.1. Agricultural function (provisioning, regulation)

One of the main functions of dry stone walls is to be stockproof and soil retaining, the first being a feature of the pastoral boundary walls and the latter a characteristic of the agricultural terraces. For stockproof walls, a financial proxy is relatively easy to find – it can be expressed as a market price for the same length of wired or any other appropriate fences in agriculture. Retaining walls might be calculated by the following counterparts: the purchasing of gabions and the cubic metres of soils, as both are results that the process of terracing has formed.

Considering that dry stone walls are human-made artefacts, the working hours and effort required to erect them may represent the first step in the monetisation of the existence of dry stone walls. In Croatia, the effort needed to erect or restore a dry stone wall was calculated for the purposes of subventions in agriculture (rural development measures 4.4. and IAKS measure 10.1.10). They were calculated both for retaining walls and the boundary walls (Uprava za potpore poljoprivredi i ruralnom razvoju 2020; Šrajer 2016b; 2016a). The reconstruction of existing and the construction of new walls has been

¹⁸¹ Discussed in chapter 5 - Dry stone wall patterns and the underlying historical processes.

unified into a mean value to enable simpler calculations. In the case of the terraces, it equals 417,17 HRK/m (≈ 56 €/m); in the case of boundary walls, it equals 739,98 HRK/m³ (≈ 100 €/m³). The intent was not to provide market prices but to calculate the time and the effort invested in the working hours in agriculture, according to the Croatian Bureau of Statistics. This was done with the intent of providing farmers fair fees for maintaining their own agricultural land.¹⁸² To these values, a slope coefficient is added. If the slope is between 20% and 50%, the coefficient is 1.2; if the slope is greater than 50%, the coefficient is 2.0. Furthermore, in cases of islands without public boat connections, a coefficient of 1.5 is added. This calculation provides the lowest possible monetary value of the dry stone walls in a given area.

Accordingly, an example was calculated for the Town of Mali Lošinj, and a value of 200–250 million euros was retrieved (T. Kremenić 2021). This calculation was based on a number of measurements and estimations:

1. The vectorised length of the dry stone walls

The Town of Mali Lošinj historically has constructed at least 4,900 km dry stone walls (see chapter 4). This number was subtracted ('Clip' in GIS) by the total length of the walls within the areas intended for construction (URBING d.o.o. ZAGREB 2016), which corresponds to 300 km. Therefore, it can be assumed the Town of Mali Lošinj will soon have about 4,600 km of dry stone walls.

2. Condition of the walls

Based on rapid field visits, it is estimated that at least 30-40% of the dry stone walls need some form of renewal or maintenance.

3. The ratio between terraced and boundary walls

Since the typology of each of the mapped dry stone walls was not completed, based on the first observations of the mapping, a 40:60 ratio of terraces and boundary walls is suggested. Then, a mean value for the renewal cost was taken and multiplied by the obtained lengths of the different walls' typology.

The degree of the slope should be included for the determination of the coefficients. This was not considered in this calculation but would be necessary for future ones, by overlapping the DEM layer with the vectorised DSWs (and their typology, if previously classified).

¹⁸² Unfortunately, the farmers' work of restoring their own terraces has been later declared as an inadmissible cost on which Šrajer reacted in a newspaper article (Šimić 2020).

The condition of the walls can significantly change this value. An idea on how to attain a more detailed and accurate insight can be gathered from the example of the Dry Stone Walling Association of Great Britain, who distributed among inhabitants a set of sheets with guidelines to conduct surveys on dry stone walls (Figure 185) (B. K. Jones 2000). Such might be distributed among farmers, foresters, hikers, hunters, and others who most frequently use the territory of the Cres-Lošinj archipelago.

Another issue with monetising the dry stone boundary walls is that, even if they are perfectly (re)built, they are no longer fully effective at protecting the livestock or agricultural yield due to the introduction of allochthonous animals,¹⁸³ namely wild boars (*Sus scrofa*) and deer (*Dama dama*), in the 1980s. After their breaking out of the designated hunting area in Tramuntana, they spread across the archipelago, causing considerable damage to agricultural production, particularly sheep husbandry, but also lowering the rates of biodiversity (Otočna razvojna agencija 2017, 19). Due to the animals' strength, it is relatively easy for them to break through the walls. Public arguments and protests have persisted throughout the last two decades but with no effective solution.¹⁸⁴ The existence of the wild boars and deer is today considered as one of the main decisive points of the futility of the dry stone wall restoration.¹⁸⁵ Therefore, most of the walls are today sometimes not even restored but instead fortified by wire and electric fencing.

¹⁸³ This circumstance is appurtenant to the case study area, as well as the other islands in Croatia. Wild boars have spread to almost all Dalmatian islands, while on the island of Krk, both wild boars and jackals are present.

¹⁸⁴ Dozens of articles on public engagement can be found in the regional newspaper 'Novi list', using the search phrases: 'divlje svinje', 'otoci', 'Cres' (Prodan 2017).

¹⁸⁵ A documentary movie on this topic – 'Ovca u muzeju' (Sheep in a museum) – was released in 2020 which includes the testimonies of local sheep breeders (Pavlovsky 2020). One particular phenomenon presented is that groups of sheep breeders living in the area of Loznati and Orlec became hunters out of necessity to protect their own herds, later forming their own hunting association.

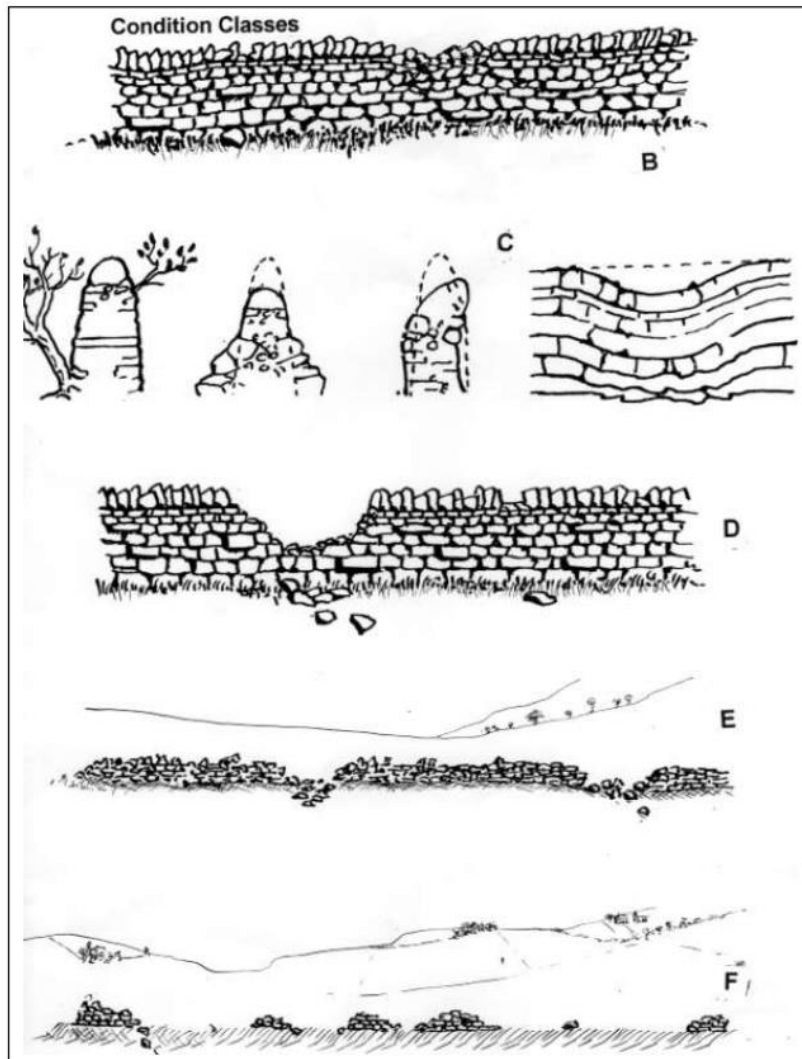


Figure 185. A segment from a 'wall survey' sheet, which is used in Great Britain to conduct surveys on walls' conditions (B. K. Jones 2000)

6.2.2. Dry stone walls as 'novel ecosystems'? (regulating services)

Biological value of dry stone walls is connected to their capability to provide biotic and abiotic factors which can accommodate life of different species. Floristic species (lichens, moss) are usually the first to become established, thus providing a biotic factor for fauna to thrive more easily (Hobbs et al. 2006, 4). The accommodation of life is worth mentioning, as it highlights an advantage of dry stone walls to concrete walls (Manenti 2014). The main features of the dry stone walls which enable life are its:

- morphology – of heterogenic form, with many crevices,

- structural characteristics – the fact that it is constructed from naturally occurring materials,
- age – most of them were built at least a century ago; their time-depth in most cases is 200–500 years old, which increased the time of their exposure to various biotic and abiotic factors, allowing for the establishment of peculiar communities (Manenti 2014, 1880), and
- location within traditionally managed areas (which are generally of higher rates of agrobiodiversity).

In his review article, Collier (2013) concluded there is a paucity of scientific work on the biological value of dry stone walls, especially in comparison to well-studied hedgerows. Nevertheless, most of the studies which have investigated the presence of species in the dry stone walls successfully found them. Moreover, dry stone walls have been suggested as ‘novel ecosystems’ (Darlington 1981), i.e. human-built, modified, or engineered niches of the Anthropocene. This might be a slight exaggeration – a more accurate way to define them would be as habitats.¹⁸⁶ In Great Britain, this is why they were included in the countryside survey (Carey et al. 2008), and the same acknowledgement was included in the Croatian plan for the implementation of ecosystem services (HAOP 2015, 22). Dry stone walls are certainly not lifeless structures, which, apart from the studies, can be observed from field visits. According to some research, there are more than 1,400 species on the island of Cres (Sušić and Radek 2007), but the degree of relevance of the dry stone walls for biodiversity is still to be determined.

¹⁸⁶ I thank biologist Ivan Šapina for his insights.

6.2.3. Legibility, aesthetic value, and touristic appeal (cultural services)

If it is agreed that the aesthetic component is indeed inherent to dry stone heritage,¹⁸⁷ such can be observed from the scales of individual structures and the landscapes they form. In quantifying the cultural ecosystem services, the landscape scale is mostly considered and it is routinely assessed by perception-based surveys in which quantitative measures of aesthetic quality are derived by averaging choices, ratings, or other measures across observers (Daniel et al. 2012).

Incomplete but indicative results were obtained from a pilot survey disseminated by the Island Development Agency and Tourist Board of the Town of Cres in 2020. The aim of the survey was to investigate the current state of tourism in the town of Cres environs as part of the SUSTOWNS project.¹⁸⁸ More than 100 respondents provided information about their age, gender, formation level, occupation status, and the length of their habitation in the town of Cres. Two polar questions were added to this survey, per author's suggestion to initiate the investigation of the dry stone wall landscape in the touristic strategies:¹⁸⁹

- 1. Do you think the dry stone wall landscapes are an important factor of the touristic appeal of the Town or the island of Cres?*
- 2. Do you believe more resources should be invested in the rural areas outside of the town borders, restoring or maintaining and better presenting dry stone wall landscapes?*

The answers left little space for ambiguity. From 105 respondents, 97 responded that the dry stone wall landscapes are not an important factor of the touristic appeal of the island of Cres, and 91 responded that no more resources should be allocated to investing in the rural areas (restoring or maintaining and better presenting the of dry stone wall landscapes). Only 10 responded favourably.

'If a tree falls in a forest and no one is around to hear it, does it make a sound?', or, in the case of the dry stone walls: if dry stone walls are not observable or mappable due to

¹⁸⁷ Whether the aesthetic component of the dry stone structures is considered intentional, or a by-product of pragmatic imperative is discussed in chapter 3, sub-section '3.3.4. The question of the aesthetics of dry stone walls'.

¹⁸⁸ SusTowns project is back in two beautiful Croatian islands: Cres and Lošinj. 2021. *Interreg Mediterranean*. Last modified: July 14. Accessed: November 12, 2021. <https://sustowns.interreg-med.eu/special-pages/rss-feed/events/actualites/sustowns-project-is-back-in-two-beautiful-croatian-islands-cres-and-losinj/>.

¹⁸⁹ I thank the Tourist Board of the Town of Cres and the Island Development Agency for help.

canopies they are covered with, should they be taken into consideration? The visibility, or legibility, is here considered as the possibility to observe the dry stone walls, generally from an aerial perspective and appreciate the aesthetic component of the landscape, as well as its importance for the scientific interpretation. As was found in chapter 4, 50% of the dry stone walls are covered with forest, and most of the others are in the process of overgrowth, therefore, legibility of the historical enclosures is steadily diminishing.

The choice to map neglected and overgrown areas such as the *Lovreški* vineyards was a deliberate one. It differs from the work on the valuation of the dry stone walls made by Powell et al., in which dry stone wall areas that were no longer visible were automatically disregarded (Powell et al. 2018, 6). Visibility is indeed a key factor in dry stone wall valorisation because it makes a direct contribution to legibility, local landscape character, sense of place, and sense of history. However, existing under the current surface features or not, they represent an inherited latent potential of agricultural, ecological, and cultural value. Given the durability of dry stone walls, which is counted in centuries if constructed in a professional manner (Murtas 2015, 28), most of these areas can still be reused and revived. All the stone structures still provide corridors for species, they still embody the working hours, retain the anthropogenically formed soil, and testify to the historical circumstances.

6.2.4. Value found in archaism or relatability? (cultural services)

As reviewed in chapter 5, dry stone walling is a millennium-old technique used for agricultural enclosing and building military and defensive structures. It is also a result of very recent events, some of which are still part of the people's living memory. Even though dry stone walling represents an important part of the past of the people of the Cres-Lošinj archipelago, it is still unclear how much of this traditional activity is ingrained into the people's awareness and perceptions. No study until now has assessed the level of the (dis)attachment of the people from 'tradition' (Figure 188), which is an important aspect in the defining the rates of the cultural ecosystem services. Some indicators were gathered and analysed during this study to gain initial insights into the topic.

Since sheep breeders from Loznati and Orlec decided to form an association to protect their herds from the allochthonous animals, and since the same association is registered in the List of the holders of the knowledge of dry stone walling of Croatia (Ministarstvo kulture Republike Hrvatske 2016), the numbers of inhabitants involved with agriculture might indicate the level of attachment to the territory, considering the dry stonework to be an integral part of their agricultural plots. In Mali Lošinj, 198 legal persons have been registered as engaged with agriculture, which corresponds to 3.5% of the population. In Cres, the numbers are slightly higher – 8% of the inhabitants are working in agriculture. The drastic loss of Mali Lošinj's ties to its agricultural area is also noticed from other indicators: most of the terraced olive groves and vineyards have been fully overgrown, and the olive oil production is all directed to the town of Cres. Veli Lošinj, on the other hand, with approximately 800 inhabitants,¹⁹⁰ has a slightly larger number of farmers and agricultural activity. 45 legal persons are occupied with agricultural activity as their primary or secondary economic activity (APPRRR 2021), which corresponds to slightly more than 5% of the inhabitants (Table 18).¹⁹¹

¹⁹⁰ 863 as of the last census. It needs to be considered that the numbers given by the bureau are, especially in the case of the island's population, exaggerated to a certain degree, especially during the colder part of the year. Many people register their domicile on them for certain transportation (ferry and catamaran) deduction from the usual cost.

¹⁹¹ The numbers only partially indicate the agricultural activity. Many registered family farms produce only for their personal needs, while others tend to register only for agricultural subventions.

Table 18. Calculation of the inhabitants-farmers ratio; data obtained from the Croatian Agency for Payments in Agriculture (2020 census) and Croatian Bureau of Statistics (2021 census)

Towns	# of inhabitants (census 2021)	# of legal persons who register agriculture as their economic activity	registered agriculture / inhabitants (%)
Cres	2205	179	8.1
Mali Lošinj	5577	198	3.5
Veli Lošinj	863	45	5.2

However, Mali Lošinj, in comparison to Cres, has demonstrated stronger civic activism actions which specifically address the dry stone heritage. From 2014–2015, the Town of Mali Lošinj participated in the Interreg project ‘Kamen-most’ which specifically aimed at the renewal and valorisation of the dry stone walls. Their involvement followed the Town of Cres’ refusal to participate in the project. In addition to an organised dry stone walling competition and the renewal of several areas, one of the results of this project was the first study to specifically address the dry stone heritage, its structures and its landscapes (Frangeš et al. 2015b). However, since 2015, none of the findings or propositions suggested within the study have been implemented as part of the municipalities’ strategies.

Since 2008, public commentaries have been made regarding the destruction of dry stone walls for the purposes of new infrastructures, mainly through the association ‘Centar za zdravo odrastanje – Idem i ja’. Several years later, as part of the project ‘Suhozidi su vrijedna baština’ (Figure 186) funded by the Croatian Science Foundation, a 30-minute documentary movie about the island’s dry stone walls was released (Aćimović and Bijeljac 2011). It was coordinated by archaeologist Aleksandra Faber¹⁹² and the abovementioned local association as part of a wider campaign inviting the local community to the safeguarding of the island dry stone heritage.¹⁹³

¹⁹² The vagueness of the use of the term ‘barbakan’ (see chapter 3, sub-section 3.2.2.4. *Barbakani*) can be noted in this short film as well. At 11:28, Faber – a credible archaeologist – erroneously describes *barbakan* walls as intended to protect pastoral areas from wolves or areas close to the settlements from dogs, at least in the context of the Cres-Lošinj archipelago.

¹⁹³ On the web forum ‘Volim Lošinj’, a recording of a radio interview with the association’s president Bojana Genov and a long time association volunteer Goran Jambrešić (who is also a civil engineering expert) can be found. In this interview, they discuss the dry stone walling project on the island of

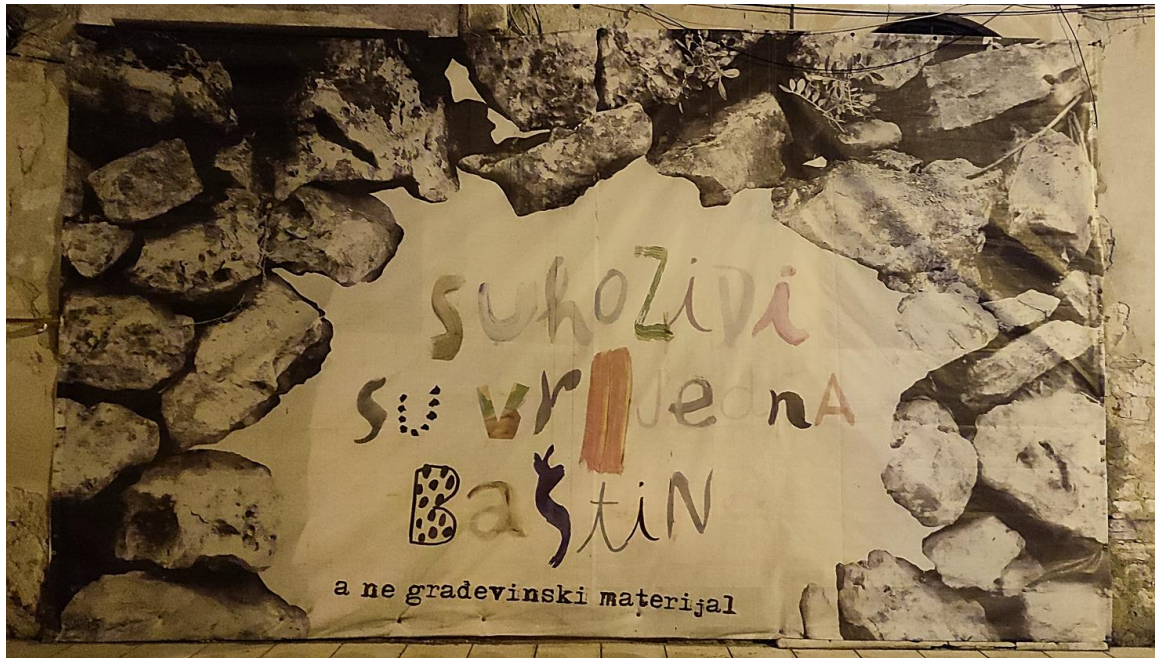


Figure 186. 'Suhozidi su vrijedna baština, a ne građevinski materijal' (Croatian for: 'Dry stone walls are valuable heritage and not a construction material') on a jumbo poster on one of the Mali Lošinj buildings, hanging since 2009, as part of the civil association 'Centar za zdravo odrastanje - Idem i ja' campaign. This photograph was taken in 2021.

The Towns of Cres and Lošinj were part of the same municipality (*Općina Cres-Lošinj*) from 1962 until 1993 (mostly during the Federative Republic of Yugoslavia rule). During that time – specifically, in 1979 – a decision was made to forbid new constructions from the dry stone wall material, along with designated fines for its violators. The decision still stands, even though it has not been adapted to the current conditions (new government and new currency) (Koščić 2008).

One of the rare attempts to organise a dry stone walling workshop in Cres was made in 2015. Besides workshop organisers – association *Susajda*, the Island Development Agency, *Ulika*, *Susajda* and *Dragodid* association – no one participated (Salković 2015).

The inhabitants of the town of Cres have displayed certain resentment toward the idea of the formal protection of the dry stone walls, as they perceive it as an aggravation for economic activities. A 2017 lecture was held by Tarcisio Bommarco at the Cres Museum, who presented his research on the topic of the dry stone walls in the town of Cres olive grove. His proposal that the grove is 'worthy of UNESCO's protection' (Purić 2015), was not warmly welcomed. The local community – if its opinion is the one expressed through

Lošinj: Priznanje za umijeće suhozidne gradnje. 2019. *Volim Lošinj*. Last modified: April 19. Accessed: October 20, 2021. <http://www.volim-losinj.org/udruge/2825-priznanje-za-umijece-suhozidne-gradnje>.

the gathered audience and what was later noticed during conversations – is extremely reluctant to further prohibitions which might come together with an international organisation. This situation is probably due to these people’s experiences with the conservation rules regulating the historical town centre of Cres. From the informal conversations with the locals (members of the *Ulika* association and Agricultural Cooperative), it seems that a consensus has been reached – the perforation of the dry stonework and concreting of the gravel roads leading to the olive grove parcels is a necessary compromise if Cres is to continue its olive oil production (Figure 187).¹⁹⁴



Figure 187. The annual work of the members of the Cres olive growers’ association ‘Ulika’ of concreting the roads to olive groves in order to facilitate agricultural production, but at the expense of the vernacular dry stone architecture (© Franko Fučić)

Figure 188. Three generations of the same family from Cres (Pernat) repairing a dry stone wall (© Anamarija Dlačić)

¹⁹⁴ Some of the mentioned observations are results of the author’s previous work within the Island Development Agency and participation in the workshops with local community within the Council of Europe’s Local development pilot project (LDPP Island of Cres). URL: Pilot project lokalnog razvoja – Otok Cres. n.d. OTRA. Accessed: November 18, 2021. <http://www.pplr-otokcres.info/>.

6.3. Exceptionality? Valorisation through the category of cultural landscapes – the town of Cres olive grove as Cres-Lošinj archipelago's candidate

6.3.1. Cultural landscapes and legislative

In 1992, the UNESCO's World Heritage Committee¹⁹⁵ agreed that cultural landscapes meet the criteria of 'outstanding universal value'. The World Heritage Convention of 1972 was revised accordingly, and the protection of the outstanding examples of the 'combined works of nature and humankind' were given attention (Finke 2014, 18; Jansen-Verbeke and McKercher 2013, 243; Rössler 2006). Cultural landscapes are focused on landscapes where human relationships with the natural environment define their essential character over time. The emphasis in cultural landscapes has been on human history, the continuity of cultural traditions, and social values and aspirations.¹⁹⁶

Since 1992, landscape research has generated a wealth of knowledge in different disciplines and triggered ongoing discussions about the most appropriate modes of its management. Studies, especially those considering Italy's tradition of exploring and registering rural historical landscapes (Agnoletti 2013), have been recognised by organisations such as International Council on Monuments and Sites (ICOMOS), The United Nations Educational, Scientific and Cultural Organization (UNESCO), Food and Agriculture Organization (FAO), and Council of Europe (CoE). The FAO created the Globally Important Agricultural Heritage Systems (GIAHS) – which focuses on five pillars which determine whether a certain landscape can be considered as one of international value: food and livelihood security; agrobiodiversity; local and traditional knowledge systems; cultures, value systems, and social organisations; and landscapes features.¹⁹⁷

The attribution of the category of an exceptional cultural landscape differs from the valuation framework in that it also includes the incalculable criteria such as significance, integrity, and vulnerability (Agnoletti, Santoro, and Gardin 2013, 26; Aničić and Andlar 2018). Here, an attribution of the category of a cultural landscape (Kladnik, Hribar, and

¹⁹⁵ The World Heritage Committee. n.d. *UNESCO*. Accessed: November 21, 2021. <https://whc.unesco.org/en/committee/>.

¹⁹⁶ This tradition of dichotomous separation of the natural and cultural heritage has been criticised in many works, emphasis the two are inextricably linked (Mitchell and Buggey 2000), and that the conservation approach could benefit from more integration (Mrđa and Bojanić Obad Šćitaroci 2016).

¹⁹⁷ Become a GIAHS. Designation process. n.d. *FAO*. Accessed: May 23, 2021. <https://www.fao.org/giahs/become-a-giahs/designation-process/en/>.

Geršič 2017) and international visibility are considered as forms of landscape valorisation, considering such category and title would in practice facilitate the development of the recognised landscape's strengths and prioritise scientific research. In the context of the Cres-Lošinj archipelago, the town of Cres olive grove has been recognised as the primary candidate for its institutional recognition as a cultural landscape. In 1982, Cres olive grove became part of the FAO/UNDP project¹⁹⁸ and, therefore, had by then already become a part of a relevant global environmental and cultural and sustainable development discussion. Since then, this landscape has not been part of any protection or designation model. Its place within the spatial plan is not adequate – it does not regard all its values, and it has an arbitrary boundary area and vague spatial plan provisions. Furthermore, due to increasing demands for areas of touristic and housing infrastructure, the extent of this protection will probably be reduced in future amendments.

Within the Croatian national legislation, there are two (theoretically) appropriate categories for this kind of landscape. They have almost identical definitions of landscape and come from different sectors (Andlar et al. 2010). The first one is 'significant landscapes' within the Nature Protection Act. Despite having the same formal definition as the IUCN category Protected landscape/seascape V (a category designed to protect living rural landscapes whose character is based on a combination of natural, cultural, and aesthetic values),¹⁹⁹ it is usually applied only to areas of natural significance. The second category is 'cultural landscape' within the Act on the Protection and Preservation of Cultural Goods, but this is mostly focused on historical structures. Even though these categories are very rarely applied on living rural landscapes in practice, both lack integral and landscape-scale comprehension, while existing practices, products and multifunctionality are overlooked. On the other hand, the international GIAHS designation specifically addresses 'agriculture' among its criteria, which also considers culture, traditional knowledge, food production, agrobiodiversity, and landscape.²⁰⁰

¹⁹⁸ 'Experimentation and Demonstration for the Improvement of Olive and Olive Oil Production, Yugoslavia. YUG/76/002. Rome, Italy: FAO' (Perica et al. 2014, 8–9).

¹⁹⁹ Category V: Protected Landscape/Seascape. n.d. IUCN. Accessed: February 16, 2021. <https://www.iucn.org/theme/protected-areas/about/protected-areas-categories/category-v-protected-landscapes-seascape#:~:text=Category%20V%20aims%20to%20protect,be%20larger%20than%20category%20IV.>

²⁰⁰ These criteria have partly inspired the author's identification of the research gaps for the landscape of the Cres olive grove.

6.3.2. The cultural landscape of the town of Cres²⁰¹

Cres olive grove has been identified as an exceptional case of a cultural landscape based on the following aspects: age, structural and functional preservation, the richness of the traditional knowledge, environmentally apt management, locally led participation in driving the changes, the functional plurality of its re-emergence as an active landscape, its ability to maintain its economic and demographic activity, its diversity, and the legibility of its historical dry stone walls structures. Furthermore, the Cres olive grove is now at an intersection between different paths to choose from and should be part of an adequate management.

6.3.2.a Historical significance and continuity through sustainable use

The town of Cres is the town of the longest historical continuity on the archipelago. Other ancient and historically important settlements, such as Osor, Lubenice, and Beli, share the same role but do not exhibit the same demographic and economic trends. According to the last census, Osor had only 28 inhabitants, while Beli had 54 and Lubenice had six (Croatian Bureau of Statistics 2022). The town of Cres also marked a decline but had 2,205 inhabitants, making it the second-largest town of the archipelago. The archipelago's largest town, Mali Lošinj (5,577 inhabitants), however important due to its largely preserved historical centre and dry stone terraces, is (relative to the archipelago's history) a young settlement.²⁰² Furthermore, its economic direction largely deviated from agriculture. The town of Cres is still tied to its agricultural area, which is also noticeable through the network of the dry stone wall-lined pathways (Figure 190).

Its continuity was enabled by a range of adjustments. By adopting the simple upgrade in the form of an 'olive-sheep' model²⁰³ in the 1950s, the local community introduced a novel and environmentally apt tool for the preservation of the historical landscape (Figure 189). Introduced agropastoralism facilitated the maintenance of the traditional agricultural use (olive oil exploitation) and the conservation of the inherited capital (dry stone walls and anthropogenic soil). It provided a new agricultural quality product

²⁰¹ The research of the Cres olive grove landscape area was adapted from the article published by the author (T. Kremenić, Andlar, and Varotto 2021).

²⁰² The island of Lošinj was populated only in the 13th century (Crnković 2001, 14:26).

²⁰³ On the island of Ilovik, sheep were also recently introduced into olive groves, but in a less systematic manner.

(island grass fed lamb) and prevented the need for additional herbicides and mechanisation, which usually entails demolishing the existing enclosures and terraces.

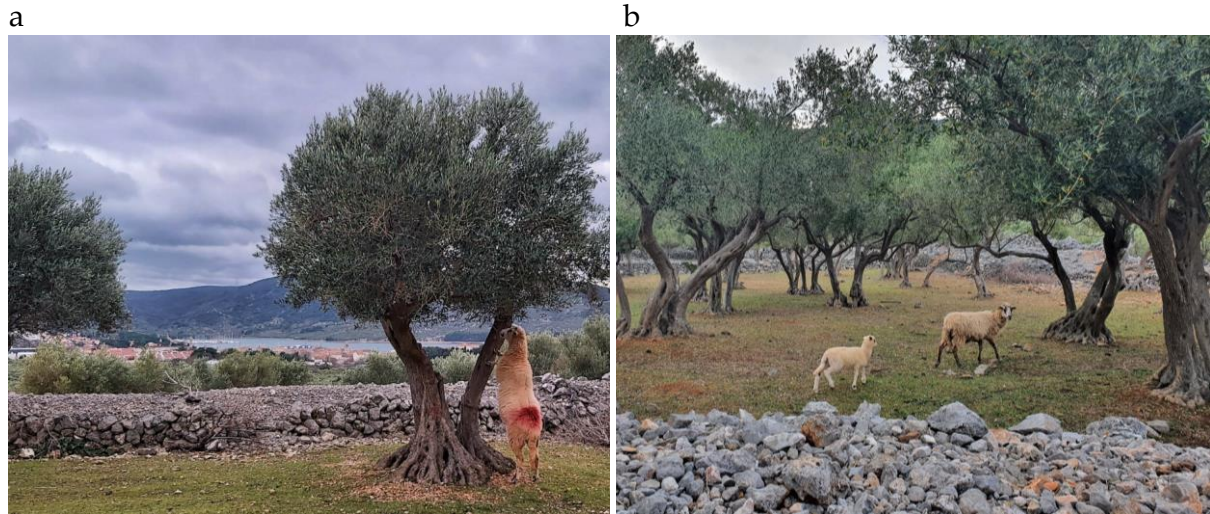


Figure 189. Agropastoral (olive-sheep) systems of the Cres olive grove: a) sheep foraging the olive tree leaves and contributing to 'exterior design', leaving the olive grove appearing neat and maintained (© Dubravko Matić 2019) and b) a common sight from January to April in the town of Cres olive grove (2020).

Investing in new olive oil processing technology in the 1970s, the local community met the needs of the market in the form of a quality product that, today, is considered one of the main guarantees of maintaining the agricultural function of terraced landscapes. The perforation of new gravel roads in the last two decades reduced the area of the dry stone wall heritage but also enabled better access to certain parcels, increased oil production, and later became part of the touristic paths. Olive harvesting is an important economic activity, as it compensates for the seasonality of tourism and prolongs social cohesion, thus alleviating the island's annual bipolar biorhythm (Toić 1992). The autonomous preparation and acceptance of a PDO designation (Udruga Ulika 2014) further emphasised the importance of local participation in directing changes that affect their territory.

6.3.2.b Landscape

The Cres olive grove is located in a semi-flooded, differential erosion-formed karst valley with dolomite and anthropogenic soils surrounding the town of Cres. Andlar recognises that among 69 registered outstanding agricultural landscapes of Adriatic Croatia, the Cres site was one of only two examples of agropastoral polyculture and one of the few

that have preserved historical morphological relations to the urban fabric. Today, it is one of the largest homogenous traditional olive grove areas in the Croatian Adriatic (Andlar 2012, 129).

The resistance and longevity of the dry stone wall structures help the preservation of the landscapes. The multifaceted blend of the legible dry stone walls and other dry stone structures, combined with the area's extensiveness and current active use, represents a rarity in national landscapes. As such, this area is a valuable land-use example of Mediterranean cultural landscapes, where the abandonment, neglect, and illegibility of dry stone walls are increasingly pronounced (Tarolli, Preti, and Romano 2014).

6.3.2.c Urban-agricultural integrity

Today, urban-agricultural integrity is still observed in its structural and functional interconnections. Gathered yield which is brought to the town centre – where the oil is produced – may attest to its functional connection. A structural connection is visible in a network of pathways extending in a semi-concentric web from the town centre (Figure 190), following the central road laid in a north-south direction, which has been a part of a wider network of field roads to the surrounding olive groves and vineyards (Borić and Gudelj 2019, 31).

Although these pathways to the agricultural plots have been interrupted by concrete roads and the urban expansion of low-density housing, the town's olive grove is still an integral part of the town. The use of extensive traditional agriculture-related vocabulary, even if it has been reduced, attests to the current connection between people and their agricultural area. This knowledge is used mainly by elderly inhabitants and is no longer a universal phenomenon of the local community today. Alongside the lack of a detailed and accurate local dialect vocabulary, it may threaten this intangible part of heritage.

Currently, the construction of new roads has been beneficial for many of the olive growers and for olive oil production, but it is performed with no underlying strategy, nor is it regulated by compensatory measures (such as reconstruction of dry stone walls). This, in addition to the low number of registered craftsmen in dry stone walling and rare renewal of the dry stone walls and houses, may suggest a lower appreciation of the dry stone wall heritage within the local community.

6.3.2.d Touristic appeal

An important factor in the landscape's durability is the appeal of the island of Cres and its inclusion in the tourism industry, which brought about increased demand for local agricultural products directly to the olive grower's doorstep. It is an important variable, as the strenuous terraced olive growing practice becomes vulnerable in case of a lack of profitability. Touristic exploitation affects the broader socioeconomic system (Terkenli, Castiglioni, and Cisani 2019, 305), and in the example of Cres, problematic impacts are visible in questionable spatial interventions. The gravity of this issue depends on its reversibility potential; while torn dry stone walls are restorable, tourist housing construction on valuable agricultural land is permanent.

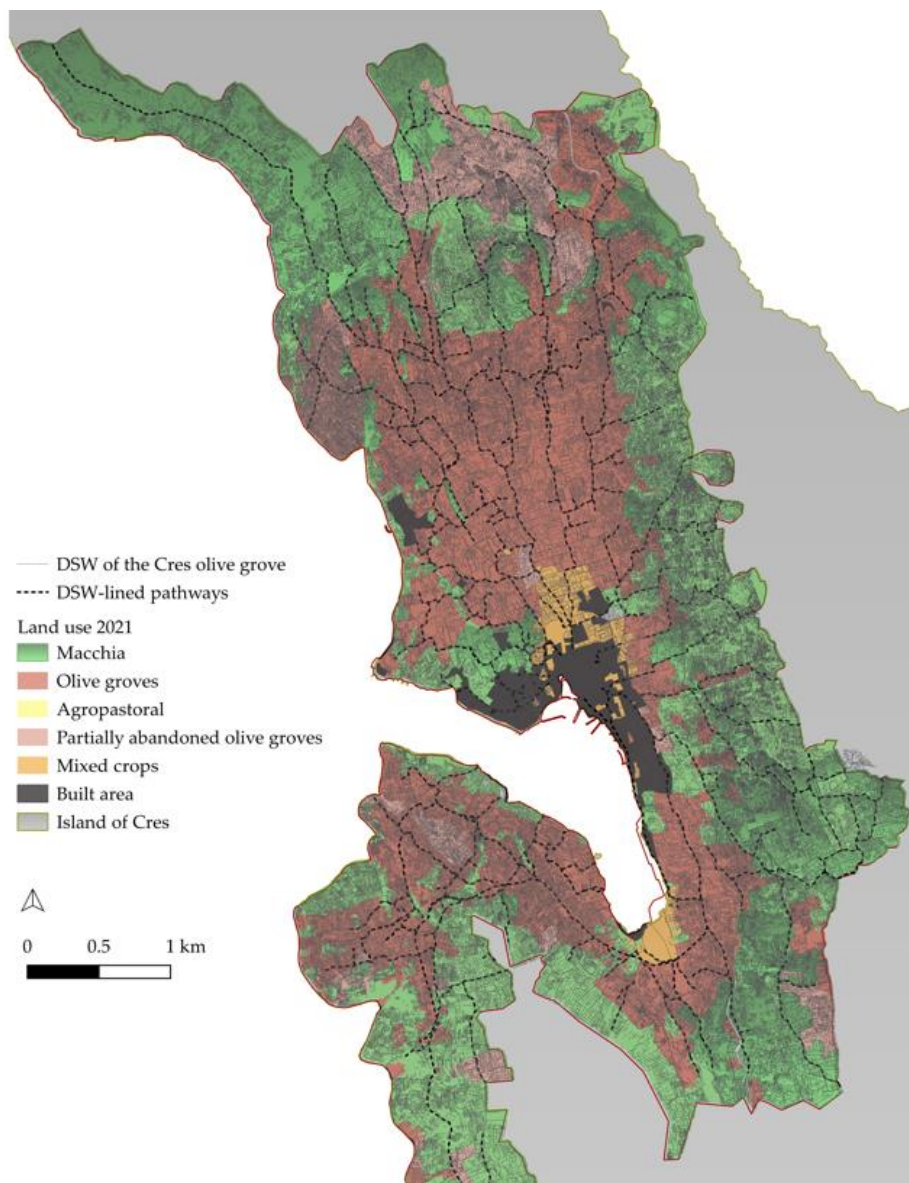


Figure 190. The dry stone wall-lined pathways extend radially from the town of Cres, symbolising the town's connection to its agricultural surroundings. (DSWs vectorised from DOF53, land use from DOF2014)

6.3.2.e Problems

Demographic decline and insufficient research and management in the area have also negatively affected spatial trends. As a result, marginal parts of the area are visibly deteriorating due to reforestation caused by agricultural abandonment, and the immediate surroundings are pressured by the expansion of touristic and housing infrastructure. Increased reliance on tourism has increased the profitability of some products, but it has simultaneously discouraged agricultural activity, accelerated the abandonment of stone masonry, and deprived this agricultural system of its main elements – namely, the dry stone walls and the people and practices that promote its upkeep.

The Cres olive grove is not a fully conserved relic of an (agri)cultural traditional landscape. It would be unrealistic to expect a facsimile preservation from a constantly inhabited place subject to touristic economic trends, especially bearing in mind that the most extensive area was cultivated only in the short period during the greatest population increase in history and in the presence of ephemerally favourable conditions for viticulture.

6.4. Discussion and conclusions on the actual and potential values of the dry stone

The application of the ecosystem services in Croatia is only in its beginning stages. It was initiated by the drafting of the first study at the national level in 2015, in which the ecosystem services and habitats were mapped (HAOP 2015, 22). In it, the dry stone walls were mentioned, symbolising the beginning of their consideration in this framework.

Since no other studies have been done which would further elaborate on the connection of the dry stone walls or dry stone walls landscapes with the services, this chapter provides a discussion on the first steps to be taken based on the approach applied to the UK's Peak District (Powell et al. 2018). The application of the full model was not possible for several reasons. Firstly, the study was done by a team of four at CCRI, with background formation in environmental economics, a process which took over a year. Secondly, the input data, such as the stock of the walls and time-depth, were already provided and did not need to be part of their research. Thirdly, the region inspected by the CCRI regarded a national park with an entrance fee, which was one of the main components of the calculation of the cultural services. The cultural services in the CCRI study comprised 90% of the services provided by the dry stone walls. The Cres-Lošinj archipelago is under no category of protection, and no preliminary input data are available.

Within this chapter, some of the values of the dry stone walls were discussed: their agricultural, aesthetic, historical, and ecological functions, as well as their importance within the local community. Most of the values reflect those of the Croatian Adriatic (same historical and current functions, similar rates of neglect). However, in other instances, it was shown the area had some specificities (the presence of allochthons animals). The preliminary survey data showed that the citizens of Cres see no value in the dry stone walls in terms of touristic exploitation, nor do they believe they should be invested in any further. Additional detachment was noticeable from the low numbers of people employed in agriculture, the advancement of the destruction of the dry stone walls for housing and roads, the low number of dry stone walling workshops, and low civic activism. The initiatives which regard the efforts to protect, renew and register the dry stone wall heritage on the Cres-Lošinj archipelago have been sporadic, and none of them have entered permanent local policies. Here, the preponderance of the Town of Mali Lošinj has been highlighted, with emphasis on the Town (wider administrative area), with three associations that have been recognised as having higher sensibility towards this type of heritage: *Puntari* from Punta Križa, *Tunera* from Ustrine and *Idem i ja* from Mali Lošinj. However sound the proposed valuation model based on ecosystem

services may be, the finality of such a number can prove to be arbitrary, especially with the low local sensibility which was demonstrated here.

To monetise its agricultural functions, some surrogates (financial approximation that matches the magnitude of a benefit received with a market-based estimation of its worth) are available. These include the effort of the human work, the market prices of for fences (gabions) and soil. However, most of the necessary data are still lacking, both in the case of the study area and in the geographical constraints of Croatian Adriatic: the historical significance (time depth of certain dry stone wall areas), a detailed examination of the conditions of the walls, the full extent and typology of the dry stone wall, the community's attachment to them, the sense of identity and place, and the beneficiaries (i.e. the users of the defined ecosystem services). Most of these categories will require separate research projects.

This chapter also aimed to deliver a timely scientific intervention of a previously insufficiently addressed area – namely, the olive grove surrounding the town of Cres – both in terms of scientific research and management. This landscape has been identified within this study as the archipelago's primary candidate for an institutional recognition as a cultural landscape or other more elaborate and adequate forms of its safeguarding. Being a part of a protected area might enhance the value and enable more elaborate management guidelines; however, the potential to also impose a constraints and limitations should not be underestimated. The town of Cres olive grove is characterised by a complex millennium-long shaping history. Its value is found in its resilience, and it is still a demographically and economically active area today. This is important considering the trajectories of other cultural landscapes which usually follow the path of either monoculture production intensification or abandonment. The synchronous combination of modern pressures (such as cutting ties with traditional land use practices, the increased momentum of spatial interventions, and the area's vulnerability to climate change), the preserved historical aspects of the Cres grove (the legibility of the dry stone structures and traditional practices), and an example-setting approach of landscape preservation (its upgrade to a multifunctional agropastoral and touristic land use system) were the main factors promoting the proposal of the protection of the town of Cres olive grove in this study.

Table 19. Recapitulation of the dry stone walls functions and benefits – a draft framework

Ecosystem services	Functions	Beneficiaries	Threats
provisioning services	soil retention and improvement of temperature and moisture conditions	local community, farmers	climate change -
	livestock management	local community, farmers	loss of ties with the landscapes due to
	livestock shelters (from wind and sun)	farmers	abandonment of agriculture
	agricultural and territorial boundaries	local community	-
supporting services	allows nutrient and water cycling	farmers	presence of allochthonous animals
	enables habitats (biodiversity and agrobiodiversity) which results in reduced need for pesticides	farmers	-
cultural services	landscape aesthetics	local inhabitants, visitors	costly renovations of the walls
	passing on 'traditional' knowledge of constructions and agriculture	researchers, local inhabitants, visitors	-
	'sense of place', local distinctiveness and, therefore touristic appeal	local inhabitants, visitors	cheaper materials
	'sense of identity'	local inhabitants	-
	recreational value	local inhabitants, visitors	lack of scientific data which attests to dry stone wall legitimacy for construction
	allows interpretation of the historic circumstances behind the of dry stone wall construction	researchers, local inhabitants, visitors	

CHAPTER 7

CONCLUSIONS

7.1. Final reflections on the empirical and conceptual outcomes

'Through interpretation, understanding; through understanding, appreciation; through appreciation, protection' (Tilden [1957] 2007) is considered to be the most quoted sentence in heritage preservation (Ham 2009, 50). In the context of dry stone wall heritage, Cres and Lošinj still have work to do regarding the first part of this formulation. These first steps have been one of the objectives of this work – to reverse the direction that has been marked by vegetation overgrowth and abandonment, by revealing the neglected part of this rural vernacular heritage and, in doing so, creating a basis for subsequent valorisation and management.

The thesis had three objectives, connected to three hypotheses, tested within the geographical scope of the Cres-Lošinj archipelago. Here follows a recapitulation of the results achieved with regard to the hypotheses posed.

H1: It is possible to develop a model that captures the value of dry stone walls in the Adriatic Croatia region

A model, or a framework which captures the values of the dry stone walls in the Adriatic Croatia regions is possible to design. Within chapter 6, a list of the universal values connected to the dry stone wall heritage (functions which facilitate for agriculture and sheep husbandry, aesthetic value and touristic appeal, sense of place, sense of identity, ecological value in form of habitat provision, historical value) as well as in chapter 5 (value of the dry stone wall patterns for scientific research). In designing of such a model, besides the universal values, a site-specific characteristic of the area must be taken in consideration. In this thesis, as a particularly important obstacle which impedes the basic functions of the dry stone walls is the presence of allochthonous animals, and a general disinterest shown by the local community towards the dry stone walls. These

two factors should not be underestimated in the future research and planning which will build upon the research direction started in this study.

H2: Mapping and interpretation of dry stone wall landscape patterns can generate new knowledge about the historical formation and function of dry stone walls

This second hypothesis has been confirmed in chapters 3, 4 and 5. Within chapter 3, while describing and exploring various types of the dry stone wall structures, new stratifications of the vernacular interventions have been observed: such as the dry stone canals in the town of Cres olive grove or the number of multicellular sheepfolds. In chapter 4, the vectorisation process instigated interpretations explained in chapter 5 – correlations between the dry stone wall (landscape) patterns and the historical circumstances. It is suggested and claimed with sufficient certainty that the diversity and extensiveness of the dry stone walls not only on the Cres-Lošinj archipelago, but on all of the Croatian Adriatic coast is a layer which can reveal new historical stratifications, with the use of adequate maps (DOF68, HOK) and LiDAR technology.

H3: Dry stone walls of the Cres-Lošinj archipelago are an important economic resource; investing in various aspects of dry stone wall landscape has a long-term positive cost-benefit ratio

Third hypothesis was neither confirmed nor rejected due to insufficient input data.

Accordingly, the following objectives of the thesis were achieved partially.

The objective “O1 Design, validate and apply a replicable valuation model of the dry stone walls on the example of the Cres-Lošinj archipelago” was achieved only in its first half. Model was not replicated in other Croatian areas, but it is assumed to be sufficiently representative and replicable in its draft form.

The objective O2: “Clarify the historical-geographical formation and assess the capital stock of the dry stone walls of the case study area” was completed both on the level of sub-case studies and the entire archipelago. Prehistoric hillforts, Cres olive grove, Pere, Lovreški and Ilovik were the case study areas within the archipelago, on the example of which historical circumstances of the dry stone wall-characterised landscape genesis was explained. On the level of the entire archipelago, the stock of the walls was mapped and generally assessed.

The objective O3: “Establish the economic cost-effectiveness of dry stone wall restoration” was achieved only in partially and the impeding factors of its completions have been explained in the chapter 6 (introduction part) and further in the discussion (6.4.). Due to the lack of input data, the economic viability of the maintenance of the dry stone walls will have to be explored in a separate study appurtenant to environmental

economics. However, by designing a framework of values the direction for the monetary calculation has been instigated.

7.2. Main results

The most relevant cartographic maps of Croatian spatial databases, namely DOF53 orthophotos, HOK base maps and 'CROTIS' layer, have been used to vectorise the dry stone walls. The systematic inventory of the case study archipelago provides many statistical values. The results show that the total length of the historically built dry stone walls of the Cres-Lošinj archipelago constructed until 1953 is 13,786.31 km, which indicates a 68% change compared to the existing vector layer of 'CROTIS'. A category of 'mapped area' was generated in GIS, which indicates the entire area in the near proximity of the dry stone walls. It was developed to indicate the 'intensity index' of the walls and to use the quantification to better portray the antropopressure on the territory and enable comparisons. The 'mapped area' is an area of 247.46 km², indicating that 50% of the archipelago area has been covered by dry stone walls. The areas of the highest walling densities are in *Lovreški* (1,224.36 m/ha), the terraces surrounding the town of Cres (1,206.1 m/ha), on the island of Lošinj, south of Privlaka pass (626.9 m/ha), and on the island of Ilovik (566.2 m/ha). Dry stone walls were most sparsely present in high, distant, and agriculturally inhospitable areas, such as the Osoršćica hill on the island of Lošinj and the Križić environs on the island of Cres. In the case of pastoral landscapes, the density of stone walls is 138.8 m/ha (Tramuntana region) or 136.2 m/ha (in the region of Punta Križa). Preliminary findings of the dry stone wall patterns close to the *Sveti Bartolomej* hillfort and observations of the dry stone structures of the island of Zeča confirm the importance of the deliberate mapping processes. Due to methodological limitations such as relatively low quality of the monochromatic orthophoto imagery, dry stone walls' similarity to other linear structures, and time restrictions which impeded a full field validation of all the structures, this result should be considered with a 3-5% error possibility. Another significant limitation to this approach has to do with the time invested, which implies that potentially high costs are involved in gathering these data. However, this mapping methodology is currently the most accurate approach considering the available cartographic data.

In this work, dry stone walls and structures on the Cres-Lošinj archipelago have been observed in terms of their form, occurrence, diversity, regional variations, and complexity, as well as their place in the broader regional context of the Croatian Adriatic. Fieldwork results, which were based on field visits and conversations with local inhabitants, demonstrated that there are significantly more types of dry stonework than

previously recorded. Prominent examples include the dry stone canal network in the Cres olive grove, dry stone multicellular sheepfolds, and dry stone ponds or wells. Some of them appear in significantly greater numbers, such as corbelled dry stone huts with round ground plans and multicellular sheepfolds. Multicellular sheepfolds exhibited higher complexity and confirmed the higher similarity between the island of Cres and the island of Krk than between the island of Cres and the islands of Lošinj and Ilovik. The islands Lošinj and Ilovik have very similar forms of dry stone walling between them, mostly comprising wide double dry stone walls which retain terraces and fields. A further insight into the details of construction conveyed different stories on the customs, agreements, and aspects the inhabitants deemed important, such as the example of the border stones between the Ustrine and Belej commons. Finally, the most distinctive dry stone structures in the study area include ponds (with *deriti*), multicellular sheepfolds, dry stone canals, and *pićohuanda* walling.

Landscape patterns give distinctiveness and a sense of unity to an area, but they can also be used as a tool in the historical reconstruction of an area. In this study, a dry stone wall landscape pattern is considered the smallest area discernible that occurs in repetition and is identifiable by the spatial arrangement, design, and relationship of its corresponding parts (other dry stone structures or vegetation cover) in a floor plan view. The five DSWP case studies (Ilovik, Lovreški, Pere, Cres olive grove, and hillfort landscapes) were chosen based on their distinctiveness and substantiation described in the literature. As such, they were used to assist to decipher the histories of the Cres-Lošinj archipelago and to observe potential correlations between socioeconomic processes and dry stone wall manifestations. Case studies from the Cres-Lošinj archipelago demonstrated variability in their patterns, which was confirmed to be caused by different historical circumstances such as the Venetian rule and olive oil production, the grapevine disease and revitalisation attempts, the increase of the inhabitants of the 19th century, and the Land Reform of 1945. The Lovreški vineyards, even though they are almost fully neglected and covered with a canopy, is a relatively recent case of land transformation from the 1920s and is a result of a post-vine disease attempt to revitalise the wine production in the area. While many of the basic pattern types described above could be applied to Croatian Adriatic landscapes (and vice versa), there are also examples where this is not applicable, as their occurrence is, to the best of our knowledge, restricted to the local scale. For example, in the Ilovik case study, a very rare dry stone wall pattern was uncovered within the Croatian Adriatic. The heterogenous patterns of the Cres olive grove suggested its centuries-long genesis, which was substantiated by the archival and literature analysis as well, while the regularity of the patterns of the island of Ilovik, Lovreški, and Pere confirmed planned and faster land reclamations, usually of mild topography. Even though the mentioned case studies were placed into causation with

certain historical socioeconomic events, using them as a *pars pro toto* is unwise. More research is needed to fully confine their typology to a particular period and location and avoid making easily defeasible claims. Nonetheless, they should be considered as strong indicators and a starting point for subsequent, more elaborate research questions.

In addition to the increased disintegration of the dry stonework of the Cres-Lošinj archipelago revealed through field visits (especially in the region of Tramuntana), the neglect of the dry stone walling is observed in the community's detachment from it. The preliminary survey data showed that 90% of the survey respondents (mostly Cres citizens) see no value in the dry stone walls in terms of touristic exploitation, nor do they believe they should be invested in any further. Additional detachment can be noticed from the low numbers of people employed in agriculture (3-8%), the advancement of the destruction of the dry stone walls for housing and roads, the low number of dry stone walling workshops, and low civic activism. In the latter case, the preponderance of activism the Town of Mali Lošinj has been noticed. This emphasises the need to develop new valorisation approaches. Since dry stone walls are considered both a natural and cultural capital, they could be approached from the monetary valuation techniques used in the ecosystem services approach, but for which this area will need to obtain more empirical data. A wealth of information is required for other location-based input data, such as the length of the walls, their condition, the landscapes they form, the type and number of beneficiaries, the time-depth of the structures, and their importance in the eyes of the local inhabitants and visitors.

Finally, in deliberating the future management, the town of Cres olive grove has been identified as the first area which could be additionally recognised institutionally as a cultural landscape. The economically conditioned temporality of dry stone walls and their current stage of neglect and disintegration need not necessarily be understood as an obstacle. Historically, because of milking and shearing, dry stone sheepfolds were places of the joint performance of duties and socialisation; these abandoned landscapes were also places of social cohesion. Indeed, they could again become points of social cohesion of a different kind – during their joint restoration by dry stone wall older artisans and young enthusiasts. On these occasions, a generational gap can be bridged, and a direct connection between grandparents and grandchildren established.

Dry stone structures aid the understanding of historical and contemporary social processes. When coming across a dry stone structure, such as a dry stone hut or a sheepfold, a passenger should understand that the space around it is explained by it. Sheepfolds are functionally tied to the larger pastures surrounding them, and huts are tied to an agricultural terrace or enclosure – they both summarise and convey a much larger material-immaterial historical and present space than is evident. Dry stone

structures, an island inheritance made not by one architect but of many nameless archipelago architects, could make it one of the most important of the archipelago's inheritances.

Ultimately, a wide range of further research questions related to the dry stone wall heritage have emerged. Some of these questions are concerned with the methodology and can be considered relevant to scientific research in general, while others are specific to the Cres-Lošinj archipelago. Some of them are concerned with the nature of professional work and management issues. These issues have been systematised after each of the thesis's chapters in several main units and are followed by the main aspects of operational or conceptual guidance for conducting research.

7.3. Key research contributions

This work can be described as appurtenant to the modern geography as it is based on the empirical-analytical epistemological foundations. It presented new data in the form of the results of empirical observations (dry stone structures vectorisation and inventory) and from a methodological perspective (mapping methodologies, dry stone wall pattern-genesis correlations, valorisation model of the dry stone walls). The different perspectives and presentations employed (terrestrial and aerial photographic and cartographic) assisted in unifying the image of the dry stone wall heritage of the Cres-Lošinj archipelago.

In line with the conclusion that 'if properly motivated, the landscape creator can become his most interested conservator' (Kale 2010, 464), this thesis also aimed to convey the richness of the heritage via the bird-eye view using drone photographs and cartographic representations. In this way, a new and more complete perspective of heritage for the local community could be conceived by considering the current low appreciation of the dry stone walls by a large part of the archipelago's inhabitants.

During the interview process, a willingness to share the knowledge on the local heritage was observed. The mere fact that the inhabitants were part of a knowledge-sharing group can be considered a form of heritage valorisation, giving them the impetus to reconsider a component which was, for most part, previously taken for granted.

Some of the key contributions of this research are reflected in its potential future use in the management and planning of the landscapes characterised by dry stone walls. By

creating a comprehensive and accurate dry stone wall GIS database of the archipelago, a usable tool is provided for its management, monitoring, planning and valuation within cultural and agricultural policies. It is particularly relevant in the latter case, as the current dry stone wall spatial data is incomplete and impedes complete subventions for farmers.

Recapitulation of results:

- the first Croatian comprehensive dry stone wall GIS database which covers an area of 500 km²
- the first graphical and descriptive inventory of Cres-Lošinj dry stone structures
- preliminary findings of previously unknown dry stone structures
- an evaluation and assessment of one category of dry stone wall structures (multicellular sheepfolds)
- reconstruction of the dry stone walls landscape areas based on their patterns, novel hypotheses (e.g. Cres olive grove), and the retrieval of new data (e.g. *Lovreški* area)
- initial steps in the valuation of the dry stone heritage within the ecosystem services
- internationalisation of the Croatian results of this topic by giving attention to local varieties, use, and tradition

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INTERLOCUTORS

The following list of local inhabitants provided valuable information on the location, characteristics, and historical use of dry stone structures of the Cres-Lošinj archipelago. In middle column are the places and areas they described and were knowledgeable of. Some of the interlocutors directed and accompanied me to the sites; with others I sat for two to four hours. I managed to converse with a few only via a phone call.

Interlocutors	Site	Date
Alberto and Auzilija Dunković	Cres environs	07 October 2020
Alberto Negovetić	Cres environs	28 September 2020
Ana Toić	Loznati and Lubenice environs	17 October 2021
Marina Lovrečić "Franićeva"	Lubenice environs	17 October 2021
Boris Belašić	Stivan environs and the sheepfold of Stivan commons	21 October 2020
Bruno Žic	Seepfold close to Loznati	25 June 2021
Dinko 'Dume' and Anđela Bucul	Merag and Cres environs	23 October 2020
Dinko 'Dume' Petrinić	Srem environs	26 October 2020
Dorijan Lovrečić	Gerbin	17 October 2021
Đulijano Benvin	Ustrine environs	17 October 2020
Elizabeta i Mario Mužić	Orlec environs	16 October 2020
Franjo Toić	Lovreški	07 June 2021
Franko Fučić	Cres olive grove	14 October 2020
Giorgio Karvin	Cres olive grove	15 October 2020
Giuliano Pino	Veli Lošinj environs	16 September 2020
Jordan Kučić	Belej environs	17 October 2020
Julijano Sokolić	Osor	20 July 2021
Klaudijo Ferlora	Cres environs	16 October 2020
Kristijan Kučica	Loznati	22 January 2022
Gordana Pavoković and Ladislav Radoslović	Ilovik	07 May 2021
Livio Hrelja	Ivanje environs, Tramuntana	25 October 2020
Ljubo Fornarić	Town of Cres environs	24 October 2020
Ljubo Galjanić	Punta Križa area	09 October 2020

Marija Jadrošić, Florina Jerolimić, Bruno Jerolimić	Ilovik	09 May 2021
Marija Jerolimić	Ilovik	09 May 2021
Marina Kalac Rukonić	Ustrine environs	16 April 2021
Mario Muškardin	Ustrine environs	19 November 2021
Mauro Hrelja	Multicellular sheepfolds of Betkav, Sveti Vid, Dražica, Mihojski; Tramuntana	05 October 2020
Mihael and Daniela Desanti	Ustrine environs	16 April 2021
Nevio i Marijano	Veli Lošinj environs	17 September 2020
Renato Deželić	Cres environs	28 January 2021
Riki and Marica Kučić	Cres and Predošćica	13 June 2020
Stefano Koljevina	Cres environs and Lovreški	13 September 2020
Tone Žic	Lovreški	05 April 2021
Tomislav Anić	Tramuntana (Ponehovice)	12 April 2021
Valentin Mikičić	Sheepfolds in Tramuntana	21 August 2021

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TANJA KREMENIĆ (Rijeka, 1989) graduated with a degree in geography (physical geography with geoecology) in 2014 from the Faculty of Science of the University of Zagreb. From 2014 to 2018, she was employed at the Island development agency (OTRA) in Cres, where she worked as a project assistant for the Council of Europe's 'Local development pilot project – island of Cres', where she coordinated and co-authored an expert publication entitled 'Landscape study of the island of Cres'. Work in the agency involved implementing and writing applications for national and international projects, which mostly concerned topics of cultural heritage and sustainable development.

From 2018 to 2022, she worked on her double doctorate thesis, 'Valorisation of the dry stone wall heritage of the Cres-Lošinj archipelago', at the Department of Historical and Geographic Sciences and the Ancient World of the University of Padova and the Faculty of Agriculture of the University of Zagreb. During this time, she was the main author of two scientific articles, reviewed unpublished manuscripts and delivered presentations at international and national conferences. Since 2020, she has been conducting practical dry stone wall construction workshops and expert presentations on dry stone wall heritage as part of the association '4 grada Dragodid'.

Published scientific articles:

1. Kremenić, Josip, and Tanja Kremenić. 2019. 'Vrijednost maslinika grada Cresa iz rukopisa Josipa Kremenića'. In *III Creski Anali*. Vol. 3. Cres: University of Rijeka - Cres.
2. Kremenić, Tanja, Goran Andlar, and Mauro Varotto. 2021. 'How Did Sheep Save the Day? The Role of Dry Stone Wall Heritage and Agropastorality in Historical Landscape Preservation. A Case-Study of the Town of Cres Olive Grove'. *Land* 10 (9): 978. <https://doi.org/10.3390/land10090978>.
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