

AN ENVIRONMENTAL RECONSIDERATION OF
SAGALASSOS FROM THE ANTIQUITY TO THE EARLY
MIDDLE AGES (1st – mid-7th CENTURY CE.)

A Master's Thesis

by
HARUN ÇELİK

Department of History
İhsan Doğramacı Bilkent University
Ankara
December 2020

HARUN ÇELİK AN ENVIRONMENTAL RECONSIDERATION OF SAGALASSOS FROM THE
ANTIQUITY TO THE EARLY MIDDLE AGES (1st – mid-7th CENTURY CE.) Bilkent University 2020

To my family and to Luca



AN ENVIRONMENTAL RECONSIDERATION OF SAGALASSOS FROM THE
ANTIQUITY TO THE EARLY MIDDLE AGES (1st – mid-7th CENTURY CE.)

Graduate School of Economics and Social Sciences
of
İhsan Doğramacı Bilkent University

by

HARUN ÇELİK

In Partial Fulfillment of the Requirements for the Degree of
MASTER OF ARTS IN HISTORY

THE DEPARTMENT OF HISTORY
İHSAN DOĞRAMACI BİLKENT UNIVERSITY
ANKARA

DECEMBER 2020

Abstract

AN ENVIRONMENTAL RECONSIDERATION OF SAGALASSOS FROM THE
ANTIQUITY TO THE EARLY MIDDLE AGES (1st– mid-7th CENTURY CE.)

Çelik, Harun
M.A, Department of History
Supervisor: Asst. Prof. Dr. Luca Zavagno
December 2020

At its core, environmental history is the study of a reciprocal relationship between that of humanity and its environment. The incorporation of environmental science to Byzantine studies has been gradual and has received merit only in the last decade. The goal of this paper is to use the ancient site of Sagalassos in the Antique to Early Byzantine periods as a case study to represent the multi-faceted benefits of incorporating environmental science in recreating a historical narrative. The focus of this paper is on utilizing the existing palynological and zooarchaeological evidence at Sagalassos to provide informative insight where archaeological and narrative sources are lacking. The most abundant environmental data available at Sagalassos are three drilled cores of the Gravgaz, Bereket and Çanaklı marshes and the investigation of a

large collection of faunal remains on the site. The use of palynological data at Sagalassos shows that while narratives based primarily on archaeological and ceramic evidence indicate a decline of the city in the 4th and 6th centuries, pollen records indicate continuation and stability. Similarly, zooarchaeological records show that social changes at Sagalassos can also be visible through livestock selection and this reveals a transformation of the function of the city from a production center to a more pastoral economy. The study has found that while the 4th century does witness a reduction in monumental building, the rebuilding programs and the presence of continued arboriculture indicate stability at Sagalassos. Similarly, while a 6th century earthquake does damage to some infrastructure in the city, the city still continues with its productive and pastoral functions until the mid-7th century when a larger earthquake relocates its inhabitants.

Keywords:

Environmental History, Material Culture, Palynology, Sagalassos, Zooarchaeology

Özet

SAGALASSOS'UN ANTİKİTEDEN ERKEN ORTA ÇAĞLARA (MS 1. – 7. YÜZYIL ORTASI) ÇEVRESEL BİR DEĞERLENDİRME

Çelik, Harun
Yüksek Lisans, Tarih Bölümü
Tez Danışmanı: Dr. Öğr. Üyesi Luca Zavagno
Aralık 2020

Çevre tarihi, insan ve çevre arasındaki çift taraflı ilişkiyi inceler. Çevre biliminin Bizans tarihi çalışmalarına dahil edilmesi kademeli bir şekilde gerçekleşmiştir ve yalnızca geçtiğimiz on yılda geçerlilik kazanmaya başlamıştır. Bu çalışmanın amacı, Antikitten Erken Bizans dönemindeki antik Sagalassos kentini bir vaka incelemesi olarak kullanarak çevre biliminin tarihsel anlatımın oluşmasında sağlayabileceği çeşitli faydaları gözler önüne sermektir. Çalışmanın odağı, Sagalassos'taki mevcut palinolojik ve zooarkeolojik bulgular aracılığıyla arkeolojik ve yazılı kaynakların eksikliğinden dolayı oluşan boşlukları doldurmaktır. Sagalassos'ta mevcut olan en bol çevresel veri, Gravgaz, Bereket ve Çanaklı bataklıklarının'dan çıkan üç çıkarılmış çekirdek (core) ve o bölgenin geniş bir fauna kalıntıları koleksiyonunun araştırılmasıdır. Sagalassos'taki palinolojik verilerin kullanımı, öncelikle arkeolojik ve seramik kanıtlara dayanan anlatılar, şehrin 4. ve 6. yüzyıllarda gerilemesine işaret ederken, polen

kayıtlarının şehirdeki sürekliliği ve istikrarını göstermektedir. Benzer şekilde, zooarkeolojik kayıtlar Sagalassos'taki hayvan seçimi yoluyla da sosyal değişimlerin görülebileceğini ve bu da şehrin işlevinin bir üretim merkezinden daha kırsal bir ekonomiye dönüştüğünü ortaya koyuyor. Bu çalışma, 4. yüzyılda anıtsal yapıda bir azalmaya tanık olurken, yeniden inşa programlarına başlanması ve devam eden fidancılık yetiştiriciliğinin Sagalassos'ta istikrar gösterdiğini ortaya koymaktadır. Benzer şekilde 6. Yüzyıl'daki gerçekleşen depremin şehirdeki bazı altyapılara zarar verirken, Sagalassos, daha büyük bir depremin sakinlerinin yerini değiştirdiği 7. yüzyılın ortalarına kadar üretken ve kırsal işlevlerini sürdürmeye devam etmekteydi.

Anahtar Kelimeler:

Çevre Tarihi, Maddi Kültürü, , Palinoloji, Sagalassos, Zooarkeoloji

Acknowledgements

Despite having to write this thesis in the troubling period of the coronavirus pandemic, I have many people to thank for mitigating the difficulties of this period and in aiding the accomplishment of this arduous task. I would foremost like to thank all of my professors and the Department of History in Bilkent University itself for providing me the funding and opportunity to write this thesis. I would particularly like to thank Assistant Professor Paul Latimer for always willing to empathize and in sharing his knowledge and experience about the Medieval world with me. I would also like to express my gratitude to all of my friends in the department who have listened to my troubles and made writing this thesis an easier task with their input.

I would like to express my deepest gratitude and thanks to my advisor Assistant Professor Luca Zavagno. Whom without his opinions and help, the completion of this thesis would not have been possible. I am indebted to his constant source of support and encouragement, demand of quality, and his motivation throughout all of my graduate education to perform my best. I cannot express enough gratitude to him for being a true advisor, a teacher, a mentor, and most importantly, for being an incredible friend. Thank you, Luca.

I would also like to express my thanks to my lifelong friends, Zeynep Olgun, Muhammad Asad Rafi, and Alper Aanal for always being supportive of me. I would also like to thank my family and Amy for their consistent support and

efforts to provide an environment which without the completion of this thesis would be difficult.



Table of Contents

Abstract.....	ii
Özet.....	iv
Acknowledgements.....	vi
Table of Contents.....	viii
List of Figures	ix
Chapter One: Introduction	1
I.I Environmental History.....	1
I.II Methodology.....	10
I.3 Shortcomings of Environmental Data	18
I.4 Thesis Outline	22
Chapter Two: Environmental History in Byzantine Literature	24
II.1 Environmental history in Byzantium.....	24
II.2 Byzantine environmental history in Anatolia: the view from Sagalassos (and its chora).....	40
Chapter Three: Palynology at Sagalassos	44
III.1 Anthropogenic indicators as a method of analysis.....	44
III.2 The ecology of Sagalassos' chora.....	54
III.3 Conclusions (provisional)	83
Chapter Four: Environmental History at Sagalassos	87
IV.1 Surveying Sagalassos's environment.....	87
IV.2 A History of Sagalassos and its <i>chora</i>	89
IV.3 Material culture and urban fabric	92
IV. 4 What happened to Sagalassos at the end of Late Antiquity? When environmental studies meet history and archaeology.....	104
Chapter Five: Conclusion.....	115
Bibliography	120

List of Figures

Figure 1. The Pollen Derived Vegetation Patterns (PDVP) of the Gravgaz cores.....	59
Figure 2. PCA and PDVP representations in the Gravgaz core.....	65
Figure 3. Comparison of the Bereket and Gravgaz Cores in Pollen Percentage.	73
Figure 4. Comparison of the Warm and Wet Phases of Weather across the Mediterranean.	78



Chapter One:

Introduction

*"De Historia Ambientium"*¹

I.I Environmental History

Even to the ancient Greeks and Romans, the relationship between the environment and people has always been a question of interest.² The goal of incorporating the environment to works of history though is phenomenon that derives its roots from geographical literature written in nineteenth century Europe. Among many works, the one most relevant to history is of Fernand Braudel's study of the Mediterranean in *The Mediterranean and the Mediterranean World in the Age of Philip II* both in terms of location and its incorporation of the environment into an historical work.³ For Braudel, a fundamental understanding of social changes in history for the *longue durée* meant being informed about the relationship between man and his environment as this outlines general reoccurring patterns in history.⁴ Ultimately, Braudel's interest in incorporating the environment to the narrative of the Mediterranean

¹ "On the History of Surroundings"

² For more detail. See, D. L. Simms and Johnson Donald Hughes, *Pan's Travail: Environmental Problems of the Ancient Greeks and Romans, Technology and Culture* (Johns Hopkins University Press, 1995), xxxvi <<https://doi.org/10.2307/3106378>>.

³ Fernand Braudel, *Mediterranean & the Mediterranean World in the Age of Philip*, 1st edn (University of California Press, 1996).

⁴ James R Hudson, 'Braudel's Ecological Perspective', *Sociological Forum*, 2.1 (1987), 146–65 (p. 150).

was enticing enough to encourage more scholars to pursue agendas of the same relationship between man and its environment elsewhere than the Mediterranean.⁵ The ensuing debates of environmental history in the United States since the 1960s would further contribute to this trend in different ways. On the far side of the Atlantic, Donald Worster and William Cronon set the ground for the discussion of environmental history particularly with respect to American history.⁶ While Donald Worster's later discourses like that of *Nature's Economy* focused on providing moral lessons learned from the environmental history of North America, Cronon's work has focused more on the usefulness of environmental science for creating narratives of environmental history for the United States.⁷ In a more global remit, the work of Alfred Crosby has utilized environmental science for revisiting histories of European colonization around the globe including the Americas.⁸ For the Mediterranean, Johnson Donald Hughes' initiatives to introduce environmental history with a focus on the Mediterranean, and later, the world at large, acted as a primer for many studies focusing on Roman and Greek environmental studies.⁹ Also a trend represented

⁵ Adam Izdebski, 'Setting the Scene for an Environmental History of Late Antiquity', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski and Michael Mulryan (Brill, 2019), pp. 3–13 (p. 7).

⁶ Their first seminal works within these fields are, William Cronon, *Changes in the Land: Indians, Colonists, and the Ecology of New England* (New York: Hill & Wang, 1983); Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West - Donald Worster - Google Kitaplar* (Oxford: Oxford University Press, 1992).

⁷ William Cronon, 'The Uses Of Environmental History', *Environmental History Review*, 17.3 (1993), 1–22; Donald Worster, *Nature's Economy: A History of Ecological Ideas (Studies in Environment and History)* (Cambridge University Press, 1994).

⁸ Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe, 900–1900, Second Edition, Ecological Imperialism: The Biological Expansion of Europe, 900-1900* (Cambridge University Press, 2010) <<https://doi.org/10.1017/CBO9780511805554>>.

⁹ The work of Donald Hughes has had great impact in priming the works of many studies in the Mediterranean; See, Lukas Thommen, *An Environmental History of Ancient Greece and Rome* (Cambridge University Press, 2012); Ronnie Ellenblum, *The Collapse of the Eastern Mediterranean: Climate Change and the Decline of the East, 950–1072* (Cambridge University Press, 2012).

in his books, *Ecology in Ancient Civilizations* (1975), *Pan's Travail: Environmental Problems of the Greeks and Romans* (1994), *The Mediterranean: An Environmental History* (2005); and *An Environmental History of the World: Humankind's Changing Role in the Community of Life* (2009), shows Hughes' interest in the Mediterranean expanding over time to the rest of the world; reflecting the growing field of environmental history up to date.¹⁰

As the field of environmental history grew larger, journals and outlets for the culmination of scientific and historical narratives began to establish around these names. In the United States, this was marked by the creation of The American Society for Environmental History (ASEH) founded by John Opie in 1977 and edited by Donald Hughes.¹¹ Additionally, both Cronon and Worster held presidential positions in ASEH. This is indicative of a collective effort that formed in the United States around environmental history since the late 70s.¹² In Europe, a collective organization through Elsevier produced the Quaternary Science Reviews as an outlet for publishing new data in any Quaternary environmental field.¹³ In the early 90s, SAGE produced a journal by the name of The Holocene.¹⁴ Like the Quaternary Reviews, The Holocene was also established to discuss the more scientific and databased environmental

¹⁰ Simms and Hughes, xxxvi; Johnson Donald Hughes, *Ecology in Ancient Civilizations* (University of New Mexico Press, 1975); Johnson Donald Hughes, *The Mediterranean: An Environmental History*, ed. by Mark R Stoll (ABC-CLIO, 2005); Johnson Donald Hughes, *An Environmental History of the World: Humankind's Changing Role in the Community of Life* (Routledge, 2009); Mei Xueqin, 'In Memoriam: J. Donald Hughes (1932–2019)', *Environmental History*, 24.3 (2019), 459–62.

¹¹ Xueqin, p. 459.

¹² Douglas Weiner, Carolyn Merchant, and Lisa Mighetto, 'American Society for Environmental History - History' <<https://aseh.org/history>> [accessed 7 June 2020].

¹³ 'Quaternary Science Reviews' <<https://www.journals.elsevier.com/quaternary-science-reviews>> [accessed 7 June 2020].

¹⁴ 'The Holocene - Journal Description' <<https://journals.sagepub.com/description/HOL>> [accessed 7 June 2020].

disciplines spanning the Holocene period. The chronologies and names of each journal after the 1990s could be mentioned in detail but there is little need to do so as the objective here is to outline a generalized trend of efforts in environmental history seeking to incorporate more environmental science.¹⁵

While literature in the United States was able to create a self-reflecting discipline, European journals have remained more fragmented in this sense despite producing a large corpus of environmental literature. This fragmentation will receive more attention in Chapter 2 as the roots of Byzantine environmental history are largely based on European offshoots in environmental science.

While environmental history has been referred to as the subject of this thesis, little has actually been said about what environmental history denotes. As is the case with many social disciplines, there is no definitive answer to this large field though there is a centrality of themes among the works which help to answer this question.¹⁶ Essentially, the common point of all environmental history is the attempt to explain the different states of environment(s) over time and to delineate the relationship(s) between anthropogenic and environmental forces.¹⁷ The main assumption is that modifications to the environment are caused by the work of human beings.¹⁸ Since hunter-gatherer societies, humans

¹⁵ . For reference to general methods and works of environmental science; See, *Encyclopedia of Quaternary Science*, ed. by Scott Elias (Elsevier, 2007).

¹⁶ Johnson Donald Hughes, *What Is Environmental History?*, 2nd edn (Polity, 2006), p. 4.

¹⁷ Hughes, *What Is Environmental History?*, p. 1.

¹⁸ James O'Connor, 'What Is Environmental History? Why Environmental History?', *Capitalism, Nature, Socialism*, 8.2 (1997), 3–29 (p. 11).

have altered their environment for their everyday use.¹⁹ As a result, understanding the relationship of how the environment has affected and been affected by anthropogenic forces is at the heart of environmental history. Because of its broad purpose and reliance on the work of science, what defines the modern methodology of environmental history most concisely is the emphasis placed on an interdisciplinary approach. At Sagalassos, an ancient site located in the modern-day province of Burdur in southwest Turkey, archaeological, palynological, zooarchaeological, lithological, and osteological research was conducted in order to create a comprehensive environmental narrative.²⁰ Therefore, when reflecting on scholarly works of environmental history, it is important to realize that multiple disciplines of varying natures have to come together to contribute to a common goal of providing a historical narrative.²¹ Certainly, consciousness of the environment is not a new phenomenon as writers like Alexander von Humboldt in the eighteenth century and George Perkins Marsh in the nineteenth century prove.²² The novelty though, is in how the modern environmental historians' interest lies in

¹⁹ F.-J. Brüggemeier, 'Environmental History', ed. by Neil J Smelser and Paul B Baltes, *International Encyclopedia of the Social & Behavioral Sciences* (Pergamon, 2001), pp. 4621–27 (p. 4623).

²⁰ Benjamin T Fuller and others, 'Isotopic Reconstruction of Human Diet and Animal Husbandry Practices during the Classical-Hellenistic, Imperial, and Byzantine Periods at Sagalassos, Turkey', *American Journal of Physical Anthropology*, 149.2 (2012), 157–71; Bea De Cupere, An Lentacker, and others, 'Osteological Evidence for the Draught Exploitation of Cattle: First Applications of a New Methodology', *International Journal of Osteoarchaeology*, 10 (2000), 254–67; Marc Waelkens and others, 'Archaeological, Geomorphological and Geological Evidence for a Major Earthquake at Sagalassos (SW Turkey) around the Middle of the Seventh Century AD', in *The Archaeology of Geological Catastrophes*, ed. by W J McGuire and others (Geological Society of London, 2000), CLXXI, 373–83; Peter Talloen and Jeroen Poblome, 'The 2014 and 2015 Control Excavations on and around the Upper Agora of Sagalassos: The Structural Remains and General Phasing', *Anatolica*, 42 (2016), 111–50.

²¹ Dena F. Dincauze, *Environmental Archaeology: Principles and Practice* (New York: Cambridge University Press, 2000), p. 24.

²² *The Oxford Handbook of Environmental History*, ed. by Andrew C Isenberg (Oxford University Press, 2014), p. 4.

amalgamating and promoting the application of different methodologies for the common purpose of environmental history, ultimately relating environmental science to historical understanding. As Alfred Crosby makes clear, “[modern] environmental historians have discovered that the physical and life sciences can provide quantities of information and theory useful, even vital, to historical investigation.”²³ As a result, science has become an indispensable part of the environmental historian’s toolkit to accomplish the task of environmental histories.²⁴ This point will become clearer in both the methodology section of this chapter and in Chapter 3 which relies heavily on environmental science.

According to Worster, “environmental history is, in sum, part of a revisionist effort to make the discipline far more inclusive in its narratives than it has traditionally been.”²⁵ In this light, the research questions which environmental history tackles are generally an outcome of the discipline and methodologies it utilizes in a given project. While this is true, it is better to think of environmental histories as often having three distinct research questions in mind. The first of these questions is to which degree the influence of environmental factors [have] on human history.²⁶ Here, the environment is the forerunning agent and outlines its course on human societies. Whether by natural disasters, changing climate conditions or anomalies in general weather patterns, it is humans which show the counter-response to such changes in these conditions. Both archaeology and

²³ Alfred W. Crosby, ‘The Past and Present of Environmental History’, *American Historical Review*, 100.4 (1995), 1177–89 (p. 1189).

²⁴ Kristina Sessa, ‘The New Environmental Fall of Rome: A Methodological Consideration’, *Journal of Late Antiquity*, 12.1 (2019), 211–55 <<https://doi.org/10.1353/jla.2019.0008>>.

²⁵ Donald Worster, ‘Appendix: Doing Environmental History’, in *The Ends of the Earth: Perspectives on Modern Environmental History*, ed. by Michael Williams and Donald Worster (Cambridge University Press, 1990), pp. 289–307 (p. 290).

²⁶ Hughes, *What Is Environmental History?*, p. 4.

palaeoscience are methodologies which address this question well because of “their ability to identify long-term patterns of cultural or environmental development.”²⁷

Hughes identifies a second research question that environmental history focuses. This, he writes, is “the environmental changes caused by human actions and the many ways in which human-caused changes in the environment rebound and affect the course of change in human societies.”²⁸ Quite clearly, this is in effect a reversal of the relationship outlined in the first question. Here, the environment is at response to the changes that man has made to it. While it will be elaborated upon further in the thesis, an example of this can be made from tree crops found in pollen records. When these records in lakes show an abundance of tree crops, especially in the cultivation of walnuts, grapes or olives, this often implies more than just a rich practice of tree farming. Because tree crops like olives take long periods of time to mature and produce the olives required for their use, this implies that they are long-term economic investments as they can also reflect trading networks.²⁹ Through this information preyed upon the environment, one can deduce that periods of olive cultivation generally coincide with those of political and environmental stability.³⁰ The growth of olives in a certain region would then indicate that a

²⁷ Neil Roberts, *The Holocene: An Environmental History*, 2nd edn (Wiley-Blackwell, 1998), p. 4.

²⁸ Hughes, *What Is Environmental History?*, p. 4.

²⁹ Jennifer Ramsay, ‘Trade or Trash: An Examination of the Archaeobotanical Remains from the Byzantine Harbour at Caesarea Maritima, Israel’, *International Journal of Nautical Archaeology*, 39.2 (2010), 376–82 (p. 379) <<https://doi.org/10.1111/j.1095-9270.2010.00267.x>>.

³⁰ Neil Roberts, ‘Revisiting the Beyşehir Occupation Phase: Land-Cover Change and the Rural Economy in the Eastern Mediterranean During the First Millennium AD’, in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2015), pp. 53–68 (p. 53).

stable trading network must have been in place. Furthermore, the size of the practice would also indicate the wealth of that particular region or its importance as an agricultural center. Similarly, areas with larger records of cereal pollen would indicate a region dedicated to producing the sustenance of that area or even for the capital of an empire depending on location and size.³¹ For this reason, the second research question is interested in how, because human activities undoubtedly leave marks on the land, studying the environment is a way in which the environmental historian can learn better about human activities in the past.

The last research question that environmental history uniquely deals with is what Hughes refers to as “the history of human thought and the ways in which patterns of human attitudes have motivated actions that affect the environment.”³² While this thesis focuses less on the artistic consequences of this question, it is an important theme of environmental history that shouldn’t be overlooked. The way in which societies understand the environment affect the way in which they deal with their landscapes. As such, human attitudes towards their environments are invaluable sources for being able to better obtain reasons for why they would modify their land. I believe that Cronon best explained this when he wrote that, “the lines and shapes we draw on the land reflect the lines and shapes we carry inside our own heads, and we cannot understand either without understanding both at the same time.”³³ While the

³¹ Marie-José Gaillard and others, ‘The Use of Modelling and Simulation Approach in Reconstructing Past Landscapes from Fossil Pollen Data: A Review and Results from the POLLANDCAL Network’, *Vegetation History and Archaeobotany*, 17.5 (2008), 419–43.

³² Hughes, *What Is Environmental History?*, p. 4.

³³ Cronon, ‘The Uses Of Environmental History’, p. 19.

methodology, whether it be archaeology, palynology or climatology, used by environmental history will determine the more detailed research questions asked, the narrative will ultimately revolve around these three themes discussed.

In this thesis, the same research questions will be applied as a case study for the ancient site of Sagalassos. Sagalassos is an ideal case study because of the extensive archaeological excavations and the environmental studies conducted there in the course of the past thirty years.³⁴ By design, the excavations have been conducted to include environmental sciences like palynology and zooarchaeology so that the environmental data can fit within the historical narrative.³⁵ While archaeological finds of the city provide narratives which detail periods of boom from the first to the third century and periods of busts from the mid-4th to the mid-7th,³⁶ environmental history utilizing palynology and zooarchaeology provide additional insight regarding the relationship between man and the local environment.³⁷

As will be seen in the following chapters, the value of environmental data at Sagalassos is not only bound to supplementing the existing archaeological finds

³⁴ See, Johan Claeys and Jeroen Poblome, 'The 2011 to 2016 Excavation Campaigns at Site PQ2, Sagalassos. Dissecting a Suburban Club House (Schola)', *Anatolica*, 43 (2017), 1–36; Talloen and Poblome; Marc Waelkens, *Sagalassos I: First General Report on the Survey (1986-1991) and Excavations (1990-1991)* (Leuven University Press, 1993), 1; *Sagalassos IV: Report on the Survey and Excavation Campaigns of 1994 and 1995*, ed. by Marc Waelkens and Jeroen Poblome (Leuven University Press, 1997).

³⁵ See, Marc Waelkens and Patrick Degryse, *Sagalassos VI: Geo- and Bio-Archaeology at Sagalassos and in Its Territory, Sagalassos VI* (Leuven University Press, 2019) <<https://doi.org/10.2307/j.ctt9qdxzk.3>>.

³⁶ See, Marc Waelkens, 'Sagalassos, Archaeology Of', in *Encyclopedia of Global Archaeology*, ed. by Smith Claire (Cham: Springer International Publishing, 2018), pp. 1–32 <https://doi.org/10.1007/978-3-319-51726-1_1121-3>.

³⁷ Fuller and others; Johan Bakker, Etienne Paulissen, David Kaniewski, Jeroen Poblome, and others, 'Climate, People, Fire and Vegetation: New Insights into Vegetation Dynamics in the Eastern Mediterranean since the 1st Century AD', *Climate of the Past*, 9.1 (2013), 57–87.

on the relationship between man and his ecology, but also to reform existing notions of economic and political decline around the area.³⁸ Using the environmental data in Sagalassos therefore not only benefits existing narratives of prosperity but also undermines those narratives which resort to decline in the absence of archaeological records.³⁹ Essentially, the case study will use the environmental data to provide a revisionist narrative of the decline presented for the city of Sagalassos from the Antique to the Early Middle Ages (1st AD – mid-7th AD).⁴⁰

I.II Methodology

As partially mentioned already, the core methodology of this thesis are environmental data and document analysis related to the excavations at Sagalassos. A general trend of palynological records across Anatolia show that coring sites are often found within lake sediments.⁴¹ In the case of Sagalassos

³⁸ Hannelore Vanhaverbeke and others, 'What Happened After the 7th Century A.D.? A Different Perspective on Post-Roman Rural Anatolia', in *Archaeology of the Countryside in Medieval Anatolia*, ed. by Tasha Vorderstrasse and Jacob Roodenberg (Nederlands Instituut voor het Nabije Oosten, 2009), XLIII, 177–90.

³⁹ See for a discussion of Arab raids and general crises as causes of decline in Sagalassos and in Anatolia overall; Waelkens, 1; Marc Waelkens and others, 'Man and Environment in the Territory of Sagalassos, a Classical City in SW Turkey', *Quaternary Science Reviews*, 18.4–5 (1999), 697–709 <[https://doi.org/10.1016/S0277-3791\(98\)00105-X](https://doi.org/10.1016/S0277-3791(98)00105-X)>; Neil Roberts and others, 'Not the End of the World? Post-Classical Decline and Recovery in Rural Anatolia', *Human Ecology*, 46.3 (2018), 305–22 <<https://doi.org/10.1007/s10745-018-9973-2>>; Jeroen Poblome, 'Life in the Late Antique Countryside of Sagalassos', in *Pisidia Yazıları Hacı Ali Ekinci Armağanı: Pisidian Essays in Honour of Hacı Ali Ekinci*, ed. by Hüseyin Metin and others (Ege Yayinlari, 2015), pp. 99–110.

⁴⁰ To name a few of them; Bakker, Paulissen, Kaniewski, Poblome, and others; Johan Bakker, Etienne Paulissen, David Kaniewski, Véronique De Laet, and others, 'Man, Vegetation and Climate during the Holocene in the Territory of Sagalassos, Western Taurus Mountains, SW Turkey', *Vegetation History and Archaeobotany*, 21.4–5 (2012), 249–66; Waelkens and others.

⁴¹ Some examples of this can be seen here; See, Catherine Kuzucuoğlu and others, 'Mid- to Late-Holocene Climate Change in Central Turkey: The Tecer Lake Record', *Holocene*, 21.1 (2011),

however, the pollen records are mostly taken from marshes (wetlands), meaning that instead of coring into the sediments of a lake, the cores were taken from sediments of wetlands near Sagalassos.⁴² From a sediment core, mainly three components are considered for analysis; the lithological, palynological, and the isotopic records.

The lithological studies are helpful for understanding the nature and different states of the lake.⁴³ For instance, the sediments of a maar lake will contain different minerals than those from that of a shore lake and this would be reflected in the chemical analysis of zooarchaeological finds.⁴⁴ For this reason, lithological studies are useful for understanding the different chemical components found within the diagrams of rock layers. Additionally, these studies are helpful in determining measures of Magnetic Susceptibility. Magnetic Susceptibility (MS) is a proxy for the measure of the magnetic particle variation in silica-based sediments.⁴⁵ This means that, as Dylan Blumentritt and Ioan

173–88 <<https://doi.org/10.1177/0959683610384163>>; Elena Xoplaki and others, 'The Medieval Climate Anomaly and Byzantium: A Review of the Evidence on Climatic Fluctuations, Economic Performance and Societal Change', *Quaternary Science Reviews*, 136 (2016), 229–52; Adam Izdebski, Jordan Pickett, and others, 'The Environmental, Archaeological and Historical Evidence for Regional Climatic Changes and Their Societal Impacts in the Eastern Mediterranean in Late Antiquity', *Quaternary Science Reviews*, 136 (2016), 189–208; Alexandra Gogou and others, 'Climate Variability and Socio-Environmental Changes in the Northern Aegean (NE Mediterranean) during the Last 1500 Years', *Quaternary Science Reviews*, 136 (2016), 209–28 <<https://doi.org/10.1016/j.quascirev.2016.01.009>>.

⁴² Johan Bakker, David Kaniewski, Gert Verstraeten, Véronique De Laet, and others, 'Numerically Derived Evidence for Late-Holocene Climate Change and Its Impact on Human Presence in the Southwest Taurus Mountains, Turkey', *The Holocene*, 22.4 (2012), 425–38; Bakker, Paulissen, Kaniewski, Poblome, and others.

⁴³ The importance of sediment studies in paleoenvironmental constructions can be found in, Fekri A. Hassan, 'Sediments in Archaeology: Methods and Implications for Palaeoenvironmental and Cultural Analysis', *Journal of Field Archaeology*, 5.2 (1978), 197 <<https://doi.org/10.2307/529452>>.

⁴⁴ Patrick Degryse, Philippe Muchez, and others, 'Statistical Treatment of Trace Element Data from Modern and Ancient Animal Bone: Evaluation of Roman and Byzantine Environmental Pollution', *Analytical Letters*, 37.13 (2004), 2819–34.

⁴⁵ Umut Bar\i\cs Ülgen and others, 'Climatic and Environmental Evolution of Lake Iznik (NW Turkey) over the Last~ 4700 Years', *Quaternary International*, 274 (2012), 88–101. 93.

Lascu observe, “under optimal circumstances, inferences [can] be made about the formation, erosion and transport of the sediment.”⁴⁶ Furthermore, MS values can indicate important conditions like run-off and rainfall and help to match chronologies of two different cores. Unfortunately, what MS values indicate are often local phenomenon based on the differences of lake sedimentation and interfering chemicals, making standard explanations apocryphal.⁴⁷ Luckily, most studies are conscious of this problem and present the data with a local scope, allowing the appropriate usage of this data.⁴⁸

Aside from lithological study, sediment cores also provide a method by which palynological studies are conducted. Shortly, palynology is the study of pollen and other spores for the purpose of recreating the vegetational landscape of an environment.⁴⁹ In the case of sedimentation cores, the pollen studied are those which are preserved in the deposits of the lake. As anemophilous (meaning wind-carried) pollen are transported, they fall into the catchment areas of lakes and are trapped in these deposits. After the core of the lake is taken, efforts are made in a laboratory to sieve and identify the pollen for constructing pollen

⁴⁶ Dylan J Blumentritt and Ioan Lascu, ‘A Comparison of Magnetic Susceptibility Measurement Techniques and Ferrimagnetic Component Analysis from Recent Sediments in Lake Pepin (USA)’, *Geological Society*, 414 (2015), 197–207. 197.

⁴⁷ C. Batt, S. Fear, and C. Heron, ‘The Role of Magnetic Susceptibility as a Geophysical Survey Technique: A Site Assessment at High Cayton, North Yorkshire’, *Archaeological Prospection*, 2.4 (1995), 179–96 <[https://doi.org/10.1002/1099-0763\(199512\)2:4<179::AID-ARP6140020402>3.0.CO;2-K](https://doi.org/10.1002/1099-0763(199512)2:4<179::AID-ARP6140020402>3.0.CO;2-K)>.

⁴⁸ Some examples of more recent publications are; Suzanne A.G. Leroy, Markus J. Schwab, and Pedro J.M. Costa, ‘Seismic Influence on the Last 1500-Year Infill History of Lake Sapanca (North Anatolian Fault, NW Turkey)’, *Tectonophysics*, 486.1–4 (2010), 15–27 <<https://doi.org/10.1016/j.tecto.2010.02.005>>; Faruk Ocakoğlu and others, ‘A 2800-Year Multi-Proxy Sedimentary Record of Climate Change from Lake Çubuk (Göynük, Bolu, NW Anatolia)’, *The Holocene*, 26.2 (2016), 205–21 <<https://doi.org/10.1177/0959683615596818>>; Ülgen and others.

⁴⁹ Margaret Kneller, ‘Pollen Analysis’, in *Encyclopedia of Earth Sciences Series* (Springer Netherlands, 2009), pp. 390–98 <https://doi.org/10.1007/978-1-4020-4411-3_192>.

diagrams.⁵⁰ Since it falls under the goal of this thesis to create an environmental history particularly regarding agriculture and livestock practices in Sagalassos and its chora, palynological data here have priority. The data from palynological studies are certainly not indefinite, but because it presents some of the closest links to being able to recreate an agrarian past of the Byzantine society at Sagalassos in the period between the first century to the seventh century, palynological data comprise the core of the analysis. This analysis will be conducted through examining the diagrams and charts published from the findings of the cores near Sagalassos.⁵¹ Indeed, the pollen diagrams and charts are fortunately published in articles with representations of all relevant sediment core data. When discussing other cores in the region of southwestern Turkey, the data of these works are submitted to the European Pollen Database (EPD) and will be accessed from there.⁵²

Recreations of local vegetation vary according to those plants which are indigenous to a local area. In considering the methodology of the palynological assessment, there is therefore the need to inform the reader of the less anthropogenically affected habitat.⁵³ Additionally, not all vegetation can be represented to the same extent because of differences in pollen transfer and

⁵⁰ The process by which this is done is involved and also not exactly standardized but studies often follow the Faegri and Iversen method; See, Knut Faegri and others, *Textbook of Pollen Analysis*, 4th edn (The Blackburn Press, 2000).

⁵¹ Bakker, Paulissen, Kaniewski, Poblome, and others; Sytze Bottema and Henk Woldring, 'Late Quaternary Vegetation and Climate of Southwestern Turkey, Part II', *Palaeohistoria*, 26.0 (1984), 123–49; Bakker, Paulissen, Kaniewski, De Laet, and others.

⁵² 'European Pollen Database' <<http://www.europeanpollendatabase.net/index.php>> [accessed 7 June 2020].

⁵³ An effort carried out by the Dutch botanist teams in the 70's. See; Willem Van Zeist, H Woldring, and D Stapert, 'Late Quaternary Vegetation and Climate of Southwestern Turkey', *Palaeohistoria*, 17 (1975), 53–143; Bottema and Woldring, 'Late Quaternary Vegetation and Climate of Southwestern Turkey, Part II'.

pollen reproduction. For instance, the pollen of *Pinus* (Pine) is always more heavily represented than those of other pollen.⁵⁴ This is because it can be carried from further away and survives longer. *Cerealia*-type pollen on the other hand is virtually the opposite. While a 40% representation of *Pinus* pollen suffices to consider the presence of pine trees in the region, less than 2% suffices for the presence of *Cerealia* cultivation.⁵⁵ To make this analysis easier however, certain *taxa* of pollen are placed into categories which represent forested, cultivated, or semi-forested vegetation. Additionally, the analyses of pollen data at Sagalassos use complex statistical groupings for the organization of the plant *taxa* and help to identify correlation between certain plant types.⁵⁶ To prevent redundancy, explanations regarding the classification of the vegetation types and zones specifically for the southwestern region of Turkey will be presented in Chapter 3.

Older and less computational works commonly group up the data based on their relationship with anthropogenic value; generally, these include primary anthropogenic, secondary anthropogenic, arboreal pollen and non-arboreal pollen. Paleobotanist Karl-Ernst Behre defines primary anthropogenic indicators as “those species which are cultivated in fields, orchards, and gardens, which means that they are intensely grown in order to harvest them as crops.”⁵⁷ Secondary indicators are those that have grown, not intentionally by man, but

⁵⁴ Irena Agnieszka Pidek, Krystyna Piotrowska, and Idalia Kasprzyk, ‘Pollen–Vegetation Relationships for Pine and Spruce in Southeast Poland on the Basis of Volumetric and Tauber Trap Records’, *Grana*, 49.3 (2010), 215–26 <<https://doi.org/10.1080/00173134.2010.514006>>. 215.

⁵⁵ Adam Izdebski, *Rural Economy in Transition: Asia Minor from Late Antiquity Into the Early Middle Ages* (Journal of Juristic Papyrology, 2013), xviii, p. 126.

⁵⁶ Bakker, Kaniewski, Verstraeten, De Laet, and others.

⁵⁷ Karl-Ernst Behre, *Some Reflections on Anthropogenic Indicators and the Record of Prehistoric Occupation Phases in Pollen Diagrams from the Near East* (Balkema, 1990), p. 221.

because of the propitious environment created from anthropogenic influence.⁵⁸

Arboreal pollen is those of trees and non-arboreal are those of meadow or steppic non-tree vegetation. The significance of dividing the pollen groups will become clearer when each group is discussed with respect to their peculiarities in place.

The last pertinent information that sediment cores provide for understanding the environmental region are records for oxygen isotopes. While the thesis will mainly consider isotope records from cave speleothems, lakes across Anatolia, like the Nar Lake, will also be considered in order to make a comparative analysis. Oxygen isotopes in carbonates are useful to look at since they can inform us of the change in weather, in particular as a proxy for precipitation.⁵⁹

As isotopes are not affected much by human forces, they provide reliable accounts of weather change at all times. Unlike the pollen analysis, the interpretation of oxygen isotopes is more standard and less affected by local conditions making them easier to utilize in environmental history.⁶⁰ The general rule is that lower proportion of the isotopic value indicates higher rainfall and higher proportions for general dryness. This information is important for understanding the growth of certain primary anthropogenic plants in the

⁵⁸ Behre, *Some Reflections on Anthropogenic Indicators and the Record of Prehistoric Occupation Phases in Pollen Diagrams from the Near East*, p. 223.

⁵⁹ Katherine E. Dayem and others, 'Lessons Learned from Oxygen Isotopes in Modern Precipitation Applied to Interpretation of Speleothem Records of Paleoclimate from Eastern Asia', *Earth and Planetary Science Letters*, 295.1-2 (2010), 219-30 (p. 220) <<https://doi.org/10.1016/j.epsl.2010.04.003>>.

⁶⁰ C Neil Roberts, Giovanni Zanchetta, and Matthew D Jones, 'Oxygen Isotopes as Tracers of Mediterranean Climate Variability: An Introduction', *Global and Planetary Change*, 71.3-4 (2010), 135-40 (p. 135).

region.⁶¹ As periods of increased humidity favor excessive plant cultivation, the isotope values can help to justify the favorable circumstances in the environment which humans would have exploited for growing crops abundantly. Likewise, the reduction of those same plants in drier phases could vouch for the effect of inimical settings to plant growth. For the validity of the isotope records, speleothems provide good temporal resolution and will be considered the benchmark.⁶² When taken from the lakes, those records from varved lakes will be used as their resolution refers better to calendrical dates when necessary.

So far, only the methodology by which environmental science of the thesis is to be analyzed has been considered. The establishment of a work of environmental history, however, demands a discussion of historical sources to supplement the science. Most of the non-environmental sources come from archaeological reports in the site of Sagalassos. Since activities related to vegetation were not done within the city center, most official sources remain obsolete in informing the narrative of this work. The sources which remain especially helpful for the work of this thesis are the collection of weather reports mentioned among Byzantine primary sources. Along with a number of articles by Dionysios Stathakopoulos, this information has been organized meticulously in his book *Famine and Pestilence in the Late Roman and Early Byzantine*

⁶¹ Matthew J. Amesbury and others, 'Can Oxygen Stable Isotopes Be Used to Track Precipitation Moisture Source in Vascular Plant-Dominated Peatlands?', *Earth and Planetary Science Letters*, 430 (2015), 149–59 (p. 149) <<https://doi.org/10.1016/j.epsl.2015.08.015>>.

⁶² As a case study, see; T. L. Ku and H. C. Li, 'Speleothems as High-Resolution Paleoenvironment Archives: Records from Northeastern China', *Proceedings of the Indian Academy of Sciences, Earth and Planetary Sciences*, 107.4 (1998), 321–30 <<https://doi.org/10.1007/BF02841598>>.

Empire.⁶³ The same type of sources can be found in the publications of Ioannis Telelis and Michael McCormick.⁶⁴ Luckily, their works have already been reviewed with the available climate data of the time and have been published in an article titled, “The environmental, archaeological and historical evidence for regional climatic changes and their societal impacts in the Eastern Mediterranean in Late Antiquity.”⁶⁵

Though not a collection of primary sources related to famines and disease, sources of resilience are also important and relevant historical discussions for this thesis. Since Sagalassos suffered multiple earthquakes from the 6th to the mid-7th century, resilience is an important discussion both in terms of assessing environmental disruption to life as well as the coping mechanism of societies like Sagalassos to these events.⁶⁶ In the work of historians, the recent work of John Haldon in collaboration with environmental scientists displays promising information into large scale resilience.⁶⁷ The idea of resilience is one that relates, “the complexity [of societies] (the degree of interdependency across social relationships and structures), their institutional and ideological

⁶³ Also relevant are, Dionysios Stathakopoulos, ‘Reconstructing the Climate of the Byzantine World: State of the Problem and Case Studies’, in *People and Nature in Historical Perspective*, ed. by József Laszlovszky and Péter Szabó (Central European University & Archaeolingua, 2003), pp. 247–61; Dionysios Stathakopoulos, ‘Death in the Countryside: Some Thoughts on the Effects of Famine and Epidemics’, *Antiquite Tardive*, 20 (2012), 105–14 <<https://doi.org/10.1484/J.AT.1.103096>>.

⁶⁴ Xoplaki and others; U Büntgen and others, ‘Cooling and Societal Change during the Late Antique Little Ice Age from 536 to around 660 AD’, *Nature Geoscience*, 6 (2016), 231–36; John F. Haldon and others, ‘The Climate and Environment of Byzantine Anatolia: Integrating Science, History, and Archaeology’, *Journal of Interdisciplinary History*, 45.2 (2014), 113–61.

⁶⁵ See, Izdebski, Pickett, and others.

⁶⁶ See, Waelkens and others, CLXXI.

⁶⁷ See, John F. Haldon, ‘Introduction’, *Human Ecology* (Springer New York LLC, 2018), 273–74 <<https://doi.org/10.1007/s10745-018-9998-6>>.

flexibility, and their systemic redundancy.”⁶⁸ John Haldon has also written about city-based resilience in some eminent Byzantine cities like Sinop and Euchaita.⁶⁹ Similar work has been conducted by Lee Mordechai on the city of Antioch which considers information on diseases, city planning for resilience and food distribution.⁷⁰ On the archaeological side, the study of resilience is covered under the findings of city planning, infrastructure on water distribution, and the castles involved. Finally, archaeological finds of rural settlements are one of the most important sources relating to this thesis. From a purely archaeological standpoint, *The Archaeology of Byzantine Anatolia* is an invaluable collection informing of settlements across Anatolia dialectically.⁷¹ Additionally, the novel work of Adam Izdebski in pairing rural settlement archaeology to environmental data is of massive aid to this thesis. Izdebski’s *A Rural Economy in Transition* is not only didactic in its precedence but also evaluates a large number of sites across central Anatolia that this thesis benefits from.⁷²

I.3 Shortcomings of Environmental Data

⁶⁸ John Haldon and others, ‘Lessons from the Past, Policies for the Future: Resilience and Sustainability in Past Crises’, *Environment Systems and Decisions*, 40.2 (2020), 287–97 (p. 288) <<https://doi.org/10.1007/s10669-020-09778-9>>.

⁶⁹ John F. Haldon and others, p. 145.

⁷⁰ See, Lee Mordechai, ‘Antioch in the Sixth Century: Resilience or Vulnerability? In: Environment and Society in the Long Late Antiquity’, in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2019), pp. 207–23.

⁷¹ See, Philipp Niewohner, *The Archaeology of Byzantine Anatolia: From the End of Late Antiquity until the Coming of the Turks*, 1st edn (Oxford University Press, 2017).

⁷² See, Izdebski, xviii.

The ambition of this thesis is matched by a number of issues that need to be addressed within environmental data. Even under optimal circumstances, there would still be a great deal of information required to make a complete reconstruction of any given environment. In this case, the endeavor is one similar to that of archaeological excavations. A lake may have great resolution for periods thousands of years into the past, but the Late Antique period may be completely ambiguous. Like finding an unidentifiable amphora, the core may contain pollen that can't be determined under the microscope. Though there are a plethora of analogies of the problems that environmental science and archaeology face together, there are some general and eccentric cases that require focus for the environmental data presented in this thesis and will be explained within this section.⁷³

The most general issue is that which constitutes a problem not only for environmental science but for all of science. This is the issue of correlation and causation. The hackneyed expression of "correlation does not equal causation" holds its validity equally in the interpretation of environmental data. It is extremely enticing for the environmental historian to peruse the data available and declare the state of that data as an immutable truth. The problem however is that simply because there are correlations between events, one doesn't entail the causation of the other. A good example of this is the interpretation of *Pinus* forests as seen within pollen data. Often times, the presence of pine trees

⁷³ A number of these issues are addressed here. See; Adam Izdebski, Karin Holmgren, and others, 'Realising Consilience: How Better Communication between Archaeologists, Historians and Natural Scientists Can Transform the Study of Past Climate Change in the Mediterranean', *Quaternary Science Reviews*, 136 (2016), 5–22.

followed by a period of visible primary anthropogenic vegetation assures that the region was cultivated and then abandoned.⁷⁴ Though this is a common trend towards the end of the BOP-Phase (a period of increased anthropogenic activity in southwestern Turkey that lasted from about BC 1450 until AD 800),⁷⁵ pine forests don't always indicate a land was used for cultivation.⁷⁶ The issue of correlation and causation in the case of environmental history can be avoided if the interpretation is supplemented by a thorough understanding of the vegetation in the region. It poses a problem for areas that are understudied however and should be kept as consideration against overextending interpretations.⁷⁷

The second issue that environmental data faces is that of carbon dating and core resolutions. Despite the carbon dating of most cores seemingly providing certain dates in diagrams, the process of carbon dating actually works in confidence intervals. This means that when a date is given, it is given with a deviation standard and any date within such a deviation is as possible as the given date. For example, the date of 3625 ± 25 means that the dating could actually be any date from 3600 to 3650 BP. Though not a problem *per se*, it can

⁷⁴ For an example of a study when abandoned lands are succeeded by pine forests, see; Don G. Wyckoff, 'Secondary Forest Succession Following Abandonment of Mesa Verde', *KIVA*, 42.3-4 (1977), 215-31 <<https://doi.org/10.1080/00231940.1977.11757877>>.

⁷⁵ Warren J Eastwood, Neil Roberts, and Henry F Lamb, 'Palaeoecological and Archaeological Evidence for Human Occupance in Southwest Turkey: The Bey{\c{s}}ehir Occupation Phase', *Anatolian Studies*, 48 (1998), 69-86 (p. 70).

⁷⁶ Efrat Sheffer, 'A Review of the Development of Mediterranean Pine--Oak Ecosystems after Land Abandonment and Afforestation: Are They Novel Ecosystems?', *Annals of Forest Science*, 69.4 (2012), 429-43 (p. 7).

⁷⁷ A discussion of the anthropogenic forces in relation to local vegetation can be found in the work of Behre. See; Behre, *Some Reflections on Anthropogenic Indicators and the Record of Prehistoric Occupation Phases in Pollen Diagrams from the Near East*, p. 226; Karl-Ernst Behre, 'The Interpretation of Anthropogenic Indicators in Pollen Diagrams', *Pollen et Spores*, 23.2 (1981), 225-45.

make the comparison of data from other cores a little difficult in precision. Likewise, there may be the issue of using some data in the interpretation of more accurately dated historical events as these intervals can shift from being multiple decades to close to a century. Though modern techniques help to reduce these intervals, the older sources not revisited do suffer from this problem, therefore the historian has to be cautious with regards to the dating of the evidence and its possible links with historical events.

The last concerns are those of a more palynological origin. This is related to the interpretation of the regionality of the pollen sources and pollen representation in cores. Depending on the size of the lake and the type of pollen present, the interpretation of whether the environmental indicators are regional or local phenomenon can vary. Lakes in sizes ranging from 50 to 250 meters in radius represent data from a 2,000-meter distance for their relevant source area of pollen (RSAP). Lakes that are 500 meters and larger in radius are those that represent the regional vegetation.⁷⁸ If the landscape is open however, then a smaller lake may also represent more than what is advised. Therefore, each lake should be considered in their respective size and general location. Otherwise, the risk of overexplaining or attributing wrong interpretations to an area runs high. Additionally, some pollen is known for their resilience and ability to travel further distances. If pine pollen is found within the core of a lake in an open area, this could mean that pine was transported from long distances and that there wasn't actually a pine forest in the near local vicinity. Therefore, environmental historians should consider the transported pollen not only in

⁷⁸ Gaillard and others, p. 430.

respect to the other vegetation present but also in the characteristics of that pollen itself.⁷⁹ Since not all the pollen of every plant that would have been available at the time is captured and viewable, these admonitory prescriptions help to better utilize the information present to us contemporarily. The development of better methodologies and models considering the variations that occur in lakes as well as literature on anthropogenic vegetation helps to mitigate the risk of erred interpretations. To reignite the analogy with archaeology, the concerns that are present in environmental data shouldn't be taken as a limit to the value of its study. Just as archaeology helps to reconstruct a social past based on the materials discovered, so too can environmental history aid in reconstructing the relationship between man and nature with the data at hand.

I.4 Thesis Outline

The following chapters will provide an outline of environmental history in Byzantine scholarship. The focus of Chapter 2 will be on detailing the trends, approaches, main studies and problems that Byzantine scholarship has with environmental history. The latter part of the chapter will focus on the chronological selection of the thesis as well as what Byzantine environmental history can add to traditional Byzantine scholarship,

⁷⁹ Kazimierz Szczepanek and others, "The Long-Range Transport of Pinaceae Pollen: An Example in Kraków (Southern Poland)", *Aerobiologia*, 33.1 (2017), 109–25 <<https://doi.org/10.1007/s10453-016-9454-2>>.

Chapter 3 will focus on the environmental data of palynology in the Sagalassos region as well as southwestern Turkey. This part of the thesis will contain an outline of the vegetation patterns in the region and later describe the data relevant to the chronology of the thesis. The goal of this chapter is to acquaint the reader with the available data and what that data can inform the historian in creating an environmental narrative. The latter part will contain examples from the southwestern region in comparison to the data near Sagalassos.

Chapter 4 is dedicated to discussing the archaeology of Sagalassos and in applying the data presented in Chapter 3 to create a more historical narrative. Chapter 4 will also host the discussion of all relevant environmental sciences and what they particularly add to the existing narratives of Sagalassos.

Chapter Two:

Environmental History in Byzantine Literature

*“De Ambientibus Constantinopolis et Mari Magno Medievali”*⁸⁰

II.1 Environmental history in Byzantium

The tradition of environmental history in Byzantine scholarship is a recent one dating only to the beginning of the 21st century.⁸¹ As a recent discipline, the purpose of this chapter is dedicated to outlining the roots of Byzantine environmental history. With regard to palynological study, in particular, Byzantine environmental history originates considerably from two different strands which will be discussed further in this chapter: through studies in archaeobotanical science and from Byzantine agricultural history.⁸² Despite having two distinct origins, Byzantine environmental history, like all environmental history, is actually an interdisciplinary scholarly endeavor that interrelates the information from environmental science and that of archaeological as well as documentary sources. This chapter will first detail the

⁸⁰ “On the Surroundings of Constantinople and the Great Medieval Sea.”

⁸¹ See, Göran Finnveden and Sverker Sörlin John Ljungkvist, Stephan Barthel, ‘The Urban Anthropocene: Lessons for Sustainability from the Environmental History of Constantinople’, in *The Urban Mind: Cultural and Environmental Dynamics*, ed. by Paul J.J. Sinclair and others (Uppsala: African and Comparative Archaeology, 2010), pp. 367–94; John F. Haldon and others; *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski and Michael Mulryan, *Environment and Society in the Long Late Antiquity* (Brill, 2019) <<https://doi.org/10.1163/9789004392083>>; Michael Decker and others, *Tilling the Hateful Earth: Agricultural Production and Trade in the Late Antique East*, 1st edn (Oxford University Press, 2009).

⁸² Particularly important are the works of Ostrogorsky for agrarian studies and Van Zeist for botanical studies. See; Georg Ostrogorsky, ‘Agrarian Conditions in the Byzantine Empire in the Middle Ages’, in *The Cambridge Economic History of Europe: Agrarian Life of the Middle Ages*, ed. by M M Postan (Cambridge University Press, 1966), I, 205–34; R T J Cappers, K der Ploeg, and M Schepers, ‘Bibliography of Wim van Zeist’, *Palaeohistoria*, 57–58 (2016), 4–10.

roots of Byzantine environmental history that stem from the agricultural studies of Byzantine scholarship then focus on the archaeobotanical roots that as a synthesis have created the aforementioned Byzantine environmental history.

The work of Byzantine environmental history owes much to earlier studies by Byzantinists on agricultural studies of the empire.⁸³ As agricultural studies deal primarily with the interaction between humans and the environment, the thematic link to environmental history is a rather obvious one. While environmental history focuses on the way in which the environment shapes human behavior, agricultural studies focus on the relationship in an inverse direction; that is by human impact to the environment.⁸⁴ While there are predecessors to his work, the Yugoslavian scholar George Ostrogorsky indubitably set the historiographical precedence for studies on agricultural history in the Byzantine Empire.⁸⁵ The commandability and distinction in Ostrogorsky's work consists of the shift of focus from institutional studies of agriculture to focusing on the place of peasantry in the rural setting of the Byzantine world. Through his work, agricultural history in Byzantine scholarship had moved from a topic of simply discussing taxation to becoming a form of social history.⁸⁶ This is argued in his article entitled "Agrarian conditions in the Byzantine Empire in the Middle Ages" by not only providing a summary of the agrarian taxing systems but also in expressing the position of peasant

⁸³ Lucas McMahon and Abigail Sargent, 'The Environmental History of the Late Antique Eastern Mediterranean: A Bibliographic Essay', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2019), pp. 17–30 (p. 17).

⁸⁴ McMahon and Sargent, p. 18.

⁸⁵ Paul Lemerle, *The Agrarian History of Byzantium from the Origins to the Twelfth Century: The Sources and Problems* (Galway University Press, 1979), p. vii.

⁸⁶ Jacques Lefort, 'Rural Economy and Social Relations in the Countryside', *Dumbarton Oaks Papers*, 47 (1993), 101–13 (p. 101).

farmers in relation to greater landowners and the village systems.⁸⁷ An important point for Ostrogorsky and Byzantine agricultural studies was that as tensions between great estate owners and the state relaxed, a sort of Byzantine feudalization formed from the eleventh century onwards.⁸⁸ This notion of feudalization, as will be seen, became the point at which scholars of the agrarian history succeeding Ostrogorsky like that of Lemerle, Kaplan, Teall, and Lefort have largely debated and placed their works in relation to.

A second foundational work to the agrarian history of the Byzantine empire, published not soon after, is the work of Paul Lemerle's *The Agrarian History of Byzantium*.⁸⁹ Though the majority of this work is devoted to the institutional, juridical and fiscal aspects of the agrarian history of the empire, it too doesn't fall short of recognizing the debate around Ostrogorsky's article.⁹⁰ Lemerle's work is packed with a collection of the most relevant primary sources and remains a textbook for the fiscal operations of the state in Byzantine agrarian practices as analyzed through Byzantine legal sources.⁹¹ The central arguments in Lemerle's work revolve around the flexibility of the eastern Roman agricultural practices from the fourth to sixth centuries and, contrary to Ostrogorsky's reasoning, the argument that large estates were suppressed and disappeared.⁹² For Lemerle, the ninth to eleventh centuries (with the Macedonian dynasty) are where the real changes to Byzantine agricultural

⁸⁷ Ostrogorsky, I, p. 220.

⁸⁸ Ostrogorsky, I, p. 221.

⁸⁹ Lemerle, p. 202.

⁹⁰ Lemerle, p. vii.

⁹¹ John W. Barker, 'The Agrarian History of Byzantium: From the Origins to the Twelfth Century', Paul Lemerle, *Speculum*, 58.1 (1983), 202-4 (p. 202) <<https://doi.org/10.2307/2846644>>.

⁹² Barker, pp. 202-3.

practices take place in terms of the efforts of the sovereign “at preserving the fiscal viability of the rural commune.”⁹³

In similar fashion, Michel Kaplan’s book, *Les Hommes et la terre a Byzance du VI au XI siecle: Propriete et exploitation du sol* also remains seminal in the agricultural historiography by analyzing the important document of the Farmer’s Law.⁹⁴ The Farmer’s Law is a collection of law codes created around the eighth century which relates directly to the experiences of the peasants and villages.⁹⁵ Therefore, Kaplan’s study of it is important both in expressing the life of the peasant in the rural setting and the interests of the imperial state. While Kaplan agrees with the work of Lemerle, he carries this analysis further by focusing on the change that the Byzantine peasantry underwent from the sixth to the eleventh century particularly in relation to larger landowners.⁹⁶

The work of John L. Teall, “The Byzantine Agricultural Tradition,” also rests among these seminal historiographical works in reflecting upon the *Geoponika* (a documentary source on the practices of Byzantine agriculture compiled under the rule of Constantine VII Porphyrogenites) as a source for recreating the model and tradition for Byzantine agriculture.⁹⁷ Using both institutionally derived documents to trace agrarian traditions, his work also holds an

⁹³ Barker, p. 203.

⁹⁴ Michel Kaplan, *Les Hommes et La Terre à Byzance Du VIe Au XIe Siècle: Propriété et Exploitation Du Sol* (Publications de la Sorbonne, 1995).

⁹⁵ Walter Ashburner, ‘The Farmer’s Law’, *The Journal of Hellenic Studies*, 30.1 (1910), 85–108 (p. 197) <<https://doi.org/10.2307/624264>>.

⁹⁶ Warren Treadgold, ‘Les Hommes et La Terre a Byzance Du VI Au XI Siecle: Propriete et Exploitation Du Sol.’, *The American Historical Review*, 99.4 (1994), 1296 (p. 1296) <<https://doi.org/10.2307/2168805>>.

⁹⁷ See, Andrew Dalby, *Geoponika - Farm Work: A Modern Translation of the Roman and Byzantine Farming Handbook* (Prospect Books, 2011); John L Teall, ‘The Byzantine Agricultural Tradition’, *Dumbarton Oaks Papers*, 25 (1971), 33–59.

important place in Byzantine agricultural historiography. Though only expressed in an article, Teall's work underlines important sources for studies of agricultural history in Byzantine historiography.⁹⁸

With the possible exception of Teall's "The Grain Supply of the Byzantine Empire, 330-1025" published in 1959,⁹⁹ most popular work on agricultural history until the 1990s consisted of general studies related to state involvement in the agrarian practices with secondary emphasis to the life of the peasant.¹⁰⁰ Though the 1990s do not constitute an abrupt switch in the focus of specialized literature, a new corpus of work with a different approach to agricultural history of the empire rose after this period.

While the studies on the larger institutional scale set the foundation for agricultural studies, those from the 1990s onwards focused more on the rural setting of agricultural history while taking a "revisionist" stance on previous works. Particularly interesting for the works of this period are their intensification in examining agricultural history in line with the economic development of the empire. A work perfectly exemplifying this trend is Jacques Lefort's, "Rural Economy and Social Relations in the Countryside," which appeared in 1993. The article first discusses the space and organization of the agricultural life within the agrarian landscape in relation to earlier debates of demographic evolution.¹⁰¹ Following this, the article then presents a section on the rural economy and circulation of money and services, followed by a final

⁹⁸ Teall, 'The Byzantine Agricultural Tradition', p. 51.

⁹⁹ John L Teall, 'The Grain Supply of the Byzantine Empire, 330-1025', *Dumbarton Oaks Papers*, 13 (1959), 87-139.

¹⁰⁰ Though this Kaplan's book may also be an exception, the documents used by Lemerle and Ostrogorsky definitely fall under this tradition. See; Lemerle; Ostrogorsky, 1; Kaplan.

¹⁰¹ Lefort, pp. 104-7.

section on the rural society. The question of economy orients the article in the newer studies of agricultural history by adding a dimension overlooked in the work of Ostrogorsky and Lemerle.¹⁰² Likewise, the section on rural society is revisionary in redefining the position of the *paroikoi* (non-proprietary peasants with fiscal responsibilities).¹⁰³ While the debate doesn't need full delineation here, Lefort's argument is simply put forward to challenge the notion of feudalization that Ostrogorsky had argued for in the past.¹⁰⁴

Though not initially as explicit as Lefort's article in its revisionist stance, another pioneering author in this secondary wave of countryside studies was Angeliki Laiou. Her most popular contribution was the book entitled *Peasant Society in the Late Byzantine Empire: A Social and Demographic Study* published in 1977, worked as a primer for newer studies by considering issues of demographics with the economy and on focusing towards the rural life of peasants in place of assessing institutional involvement as contemporaries' works had been doing.¹⁰⁵ The work of Angeliki Laiou preceding the 1990s supports the idea that the development to rural studies was a rather slow one as other articles on the countryside, like Lefort's, began appearing later.¹⁰⁶ This is because studies on the countryside demand regional studies both archaeologically and historically to account for spatial differences.¹⁰⁷ In spite of

¹⁰² The 1990s saw also the publication of another economic focused book. See; Alan Harvey, *Economic Expansion in the Byzantine Empire 900-1200* (Cambridge University Press, 1989); Lefort.

¹⁰³ Lefort, pp. 111–13.

¹⁰⁴ Lefort.

¹⁰⁵ Angeliki E Laiou, *Peasant Society in the Late Byzantine Empire: A Social and Demographic Study* (Princeton University Press, 1977).

¹⁰⁶ Lefort.

¹⁰⁷ Lefort, p. 101.

this however, Laiou set another precedence by involving the issue of economics and demographics into the peasant society.¹⁰⁸ She writes in *Peasant Society in the Late Byzantine Empire* that decline in the fourteenth century "at a time of political instability but before the catastrophic collapse of the state, the peasant was becoming poorer and his society was experiencing a demographic decline."

109

As for regional studies, Anthony Bryer's work on Trebizond and Mount Athos is an invaluable contribution to this new scholarship of the rural setting. In particular, his article entitled "Byzantine Agricultural Implements: The Evidence of Medieval Illustrations of Hesiod's 'Works and Days'" is the byproduct of both archaeological and documentation work carried out by Bryer on Mount Athos. The novelty of this article is Bryer's interest in doubling archaeological information on agricultural tools with the lesser studied depiction of agricultural tools in manuscripts within the empire. As Hesiod's "Work and Days" presents a window in understanding the life of a contemporary peasant and his tools, Bryer's approach reveals countless overlooked agricultural technologies that have missed place in the discussion of agricultural historiography.¹¹⁰ Similar regional works to further this aim have come from

¹⁰⁸ As evidenced by two of her more popular works. See, Angeliki Laiou, 'The Agrarian Economy, Thirteenth-Fifteenth Centuries', in *The Economic History of Byzantium from the Seventh Trough the Fifteenth Century*, ed. by Angeliki Laiou (Dumbarton Oaks Studies, 2002), III, 311-75; Laiou.

¹⁰⁹ Laiou, p. 8.

¹¹⁰ Anthony Bryer, 'Byzantine Agricultural Implements: The Evidence of Medieval Illustrations of Hesiod's "Works and Days"', *Annual of the British School at Athens*, 81 (1986), 45-80.

Jean Marie-Martin on Southern Italy and Helene Ahrweiler for the Aegean coast near modern-day Izmir.¹¹¹

In 2002, Dumbarton Oaks Studies published the first volume of the *Economic History of Byzantium: From the Seventh Through the Fifteenth Century* with Angeliki Laiou as the Editor-in-chief.¹¹² This is particularly important as virtually all of the articles within the volume are related to trade, production and urban studies. Likewise, two out of the four substantial parts of the volume directly pertain to rural studies by studying the use of natural resources and agricultural organization.¹¹³ This common goal to shift focus from the state to the rural side of things brought together the works of Jacques Lefort, Angeliki Laiou and Anthony Bryer. In particular, Jacques Lefort's article is extraordinarily comprehensive of all aspects of agricultural and rural life from production to specific agricultural products and class relations in the village.¹¹⁴ Laiou's contribution is similarly all-inclusive but in the interest of the agrarian economy. Relying on single case studies like Macedonia, Laiou renews ideas of the population and settlement in the empire and focuses on production in the countryside as a misinterpreted economic variable of the empire.¹¹⁵ The amount of literature and space devoted to agriculture and land in this volume as

¹¹¹ See, Jean-Marie Martin, 'Città Campagna: Economia e Società (Sec. VII-XIII)', in *Storia Del Mezzogiorno: Alto Medioevo*, ed. by Giuseppe Galasso and Rosario Romeo (Edizioni del Sole, 1993), III, 259–382; Hélène Ahrweiler, 'L'histoire et La Géographie de La r Égion de Smyrne Entre Les Deux Occupations Turques (1018 – 1307) Particulièrement Au XIIIe Siècle', *TM*, 1 (1965), 1–204.

¹¹² *The Economic History of Byzantium: From the Seventh Through the Fifteenth Century*, ed. by Angeliki E Laiou, 39th edn (Dumbarton Oaks Studies, 2002), I.

¹¹³ Part One is "The Natural Environment, Resources, Communications, and Production Techniques" and Part Three is "Part Three: Structures, Organization, and Development of Production." See, Laiou, I.

¹¹⁴ Jacques Lefort, 'The Rural Economy, Seventh-Twelfth Centuries', in *The Economic History of Byzantium from the Seventh Trough the Fifteenth Century*, ed. by Angeliki Laiou (Dumbarton Oaks Studies, 2002), III, 231–310.

¹¹⁵ Laiou, III.

opposed to its considerable predecessor written by Michael Hendy, *Studies in the Byzantine Monetary Economy: c. 300-1450* published in 1985, indicates clearly the increasing focus of Byzantine agricultural studies towards the perspective of rural studies.¹¹⁶

Newer trends following the revisionist literature aforementioned have considered areas beyond the foci of Lefort and Laiou and more in touch with issues of the environment, peasantry and of the landscape. While these studies are still in their infancy, a body of literature has formed from modern scholars utilizing different disciplines like archaeology and geography to this effect. For instance, a change in archaeological outlook for the recent works on Crete, Cyprus and Sicily point to an urban vitality that wasn't considered before.¹¹⁷ Now, extensive surveys utilize different scientific methodologies that uncover information regarding everyday activities of the Medieval world.¹¹⁸ It is these works which receive attention nowadays as of relevance to Byzantine environmental history. Indeed as the focus of Byzantine scholars have begun to address significant gaps of knowledge and employed newer archaeological

¹¹⁶ Michael F. Hendy, *Studies in the Byzantine Monetary Economy c.300-1450*, *Studies in the Byzantine Monetary Economy c.300-1450* (Cambridge University Press, 1985) <<https://doi.org/10.1017/cbo9780511896750>>.

¹¹⁷ For work on archaeological outlook and the extensive research carried out in Cyprus. See; Michael J. Decker, 'The Current State of Byzantine Archeology', *History Compass*, 16.9 (2018), e12459 (p. 4) <<https://doi.org/10.1111/hic3.12459>>; Luca Zavagno, *Cyprus between Late Antiquity and the Early Middle Ages (ca. 600-800): An Island in Transition*, *Cyprus Between Late Antiquity and the Early Middle Ages (ca. 600-800): An Island in Transition* (Taylor and Francis, 2017) <<https://doi.org/10.4324/9781315277363>>; Luca Zavagno, *Cities in Transition: Urbanism in Byzantium between Late Antiquity and the Early Middle Ages (AD 500-900)* (BAR Publishing, 2009); Luca Zavagno and Bülent Kızılduman, 'Countryside in Transition The Galinoporni Kaleburnu Plain (Cyprus) in the Passage from Late Antiquity', *Památky Archeologické*, 2018, 1-14; Luca Zavagno, 'Coinage and Economy in Cyprus in the Age of Transition (c. 600-850 A.D.)', in *First International Congress of Anatolian Monetary History and Numismatics* (Offprint, 2013), pp. 715-26; Luca Zavagno, 'At the Edge of Two Empires: The Economy of Cyprus between Late Antiquity and the Early Middle Ages (650s-800s CE)', *Dumbarton Oaks Papers*, 65/66 (2012), 121-55.

¹¹⁸ Decker, 'The Current State of Byzantine Archeology', p. 5.

methodologies like technology-based extensive or intensive surveying, this has resulted in revised interest towards the environment and the landscape.¹¹⁹ For instance, Michael Decker's *Tilling the Hateful Earth: Agricultural Production and Trade in the Late Antique East* is a great example of recent work reassessing the Byzantine countryside in light of the geographical landscape and agricultural evidence. The value of Decker's work is of utilizing the older geographical and agricultural information to shift focus away from cities to countryside production and its relation to the landscape.¹²⁰ Dedicating space to further discuss the production of staple crops like olive, grains and wine, there is a clear environmental narrative in Decker's work.¹²¹

Similarly, the work of Adam Izdebski also provides an interdisciplinary approach to the environment for better complementing the archaeology of rural Anatolia for the Byzantine period.¹²² The exceptional approach of Izdebski owes to his use of palynological information that other Byzantinists have often overlooked.¹²³ From an archaeological viewpoint, rural studies have also begun to provide newer analytical theories which have redefined the relationship of the landscape to that of the cityscape. As an example, publications on the excavation in Byzantine Crete by Enrico Zanini embody this work completely. Zanini's redefinition of the relationship revolves around the three concepts of

¹¹⁹ Decker, 'The Current State of Byzantine Archeology'; Michael J. Decker, *The Byzantine Dark Ages* (Bloomsbury, 2016), p. 33.

¹²⁰ Decker and others, p. 3; Decker, *The Byzantine Dark Ages*, pp. 124–28.

¹²¹ Decker and others, p. 1.

¹²² Adam Izdebski, 'The Economic Expansion of the Anatolian Countryside in Late Antiquity: The Coast Versus Inland Regions', *Late Antique Archaeology*, 10.1 (2013), 343–76.

¹²³ For instance, even though Decker is aware of the use of palynological studies, he doesn't mention them in his book about agricultural production in the Late Antique East. See, Decker and others.

local ecologies, micro-ecologies, and macro-ecologies.¹²⁴ Grounded in Zanini's study of Gortyn, Crete, these different spheres of interaction help to uncover how the city interacted with both its local environment and to the larger Mediterranean network defined as the macro-ecology.¹²⁵ Zanini's work "Macro-economy, Micro-ecology, and the Fate of Urbanized Landscape in Late Antique and Early Byzantine Crete" is therefore exemplary in illuminating the functionality between cities as micro-ecologies relating to both larger units of political and economic structures as well as surrounding landscapes.¹²⁶

These theories of redefining the relationship between the city and landscape have become so popular that Athanasios Vionis and Giorgos Papantoniou have repeatedly presented them in their publications. By providing an overview of place theories, the authors demonstrate the theoretical shifting over time from the central focus of cities to their micro-ecologies and to landscapes as Zanini had discussed.¹²⁷

Rural studies thus have undoubtedly created a ground for which an assessment of the countryside in terms of their relationship with cities has become possible for the Byzantine historian. Certainly, rural studies are related

¹²⁴ Enrico Zanini, 'Macro-Economy, Micro-Ecology, and the Fate of Urbanized Landscape in Late Antique and Early Byzantine Crete', in *Change and Resilience: The Occupation of Mediterranean Islands in Late Antiquity*, ed. by Miguel Ángel Cau Ontiveros and Catalina Mas Florit (Oxbow Books, 2019), pp. 139–62 (p. 140).

¹²⁵ Zanini, p. 141.

¹²⁶ *Change and Resilience: The Occupation of Mediterranean Islands in Late Antiquity*, ed. by Miguel Ángel Cau Ontiveros and Catalina Mas Florit, Joukowsky Institute Publication (Oxbow Books, 2019), ix, p. 139.

¹²⁷ See, Athanasios K Vionis and Giorgos Papantoniou, 'Central Place Theory Reloaded and Revised: Political Economy and Landscape Dynamics in the Longue Durée', *Land*, 8.2 (2019), 1–21; Giorgos Papantoniou and Athanasios Vionis, 'Landscape Archaeology and Sacred Space in the Eastern Mediterranean: A Glimpse from Cyprus', *Land*, 6.2 (2017), 40 <<https://doi.org/10.3390/land6020040>>.

to the environment, but what they often miss is an element that makes environmental studies one of environmental history; this is the element of environmental science.¹²⁸ For Izdebski, the backbone of Byzantine environmental history, in Anatolia and the Aegean, rests largely on the data produced by archaeobotanists and palynologists from the mid-1970s onwards.¹²⁹

The prominent figures starting this work were a group of Dutch archaeobotanist and palynologists based at the University of Groningen. Willem van Zeist, Sytze Bottema, Henk Woldring, and Burhan Aytuğ focused on pollen analysis taken from various lakes across Turkey.¹³⁰ The task was to extract sediment cores from designated lakes across Anatolia and to review the identifiable pollen to create an understanding of vegetation change in Anatolia. Particularly important in this group is the work of Willem van Zeist, who first conducted research on seeds and vegetation in various places outside of Europe, in which Turkey also became of interest and set the tradition for further study.¹³¹ Henceforth, the work of Bottema, Woldring and Aytuğ carried out from coring or surveying sights like the Altınova Plain, Çayönü, Korucutepe, Lake Van, Girikihacıyan, and some other regional studies for vegetation and precipitation

¹²⁸ The goal is not for displaying only environmental science but to avoid a monocausal approach to environmental history. See, Johannes Preiser-Kapeller, 'A Collapse of the Eastern Mediterranean? New Results and Theories on the Interplay between Climate and Societies in Byzantium and the Near East, ca. 1000-1200 AD', *Jahrbuch Der Österreichischen Byzantinistik*, 65 (2015), 195–242.

¹²⁹ Izdebski, XVIII, p. 113.

¹³⁰ Izdebski, XVIII, p. 113.

¹³¹ These included the places of Aşıklı Höyük, Çayönü, Erbaba, Girikihacıyan, İkiztepe, Ilıpınar, Korucutepe, and Tepecik; See, Cappers, der Ploeg, and Schepers.

in Anatolia.¹³² In large, their work went beyond Turkey to other regions of the Mediterranean, but it is through their efforts that contemporary sites in Turkey receive the attention they do.¹³³

As expected, the contemporary interest of environmental scientists and historians into Anatolia inveterately followed upon the research and data provided by the Dutch archaeobotanists.¹³⁴ This second phase saw both the implementation of similar projects across Anatolia and the presentation of data in more accessible manners through easy-to-read pollen diagrams. With newer dating precision and information taken through re-coring of lakes, the data could be fit easier into the narratives of Byzantine historians.¹³⁵ One such example is the re-coring conducted in the Southwest region of Turkey (around Balboursa, Lycia) where the data has been reconstructed, reinterpreted, and used in historical study.¹³⁶ With this renewal of data collecting came the realization

¹³² Willem Van Zeist, 'Plant Remains from Girikihaciyan, Turkey', *Anatolica*, 7 (1979), 75–89; Willem van Zeist and Jah Bakker-Heeres, 'Prehistoric and Early Historic Plant Husbandry in the Altinova Plain, Southeastern Turkey', in *Korucutepe*, ed. by M N Van Loon (North Holland Publishing Company, 1975), 1, 221–57; Willem van Zeist, Ria W Timmers, and Sytze Bottema, 'Studies of Modern and Holocene Pollen Precipitation in Southeastern Turkey', *Palaeohistoria*, 14 (1970), 19–39; Van Zeist, Woldring, and Stapert; Bottema and Woldring, 'Late Quaternary Vegetation and Climate of Southwestern Turkey, Part II'; Willem van Zeist, 'Paleobotanical Results of the 1970 Season at Çayönü, Turkey', *Helinium*, 12.1 (1972), 3–19.

¹³³ For examples of studies outside of Turkey. See; Sytze Bottema, 'A Late Quaternary Pollen Diagram from Lake Urmia (Northwestern Iran)', *Review of Palaeobotany and Palynology*, 47.3–4 (1986) <[https://doi.org/10.1016/0034-6667\(86\)90039-4](https://doi.org/10.1016/0034-6667(86)90039-4)>; Willem Van Zeist and Sytze Bottema, 'A Palynological Study of the Acheulian Site of Gesher Benot Ya'aqov, Israel', *Vegetation History and Archaeobotany*, 18.2 (2009), 105–21 <<https://doi.org/10.1007/s00334-008-0167-5>>; Sytze Bottema, 'A Pollen Diagram from the Syrian Anti Lebanon', *Paléorient*, 3.1 (1975), 259–68 <<https://doi.org/10.3406/paleo.1975.4201>>.

¹³⁴ For instance; See, Neil Roberts, 'Human-Induced Landscape Change in South and Southwest Turkey during the Later Holocene', in *Man's Role in the Shaping of the Eastern Mediterranean Landscape*, ed. by Sytze Bottema, G Entjes-Nieborg, and William Van Zeist, The Impact of Ancient Man on the Landscape of the Eastern Mediterranean Region and the Near East (A.A. Balkema, 1990), pp. 53–67; Izdebski, 'The Economic Expansion of the Anatolian Countryside in Late Antiquity: The Coast Versus Inland Regions'; Bakker, Kaniewski, Verstraeten, De Laet, and others.

¹³⁵ This has benefitted the work of Adam Izdebski for example in doing pollen data assessments across Anatolia. See, Izdebski, xviii.

¹³⁶ Eastwood, Roberts, and Lamb.

for Byzantine scholars to combine this information with existing archaeological and documental work to create an environmental history. As an initiator, Izdebski has been instrumental in reviewing Byzantine sources on settlements and using the palynological data to produce environmental histories of the Byzantine countryside. John Haldon has also shown great initiative in persuading the Byzantine scholarship to integrate environmental science.¹³⁷ Haldon's work on Euchaïta for instance, incorporates works of environmental science on the medieval climate to assess the possible production of cereal that took place in the settlement.¹³⁸ The same effort of reconciling environmental work with Byzantine scholarship is visible in the works of Johannes Preiser-Kapeller about reassessing concepts of collapse with new environmental data.¹³⁹ So, already an effort is put forward by Byzantine scholars to acknowledge the value of environmental science and to work with environmental scientists, which certainly now takes shape.

The benefits of environmental history for Byzantine scholarship go beyond its appeal as just a trendy field of history. Publications of environmental history on Byzantine studies often attempt the revision and rework of previous studies or support arguments proposed by Byzantine scholarship with data from environmental science. A good example of this, in the field of disease and plague for the Byzantine world, are Kyle Harper's and Timothy Newfield's reassessment of the origins and effects of disease in relation to the facilitating role of the

¹³⁷ See, John F. Haldon and others; Izdebski, Holmgren, and others.

¹³⁸ John F. Haldon, 'Euchaïta: From Late Roman and Byzantine Town to Ottoman Village', in *Archaeology and Urban Settlement in Late Roman and Byzantine Anatolia*, ed. by John F. Haldon, Hugh Elton, and James Newhard (Cambridge University Press, 2018), pp. 210–54 (p. 226) <<https://doi.org/10.1017/9781108557757.010>>.

¹³⁹ Preiser-Kapeller.

environment. Particularly for the Byzantine case, this has helped to illuminate new variables that point to the origins of the Justinianic Plague in the 6th century.¹⁴⁰ The study of dietary regimes in Byzantium, which had been constructed exclusively from documentary and archaeological material before, now also benefits through environmental science.¹⁴¹ By using carbon and nitrogen stable isotopes in human bones, Benjamin Fuller, among others was able to reconstruct the human diets found in the Sagalassos region in Turkey for the Byzantine consumer.¹⁴² Similarly, Henriette Kroll's studies of excavated bones from archeozoological reports from sites across Syria-Palestine, North Africa, Anatolia, Balkans and the Aegean present information of peasant diets and husbandry that documentary sources often neglect.¹⁴³ Other themes, like that of woodlands and climate have also seen the rising interest of contemporary scholars who now utilize the available data.¹⁴⁴ For instance, Peter Kuniholm's work on the trees of the Aegean coast provide information on chronologies that didn't exist before. By using the environmental science of dendrochronology, an understanding of where the supply of wooden materials come from as well as their dating to calendrical years can be deduced.¹⁴⁵ This

¹⁴⁰ Timothy P Newfield, 'Mysterious and Mortiferous Clouds: The Climate Cooling and Disease Burden of Late Antiquity', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2019), pp. 89–115.

¹⁴¹ Andrew Dalby and others, *Flavours and Delights: Tastes and Pleasures of Ancient and Byzantine Cuisine* (Armos Publications, 2013).

¹⁴² Fuller and others.

¹⁴³ Henriette Kroll, 'Animals in the Byzantine Empire: An Overview of the Archaeozoological Evidence', *Archeologia Medievale*, 39 (2012), 93–121 (p. 93).

¹⁴⁴ For two comprehensive bibliographies in thematic and environmental studies in the Late Antiquity; See, McMahon and Sargent; Merle Eisenberg and others, 'The Environmental History of the Late Antique West: A Bibliographic Essay', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2019), pp. 31–50.

¹⁴⁵ Peter Ian Kuniholm, 'Dendrochronology and Other Applications of Tree-Ring Studies in Archaeology', in *Handbook of Archaeological Sciences*, ed. by Donald Reginald Brothwell and A M Pollard (John Wiley & Sons, 2001), pp. 1–11 (p. 1).

has special benefits for the archaeological study of constructions where the wood can provide an approximate date to the monument if data is sufficient. Others, like Carol Griggs have taken Kuniholm's work and used the tree-ring data to create climate reconstructions for the Aegean in the long-durée.¹⁴⁶ Dendrochronological evidence is thus able to contribute to both knowledge in Byzantine field archaeology and also to the study of the climate in a uniquely environmental way.

For landscape and rural studies, palynologists have shown that palynological data in sediment cores can provide information regarding agricultural practices that archaeological finds may not be suitable to date, as sediment cores can often provide clearer chronologies. An example of such a contribution is visible in the agricultural studies of the early Byzantine period. While agricultural studies have acknowledged the importance of oil, wine, walnut and cereal cultivation, it is palynological studies which have referenced and given this land use practice the name of the Beyşehir Occupation Phase (BOP) and studying in more detail.¹⁴⁷ Additionally, shifts in vegetational patterns through palynological data can also provide information as to changing agricultural and settlement patterns. This has been the case of data coming from the Bereket Valley where previous notions of abandonment have been reconsidered as a shift towards pastoral activities with the availability of palynological evidence.¹⁴⁸ Clearly, the interplay between Byzantine scholars and environmental scientists is one

¹⁴⁶ Carol Griggs and others, 'A Regional High-Frequency Reconstruction of May--June Precipitation in the North Aegean from Oak Tree Rings, A.D. 1089--1989', *International Journal of Climatology*, 27.8 (2007), 1075–89.

¹⁴⁷ Eastwood, Roberts, and Lamb, p. 70.

¹⁴⁸ Izdebski, 'The Economic Expansion of the Anatolian Countryside in Late Antiquity: The Coast Versus Inland Regions', p. 358.

recognized by both parties and while work produced in Byzantine environmental history are still in their infancy, attention is required from both upcoming environmental scientists and of Byzantine scholars.¹⁴⁹

II.2 Byzantine environmental history in Anatolia: the view from Sagalassos (and its chora)

While the use of environmental science has found a place in Byzantine scholarship, there is still a large corpus of environmental science that still remains unconsidered for Byzantine environmental history.¹⁵⁰ Compared to other regions of the Mediterranean, especially to European coasts, Anatolia had been underwhelmingly studied and received attention only in areas studied where previous work was conducted in the 1970s. As the outline of recent works on Byzantine environmental history show, however, data on Anatolia previously non-existent are becoming more abundant and accessible to the historian.¹⁵¹ In particular, this abundance comes from data pertaining to sediment cores for palynological and climate studies in Anatolia.¹⁵² For instance,

¹⁴⁹ See; Izdebski, Holmgren, and others.

¹⁵⁰ Decker, 'The Current State of Byzantine Archeology', p. 5.

¹⁵¹ For example; See, Izdebski, Holmgren, and others.

¹⁵² For some examples; See, S. Leroy and others, 'Abrupt Environmental Changes within a Late Holocene Lacustrine Sequence South of the Marmara Sea (Lake Manyas, N-W Turkey): Possible Links with Seismic Events', *Marine Geology*, 190.1-2 (2002), 531-52 <[https://doi.org/10.1016/S0025-3227\(02\)00361-4](https://doi.org/10.1016/S0025-3227(02)00361-4)>; Maria Knipping, Marc Müllenhoff, and Helmut Brückner, 'Human Induced Landscape Changes around Bafa Gölü (Western Turkey)', *Vegetation History and Archaeobotany*, 17.4 (2008), 365-80 <<https://doi.org/10.1007/s00334-007-0132-8>>; Ozan M Göktürk and others, 'Climate on the Southern Black Sea Coast during the Holocene: Implications from the Sofular Cave Record', *Quaternary Science Reviews*, 30.19-20 (2011), 2433-45; Ülgen and others; Kuzucuoğlu and others; Izdebski, Holmgren, and others.

newer studies and publications on the Sofular Cave speleothem SO-1 has recently given better analysis of the precipitation and humidity records of the Black Sea coast of Turkey that wasn't available before.¹⁵³ Additionally, better statistical modeling and the abundance of data has also allowed for climate model reconstructions as well as multivariate pollen analyses.¹⁵⁴ These in particular provide further comprehension of plant-human relations with their ability to control data variables.¹⁵⁵ This growing palynological data is now at such an amount that it can be used to reconstruct the climate and vegetation across Anatolia and in particular around the area of Sagalassos. Sagalassos itself is a good case study because it presents both availability of this new type of environmental data and the abundance of archaeology that exists from the Classical to the Early Byzantine period.¹⁵⁶ Since the environment however doesn't discriminate geographically as historians do, data from the proximity of Sagalassos in southwestern Turkey will also have to be considered. The inclusion of these different locations is also beneficial when one considers the chronological time-frame for the thesis. As the goal of the thesis is to provide a comparison of environmental data and the archaeology in a long period, the records will of other places will help to situate the ecological context of Sagalassos better.

The reason for considering the Late Antiquity in the time frame of this thesis is largely due to the practicality of presenting the environmental evidence as has

¹⁵³ Göktürk and others, p. 2345.

¹⁵⁴ Xoplaki and others.

¹⁵⁵ Xoplaki and others.

¹⁵⁶ Niewohner.

been done so far in the environmental literature.¹⁵⁷ Meaning that changes of climate and vegetation in Late Antiquity are more visible than in other periods and an assessment of the influence of weather on the society becomes easier to visualize.¹⁵⁸ As for the Early Byzantine period, this time frame coincides with what is considered in the literature as the Medieval Climate Anomaly (MCA), which was a period of warmer and agricultural favoring climate.¹⁵⁹ While some of the high productivity in the BOP phase ends in the Late Antiquity, like at Sagalassos, other settlements continue their production into the MCA.¹⁶⁰

Considering the MCA in the timeline of the thesis therefore bodes well for comparing the continuity of production in some settlements and discontinuities in others as well as understanding the shift of settlements in their agricultural practices. The case of Sagalassos, shows for instance, that the MCA corresponds to a period of revitalized agricultural activity after the settlement in the city was disturbed by an earthquake in the mid-7th century.¹⁶¹

In short, Byzantine environmental history is an effort which interrelates both environmental sciences as well as the aforementioned literature of agricultural scholarship. As such, this thesis relies heavily upon those sources which adhere to the practice of combining environmental science with historical narratives to create a regional environmental history. With this in mind, three questions will

¹⁵⁷ Izdebski, Pickett, and others.

¹⁵⁸ Izdebski, 'Setting the Scene for an Environmental History of Late Antiquity', p. 4.

¹⁵⁹ See, Xoplaki and others; Hugues Goosse and others, 'The Role of Forcing and Internal Dynamics in Explaining the "Medieval Climate Anomaly"', *Climate Dynamics*, 39.12 (2012), 2847–66 <<https://doi.org/10.1007/s00382-012-1297-0>>; Michael E. Mann and others, 'Global Signatures and Dynamical Origins of the Little Ice Age and Medieval Climate Anomaly', *Science*, 326.5957 (2009), 1256–60 <<https://doi.org/10.1126/science.1177303>>.

¹⁶⁰ Xoplaki and others.

¹⁶¹ Waelkens and others, CLXXI; Vanhaverbeke and others, XLIII.

remain persistent throughout the remaining case study of Sagalassos in this thesis. Firstly, as a study spanning seven centuries, what does the data from Sagalassos explain in terms of shifting agrarian practices regionally and locally throughout different periods? Secondly, what can be said about the continuities and discontinuities about the patterns and rural landscapes as well as production at Sagalassos through data sets in archaeology, environmental data, and documentary sources? Finally, how well do these documentary, archaeology and environmental sources compare with each other in how they inform the historical narratives of Sagalassos. The following two chapters will provide the answers to these questions through an assessment of the archeozoological, ceramic, and palynological investigations carried out at Sagalassos since the late 1980s.¹⁶² As such, the next chapter is an overview of the ecological setting and the palynological investigations conducted in the areas near Sagalassos. Starting first by an overview of how pollen studies are conducted followed by an analysis of the pertaining data sets relevant to the study of Sagalassos.¹⁶³

¹⁶² For a starting point, see; Waelkens, I.

¹⁶³ Some examples of those data sets are, Bakker, Paulissen, Kaniewski, Poblome, and others; Roberts, 'Human-Induced Landscape Change in South and Southwest Turkey during the Later Holocene'.

Chapter Three:

Palynology at Sagalassos

*“Virentia de Austro-Occidente”*¹⁶⁴

III.1 Anthropogenic indicators as a method of analysis

Before assessing the pollen records of any given core in a palynological study, one has to be informed about the natural vegetation of that particular region. This is because local variation in vegetation plays an important factor in determining the possible changes that may have taken place in that ecology.¹⁶⁵ For this reason, the beginning of this chapter will focus on the role of general primary and secondary anthropogenic indicators to understand common indicators of human activity in the land and issues of land degradation. The focus will then shift towards the ecology of Sagalassos in which more specific information regarding anthropogenic indicators and vegetation will be discussed. After this, the remaining parts of the chapter will discuss specific records from cores near Sagalassos in comparison to general records in the southwestern region of Turkey. The goal in this chapter, by the use of palynological records in the Sagalassos region, is to outline when and especially what practices of agriculture changed around the settlement in relation to the environmental context of the period in question. Essentially, the chapter is

¹⁶⁴ “Plans of the Southwest”

¹⁶⁵ For this, one can check the assessment that Zohary makes while studying the vegetation of cross-vegetation zones. See; Michael Zohary, *Geobotanical Foundations of the Middle East* (Taylor & Francis, 1973), I-II.

meant to outline the visible environmental changes and to what extent, changes in the ecology were their cause.

The core of understanding any interplay between human interaction and the vegetation in a pollen diagram is firstly understanding the role of anthropogenic indicators in those diagrams.¹⁶⁶ Essentially, anthropogenic indicators are a number of vegetation species that indicate the active influence of humans on the environment. Primary anthropogenic indicators are defined by Karl-Ernst Behre as, "[those] species which are cultivated in fields, orchards, and gardens [...] intensively grown in order to harvest them as crops, to use their fruits, nuts, fibres, etc."¹⁶⁷ Secondary anthropogenic indicators are those species are not grown intentionally by man but appear as a consequence of the effect that man have had on the environment.¹⁶⁸ Understandably, anthropogenic indicators often vary due to the differing climax vegetation of a given region and work best under the homogeneity of vegetation cover. This presents a difficulty for the Anatolian case, which not only has the largest vegetational diversity in the Middle East, but also of the most diverse climate and complex land structures which play into vegetational patterns.¹⁶⁹ As such, there is a need to establish the secondary anthropogenic indicators for the region of Sagalassos and to be cautious that they do not represent the climax vegetation of a nearby region. Avoiding this issue can only be done by first, creating an understanding of the"

¹⁶⁶ Yi Yin Li, Li Ping Zhou, and Hai Ting Cui, 'Pollen Indicators of Human Activity', *Chinese Science Bulletin*, 53.9 (2008), 1281–93 <<https://doi.org/10.1007/s11434-008-0181-0>>.

¹⁶⁷ Behre, *Some Reflections on Anthropogenic Indicators and the Record of Prehistoric Occupation Phases in Pollen Diagrams from the Near East*, p. 221.

¹⁶⁸ Behre, *Some Reflections on Anthropogenic Indicators and the Record of Prehistoric Occupation Phases in Pollen Diagrams from the Near East*, p. 223.

¹⁶⁹ Zohary, I–II, p. 12.

undisturbed” vegetation of a given region and then determining which anthropogenic indicators ought to be used in assessing the pollen diagrams.

Despite the caution presented about the validity of anthropogenic indicators as being bound by localities, there are secondary anthropogenic indicators that Behre has delineated for general interpretation. The first of such indicators is that of a plantain known as *Plantago Lanceolata*. Commonly referred to as “Ribwort Plantain,” the *Plantago Lanceolata* is a common weed which grows in coastal dunes, meadows, maquis, forests, roadsides and open places.¹⁷⁰ An important characteristic of the *Plantago Lanceolata* is that it is also known to recolonize and grow on fallow lands.¹⁷¹ For this reason, *Plantago Lanceolata* can both indicate the presence of arable farming practices as well as being a possible indicator for grazing activity in cattle-based economies. When everything else in the pollen diagram is *ceteris paribus*, a rise in Ribwort Plantain accompanied by decline in cultivated crops could be a good indication of a transition from farming to pastoral activities.¹⁷²

A second important indicator of anthropogenic activity can be formed from the genus *Rumex*, belonging to the family of herbs known as *Polygonaceae*. Like the plantain, *Rumex* and more specifically *Rumex Acetosella*, occur in fallow lands as well as exposed sandy soil. The benefit of *Rumex Acetosella* is that it also acts as a good indicator of arable agriculture especially for winter cereals.¹⁷³

¹⁷⁰ Münir Öztürk and others, *Aegean Region Turkey: Plants and Landscape ; Izmir, Pergamon, Ephesus, Priene, Miletos, Didyma, Aphrodisias, Pamukkale, Kusadasi, Manisa, Aydin, Denizli ; Ege Bölgesi Bitki Örtüsü* (Aegean Tourism Association, 1990), p. 135.

¹⁷¹ Behre, ‘The Interpretation of Anthropogenic Indicators in Pollen Diagrams’, p. 234.

¹⁷² Behre, ‘The Interpretation of Anthropogenic Indicators in Pollen Diagrams’.

¹⁷³ Behre, ‘The Interpretation of Anthropogenic Indicators in Pollen Diagrams’, pp. 235–36.

Rumex Acetosa, and *Rumex Cyprius* also indicate farming practice, but unlike Northwestern Europe, *Rumex* is not as abundant in Anatolia and not always available to use as an anthropogenic indicator.¹⁷⁴

As nitrophilous species *Chenopodiaceae*, *Artemisia* and *Urtica* can also grow on cultivated lands and indicate practice of farming.¹⁷⁵ The difficulty with these species however, is that they occur in natural communities by coasts and thus their value is reduced when data is from proximity to a coastal region. Both *Chenopodiaceae* and *Artemisia* are open vegetation with steppe characteristics that can explain disturbed conditions in the land or possible clearing of forests in the case of chenopod species.¹⁷⁶ In addition to these, *Graminae* (the family of grasses) are also important indicators of lumbering and overgrazing though grass pollen are hard to identify beyond the family level.¹⁷⁷ Cerealia-type pollen also provide good indications of anthropogenic activity despite having similar problems with *Graminae* pollen. Cerealia-type pollen can exist in both domesticated and wild species, and telling them apart isn't always easy as this type of pollen is determined more by size than morphological features.¹⁷⁸

Another indicator of degraded land can be made from the *Centaurea solstitialis*

¹⁷⁴ Sytze Bottema and Henk Woldring, 'Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean', in *Man's Role in the Shaping of the Eastern Mediterranean Landscape: Proceedings of the Symposium on the Impact of Ancient Man on the Landscape of the E Med Region & the Near East: Groningen*, 1989, pp. 231–64.

¹⁷⁵ Behre, 'The Interpretation of Anthropogenic Indicators in Pollen Diagrams', p. 237.

¹⁷⁶ Bottema and Woldring, 'Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean', p. 236.

¹⁷⁷ Bottema and Woldring, 'Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean'.

¹⁷⁸ The cereals for the case of Anatolia that act as anthropogenic indicators are *Triticum monococcum*, *T. dicoccum*, *T. durum/aestivum*, *Hordeum distichon*, *H. vulgare*, *H. "nudum"*, *Secale cereale*, *Avena sativa* and *Panicum miliaceum*. See, Behre, *Some Reflections on Anthropogenic Indicators and the Record of Prehistoric Occupation Phases in Pollen Diagrams from the Near East*, p. 222.

which is referred to commonly as the “Yellow star-thistle.” The Yellow star-thistle can both be an indicator of disturbed land as well as an indicator for cattle grazing, given their representation drops after a period of stabilization.¹⁷⁹ Under ideal circumstances, having all of these pollens represented commensurately in diagrams should be enough to make an analysis of anthropogenic influence possible; but this is unfortunately not the case due to the ecology of the Eastern Mediterranean. In fact, as Sytze Bottema and Henk Woldring write, “a general conclusion is that in such a large and diverse area as the Eastern Mediterranean pollen types that are indicative for the whole area can hardly be found.”¹⁸⁰ As such, these grasses, weed and ruderal anthropogenic indicators are not enough to explain the exact presence of human activity in a given area.

An additional group of secondary anthropogenic indicators are considered from shrubs and trees which occur after forest degradation or forest recolonization. Most notably in Anatolia, these are the shrubs and small trees of the *Juniperus* and *Quercus* (oak) species. Though they are now often associated with the climax of a region, these species can take advantage of deforestation.¹⁸¹ The role of *Juniperus oxycedrus* is clear in the case of deforestation and forest colonization,¹⁸² while the species of *Quercus* are harder to interpret. As the Mediterranean maquis don’t constitute the climax vegetation of Anatolia,

¹⁷⁹ Bottema and Woldring, ‘Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean’, p. 254.

¹⁸⁰ Bottema and Woldring, ‘Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean’, p. 255.

¹⁸¹ Behre, *Some Reflections on Anthropogenic Indicators and the Record of Prehistoric Occupation Phases in Pollen Diagrams from the Near East*, p. 224.

¹⁸² Zohary, I–II, p. 276.

especially along coastal regions which host varying kinds of forests, *Quercus* maquis may not be so informative.¹⁸³ Though *Quercus* maquis may represent degradation, it may also represent a shift of the evolving vegetation towards the climax of its region. As such, this evolutionary change might be independent from anthropogenic involvement, making it difficult to utilize *Quercus* maquis as evidence of degradation. As will be seen, this uncertainty is even further exacerbated as pine-oak forests in Anatolia are common near coastal areas with varying relationships largely depending on soil types.¹⁸⁴

Unlike secondary anthropogenic indicators, most primary usable anthropogenic indicators are not as complicated in their value for understanding human influence. One difficulty, however, is that while the *Rosaceae* tree family contains many cultivated species, like apple, pear, cherry, prune and almond, they are insect pollinated and therefore are rarely present in pollen diagrams.¹⁸⁵ As such, reference to cultivation in pollen diagrams can only be made with trees (and shrubs) which are wind-pollinated. Such is the case of olive (*Olea*), as one of the earliest cultivated trees, alongside date palm, figs, and grapes.¹⁸⁶ Bottema and Woldring determine the other significant cultivated

¹⁸³ Ruggero Tomaselli, 'The Degradation of the Mediterranean Maquis', *Ambio*, 6.6 (1977), 356–62 (p. 358).

¹⁸⁴ While mesic environments may provide the conditions for *Quercus* forests to overtake *Pinus* forests, in other places, they may remain solely as underwood in the *Pinus* forests. This, in turn, brings us back to the question of the *Quercus* maquis and whether they relate to the evolving vegetation or recent degradation. While the position of spiny dwarf shrubs and thorny vegetation as signs of degradation and overgrazing are difficult to confirm, they should however, also be considered in an analysis for anthropogenic indication. Considered this way, two *Q. cerris* plants from the genus of *Quercus*, *Q. coccifera* and *Q. calliprinos*, can provide possible evidence of degradation since they are the most common dwarf oak-shrubs in the region with spiny needles. See, Sheffer.

¹⁸⁵ Izdebski, XVIII, p. 129.

¹⁸⁶ Reinder Neef, 'Introduction, Development and Environmental Implications of Olive Culture: The Evidence from Jordan', in *Man's Role in the Shaping of the Eastern Mediterranean Landscape*. Balkema, Rotterdam, ed. by Sytze Bottema, G Entjes-Nieborg, and William Van Zeist,

indicators as, "sweet chestnut (*Castanea sativa*), walnut (*Juglans regia*), manna-ash (*Fraxinus ornus*), and grape (*Vitis*)."¹⁸⁷ *Platanus orientalis* also shows correlation with the cultivated species discussed.¹⁸⁸

An important aspect of understanding how these plants are to be interpreted within the pollen diagrams are in assessing their percentage values to the total pollen sum. Unlike what may be expected in percentages, most primary anthropogenic indicator pollen provide low pollen counts to the total sum. For instance, *Olea* pollen can be transferred long distances and therefore appear below 1% in woodland or steppe areas, but for places near its cultivation, it can reach slightly higher values indicating its presence.¹⁸⁹ For *Castanea sativa*, values higher than 0.1% are enough to consider its presence. Likewise, values of *Vitis* and *Fraxinus Ornus* are represented near 0.1% which would indicate their presence.¹⁹⁰ While the percentages may seem small and insignificant, their presence is actually vital for creating a general framework for understanding what cultivational practices were conducted in the study region.¹⁹¹ Coupled with the aforementioned secondary anthropogenic indicators, this data can be the reference to degrading forms of farming practice or the possible outcomes of

The Impact of Ancient Man on the Landscape of the Eastern Mediterranean Region and the Near East (A.A. Balkema, 1990), pp. 295–306 (p. 297).

¹⁸⁷ Bottema and Woldring, 'Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean', p. 239.

¹⁸⁸ Bottema and Woldring, 'Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean', p. 240.

¹⁸⁹ Bottema and Woldring, 'Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean', p. 239.

¹⁹⁰ Bottema and Woldring, 'Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean', pp. 240, 257.

¹⁹¹ Izdebski, XVIII, p. 113.

overgrazed lands. Whatever the analysis may be, there is an intense need to involve as much indicative data whenever possible and such data is invaluable.

A final indication that can be seen within pollen diagrams are the types of forests related to a given area. While not being classified as primary or secondary anthropogenic indicators, their values can support claims of anthropogenic activity or general vegetational and climate changes. In common classifications of Anatolian forests, they are divided into three altitudinal ranges. These ranges contain “broad-leaved deciduous, coniferous and alpine grass between 0-1200m, 1200-2000m, and above 2000m respectively.”¹⁹² While Zohary has initially outlined the vegetational zones, Van Zeist, Woldring and Stapert have further elaborated upon the vegetational zones for their respective altitudes.¹⁹³ Between 0-800m, they distinguish a belt of vegetation referred to as the EU-Mediterranean belt, consisting mostly of evergreen species.¹⁹⁴ The zone from 800-2000m consists of deciduous and coniferous forests and is referred to as the Oro-Mediterranean belt.¹⁹⁵ Beyond the 2000m line are the alpine vegetation as the timber line ends near this point. These classifications are helpful for making general statements about the vegetation of these zones, but it should be noted that the intent of the initial classifications were more about grouping vegetation together and less about placing them strictly into altitudes.¹⁹⁶

¹⁹² Ibrahim Atalay, Recep Efe, and Münir Öztürk, ‘Ecology and Classification of Forests in Turkey’, *Procedia - Social and Behavioral Sciences*, 120.2 (2014), 788–805 (p. 790).

¹⁹³ See, Van Zeist, Woldring, and Stapert; Bottema and Woldring, ‘Late Quaternary Vegetation and Climate of Southwestern Turkey, Part II’.

¹⁹⁴ Van Zeist, Woldring, and Stapert, p. 64.

¹⁹⁵ Van Zeist, Woldring, and Stapert, p. 65.

¹⁹⁶ Zohary, I–II, pp. 500–577.

In the so-called EU-Mediterranean zone, the most prominent forest tree is that comprising of *Pinus brutia* woods with *Quercus calliprinos* as very common undergrowth shrub. Other important trees in this zone are the *Platanus orientalis*, *Salix*, *Ulmus campestris*, *Alnus glutinosa*, and *Liquidambar orientalis* (which is a local tree).¹⁹⁷ *Pinus brutia* extends into the lower part of the Oro-Mediterranean zone at about 1000m to 1200m depending on the available heat with *Pinus nigra* taking over as forest cover after such altitudes.¹⁹⁸ In the upper zone, from 1200m to the timber line (2000m) there are coniferous forests comprised of *Pinus nigra*, *Cedrus libani*, *Abies cilicia*, and *Juniperus excelsa*. At a degenerative state of the *Cedrus-Juniperus* forests, a *Juniperus excelsa-Quercus calliprinos* shrub vegetation can be found.¹⁹⁹

Following this belt are the Alpine vegetation which are comprised mostly of spiny cushion shaped species.²⁰⁰ These tragacanthic subalpine steppe vegetation show great diversity across different vegetation cover but are often formed of differing *Astragalus* and *Acantholimon* species.²⁰¹ An important vegetation belt that occurs towards inland Anatolia from the Mediterranean is the temperate Xero-Euxinian steppe-forest. The steppe-forest is defined in these areas by Zohary as, "steppe [vegetation] sprinkled with solitary trees which under certain conditions may become condensed and turn into a forest-like formation."²⁰² The forests of this belt consist of deciduous oak, pine and a mixed

¹⁹⁷ Van Zeist, Woldring, and Stapert, pp. 64–65.

¹⁹⁸ Van Zeist, Woldring, and Stapert, p. 65.

¹⁹⁹ Van Zeist, Woldring, and Stapert, p. 66.

²⁰⁰ Zohary, I–II, p. 493.

²⁰¹ Van Zeist, Woldring, and Stapert, p. 66.

²⁰² Zohary, I–II, p. 579.

variant of the two.²⁰³ Often these woods are left with remnants from their original cover as they have been destroyed.²⁰⁴ While there are many more associations of vegetation cover as surveyed by Zohary in this area, these are the ones which pertain notably to the discussion of anthropogenic involvement.²⁰⁵

The issue of anthropogenic involvement is to some extent also an issue of land degradation. Land degradation in the Mediterranean environments can naturally occur due to, “accelerated erosion, flooding, sedimentation and river channel changes, vegetation loss, fire, water shortages and declining water quality.”²⁰⁶ Manmade occurrences of land degradation however occur often due to grazing and logging activities. These anthropogenic involvements, “degrade the vegetation canopy, reduce the density and diversity of plants, changing the species compositions.”²⁰⁷ The change of vegetation type and cover is what makes the previous discussion of present-day forests one of special attention.

Land degradation and especially forest clearing are an important discussion primarily because they relate directly to models of environmental and cultural change. For instance, as pine are wind-dispersed species and quick in their succession of disturbed land, they can be strong indicators of afforestation in unused land.²⁰⁸ This, among the many already discussed, is just one example of

²⁰³ Van Zeist, Woldring, and Stapert, p. 68.

²⁰⁴ Such is the case of the wild orchards of *Pyrus elaeagrifolius* and *Crataeus laciniata* with remnants of *Q. cerris* and *Astragalus* steppe plants. See, Zohary, I–II, p. 581.

²⁰⁵ See, Zohary, I–II.

²⁰⁶ Donald A Thompson, ‘Land Degradation in Mediterranean Environments of the World: Nature and Extent, Causes and Solutions, Edited by AJ Conacher and M. Sala. Wiley, Chichester, 1998.’, *Land Degradation & Development*, 11.2 (2000), 195–97 (p. 196).

²⁰⁷ Matteo Jucker Riva and others, ‘Assessment of Land Degradation in Mediterranean Forests and Grazing Lands Using a Landscape Unit Approach and the Normalized Difference Vegetation Index’, *Applied Geography*, 86 (2017), 8–21 (p. 9).

²⁰⁸ Sheffer, p. 7.

how the representation of pollen can inform about the degradation or clearing of the land. While this is an issue which matters as long as anthropogenic influence is affecting the environment, the clearing of forests is particularly important because of how it relates to the Beyşehir Occupation Phase (BOP). Though the beginning and end dates for the BOP at each specific site varies, it is marked by an intense period of woodland clearing and finishes when farming abandonment occurs.²⁰⁹ In the case of Sagalassos, the end of the BOP correlates to a period of agricultural regime change where pastoralism takes priority. For this reason, dating the BOP is therefore an important tool for understanding what kind of agricultural regime is present at whatever time period is in discussion.²¹⁰

III.2 The ecology of Sagalassos' chora

Since a general outline regarding the climax vegetation of the southwestern region of Turkey has been established, a study of Sagalassos can properly take discussion. The region of Sagalassos, as partially mentioned, is an important case study of rural environmental history for two reasons. Firstly, environmental data from this region is perhaps the richest in all of Anatolia due to the surveys and initiation of coring by Van Zeist, Holdring, and Bottema as mentioned in the previous chapter. Secondly, rural sites in Sagalassos's

²⁰⁹ Roberts, 'Human-Induced Landscape Change in South and Southwest Turkey during the Later Holocene', p. 61.

²¹⁰ Eastwood, Roberts, and Lamb.

hinterland are recent discoveries with archaeological evidence where rural life continued without major interruption but may have been altered in ways archaeology can't fully interpret alone.²¹¹ In this way, there is room for environmental data to supplement the existing archaeological work and provide better insight into the continuing settlements in this region.

The site of Sagalassos was located in the Roman province (*eparchai*) of Pisidia and under the Byzantines, Antiochia became its metropolitan see.²¹² Today, the archaeological site rests within the boundaries of the province of Burdur and 5km north of the Ağlasun brook valley.²¹³ The first attempt will be to recreate the environmental setting of the Sagalassos region with data from the coring of nearby lakes. Afterwards, archaeological studies on the region will be used to correspond this data to present an environmentally historical case study for the region. Within a 30km radius of Sagalassos lies the Bereket basin and the Gravgaz marsh to the Southwest from which three detailed coring data exists. The most comprehensive study collecting all relevant discussions of these two cores has been published in 2013 by Johan Bakker et al. While the Bereket basin

²¹¹ See for instance, Athanasios K Vionis and others, 'A Middle-Late Byzantine Pottery Assemblage from Sagalassos: Typo-Chronology and Sociocultural Interpretation', *Hesperia: The Journal of the American School of Classical Studies at Athens*, 79.3 (2010), 423–64; Jeroen Poblome, Dennis Braekmans, Marc Waelkens, and others, 'How Did Sagalassos Come to Be? A Ceramological Survey', in *K. Levent Zoroğlu'na Armağan: Studies in Honour of K. Levent Zoroğlu*, ed. by Mehmet Tekocak (Suna & Inan Kiraç Research Institute on Mediterranean Civilizations, 2013), pp. 527–40; Waelkens, 'Sagalassos, Archaeology Of'; Claeys and Poblome; Waelkens and Poblome.

²¹² We know from a couple primary sources about the colonies that Augustus set up in Pisidia as well as the area and later a metropolis of Pisidia in the work of *De Thematibus*. See; Augustus Caesar, *Res Gestae Divi Augusti (The Achievements of the Divine Augustus)*, ed. by P. A. Brunt and J. M. Moore (Oxford: Oxford University Press, 1969), p. 32; Constantinus Porphyrogenitus, 'De Thematibus et De Administrando Imperio', in *Corpus Scriptorum Historiae Byzantinae*, ed. by Barthold Georg Niebuhr (Impensis Ed. Weberi, 1836), III, 544 (p. 13); Johannes Koder, 'Historical Geography', in *The Archaeology of Byzantine Anatolia: From the End of Late Antiquity Until the Coming of the Turks*, ed. by Philipp Niewohner (Oxford University Press, 2017), pp. 9–27 (pp. 12, 15).

²¹³ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 62.

core is first published in this work, the Gravgaz marsh cores were taken first in 1996 then in 1999 being published by Marleen Vermoere in 2002.²¹⁴

A newer and more detailed publication of the Gravgaz marsh was also added by Johan Bakker in 2011.²¹⁵ The Gravgaz data, due to its longer history, has better been analyzed and considered by environmental scientist of the area like Johan Bakker and David Kaniewski and therefore takes the discussion first. The area surrounding Sagalassos and the Gravgaz march is considered to have an Oro-Mediterranean climate zone having mild winters with precipitation and hot summers.²¹⁶ An airstream called the “Saharan” originating in the northeast of the Libyan Desert converges with the “Turkic” air stream in May-August.²¹⁷ This is what accounts for the less precipitous and drier temperatures in the region between June-September.²¹⁸

These weather conditions are all linked to the North Atlantic Oscillation (NAO), a fluctuation of atmospheric mass, plays a major role in weather patterns of the Mediterranean, especially in the precipitation of winters.²¹⁹ The negative phase of the North Atlantic Oscillation in winter often leads to wetter winters across Anatolia, including the region of Sagalassos.²²⁰ Since exact climatic

²¹⁴ Marleen Vermoere and others, ‘Palynological Evidence for Late-Holocene Human Occupation Recorded in Two Wetlands in SW Turkey’, *The Holocene*, 12.5 (2002), 569–84.

²¹⁵ Bakker, Kaniewski, Verstraeten, De Laet, and others.

²¹⁶ Johan Bakker et al., “Man, Vegetation and Climate during the Holocene in the Territory of Sagalassos, Western Taurus Mountains, SW Turkey,” *Vegetation History and Archaeobotany* 21, no. 4–5 (August 2012): 249–66.

²¹⁷ C Vada LaFontaine, Reid A Bryson, and Wayne M Wendland, ‘Airstream Regions of North Africa and the Mediterranean’, *Journal of Climate*, 3.3 (1990), 366–72 (p. 369).

²¹⁸ Bakker, Paulissen, Kaniewski, De Laet, and others, p. 250.

²¹⁹ M Türkeş and Ecmel Erat, ‘Influences of the North Atlantic Oscillation on Precipitation Variability and Changes in Turkey’, *Nuovo Cimento Della Società Italiana Di Fisica*, 29.1 (2006), 117–35.

²²⁰ Matthew D Jones, C Neil Roberts, and others, ‘A High-Resolution Late Holocene Lake Isotope Record from Turkey and Links to North Atlantic and Monsoon Climate’, *Geology*, 34.5 (2006), 361–64 (p. 367).

reconstructions of the NAO are not possible due to a lack of highly detailed proxies, the general trends can be followed by the isotopic values of the varved Nar lake in the Cappadocian region.²²¹ The parental soil material of the region is Limestone with local variation in soil depth, moisture content and stoniness.²²² As the soil is soft and easily erodible. As Bakker states: “intensive grazing pressure has resulted in the lower slopes surrounding agricultural fields being covered by short, open vegetation dominated by *Quercus coccifera*.”²²³ This land degradation has also shown to create meadow-steppe grass vegetation. For these reasons, they are important vegetation to consider as actors of anthropogenic indicators in the pollen diagrams. The publication by Bakker on the new Gravgaz core (lab-name SA06EP1), drilled in 2006, provides an additionally helpful way to consider vegetation as anthropogenic indicators in the region.²²⁴

Before moving to a discussion therefore, this methodology should firstly be explained. Unlike the orthodox division of primary-secondary anthropogenic indicators, a numerical analysis was conducted on the pollen types to place them into Pollen Derived Vegetation Patterns (PDVP).²²⁵ The PDVPs are essentially a cluster analysis of a group of vegetation that thrive together in the same environments. The benefit of this modeling is in the way in which it can correlate plants which have been considered as anthropogenic indicators with

²²¹ Jones, Roberts, and others, p. 393.

²²² Maximilien Fontaine and others, ‘Elevation and Exposition Rather than Soil Types Determine Communities and Site Suitability in Mediterranean Mountain Forests of Southern Anatolia, Turkey’, *Forest Ecology and Management*, 247.1–3 (2007), 18–25 (p. 19).

²²³ Bakker, Paulissen, Kaniewski, De Laet, and others, p. 251.

²²⁴ Bakker, Paulissen, Kaniewski, Poblome, and others.

²²⁵ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 427.

ones which haven't been before. Once again Bakker argues that: "a strong positive correlation [...] between a PDVP and the anthropogenic indicators most likely reflects an anthropogenic influence on that PDVP. If there is no correlation, then the PDVP is influenced by another (most likely environmental) factor."²²⁶ This way, a more comprehensive analysis concerning the impact of anthropogenic and non-anthropogenic activity can be had on the vegetation cover of the Sagalassos region. Additionally, the numerical analysis uses a Principal Component Analysis (PCA) to indicate the openness of landscapes and moisture levels based on the loadings of the different PDVPs. Simply, this means that based upon the presence of vegetation that thrives in open landscapes and humid conditions (or the inverse of these conditions), the PCA axes can represent the environmental conditions of the period in discussion. Scores of the PCA-Axis 1 indicate levels of vegetation density while the scores of PCA-Axis 2 indicate moisture availability across the same time frame.²²⁷ A higher value for Axis 1 and Axis 2 indicates higher density of vegetation and less moisture availability (dry conditions) respectively.

²²⁶ Bakker, Kaniewski, Verstraeten, De Laet, and others.

²²⁷ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 432.

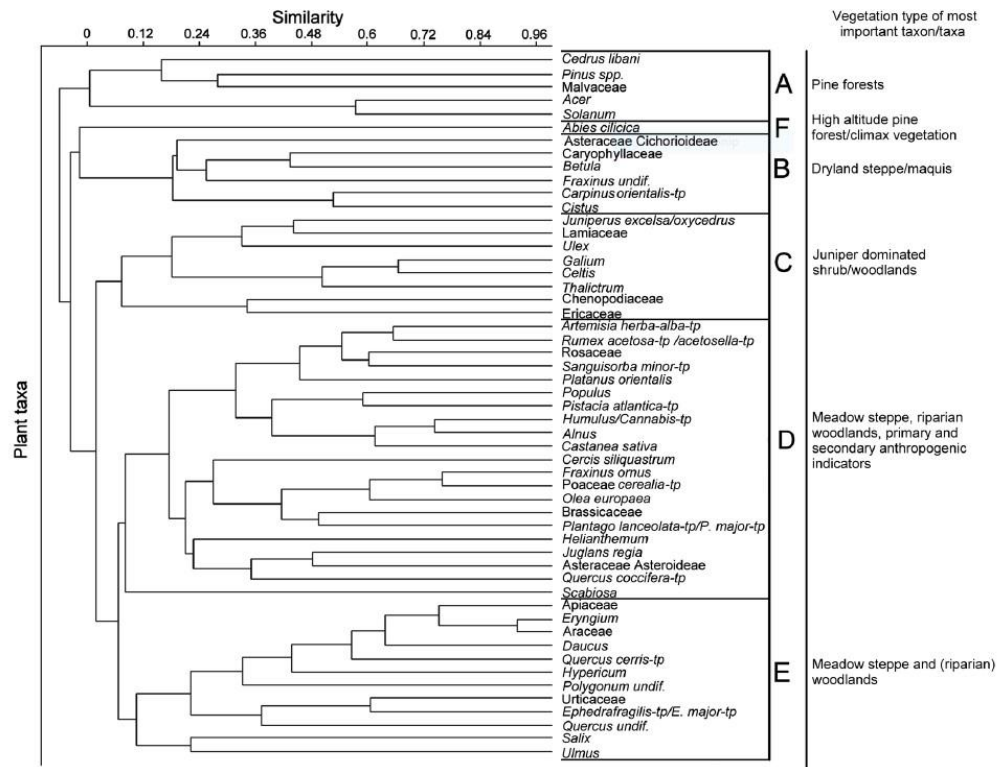


Figure 1. The Pollen Derived Vegetation Patterns (PDVP) of the Gravgaz cores.

Ref: Johan Bakker, David Kaniewski, Gert Verstraeten, Véronique De Laet, and others,
 'Numerically Derived Evidence for Late-Holocene Climate Change and Its Impact on Human
 Presence in the Southwest Taurus Mountains, Turkey', *The Holocene*, 22.4 (2012), 427.

As is common practice among publications of environmental data, the discussion of the pollen records depends primarily on the depth, as indicating time span, and the resolution of the core, detailing how precisely it can be dated.²²⁸ Once established, the discussions follow any noticeable changes in the

²²⁸ As outlined by Izdebski. See, Izdebski, XVIII.

trends of the data throughout the core's timeline. The relevant time span of the core SA06EP1 for this thesis starts from 0 up until AD 2000 with five distinct wet-dry phases; Roman Wet Period (AD 0 - 650), Early Medieval Dry Period (c. AD 640 - 940), Medieval Wet Period (c. AD 940 - 1280), Post Medieval Dry Period (c. AD 1280 - 1710), and the Post Medieval Wet Period (c. AD 1710 - Present).²²⁹ According to the data, the Roman Wet Period is one characterized by a not so dense tree/shrub landscape because humid conditions had prevailed over drier phases. The presence of the highest pollen count for cereals and cultivated trees also occur in this period. Indeed, the presence of *Castanea sativa*, *Fraxinus ornus*, *Juglans regis*, *Olea europaea*, and *Poaceae cereale* are all clearly visible in the pollen count and reach their highest density.²³⁰ High cultivation for cereals and trees is hindered visibly at approximately AD 250, where cereal pollen isn't available and cultivated trees remain at their lowest in this phase. This overall reduction occurs in a great spike turning to drier weather. A recovery of cereals and arboriculture follows but not to the abundant extent as previously visible, possibly indicating that here, the last stages of the BOP occurred at around AD 250.²³¹ The following dry phase, the Early Medieval Dry Period, starting at AD 640 shows a clear reduction in the arboriculture and cereal production of the Sagalassos region. Additionally, pollen for *Olea europaea* is not present at all in this period, making a minimal return only in the Medieval Wet period 400 years later. Data in this period shows a great increase in the aridity of this period with a shift towards more open landscapes. Dryland

²²⁹ Bakker, Kaniewski, Verstraeten, De Laet, and others, pp. 433–36.

²³⁰ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 434.

²³¹ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 432.

maquis like *Asteraceae*, *Juniperus*, and *Fraxinus*, shows a noticeable rise in pollen count. Additionally, the initial hot dry phase runs parallel to a decline in the pollen count of the deciduous *Q. cerris* with gradually rising shrub woodland vegetation and rising values of *Pinus* which fluctuate.²³² These changes in vegetation are not indicated gradually and can be the result of either intense human activity or environmental conditions.

Environmentally, the drier weather may well have affected the growth of cultivated trees, limiting the growth of the *Olea europaea* for example. It could also have been a human decision to reduce arboriculture and focus on the production of livestock.²³³ One explanation to the openness of the landscape in this period may well have been because of overgrazing and could account for the fluctuation of *Pinus* values as pine pollen travels longer distances through open landscapes.²³⁴ The turn to more pastoral practices would also make sense given the event of a serious earthquake in the Sagalassos region in the mid-seventh century.²³⁵ The environmental conditions limiting the growth of arboriculture would also have been affected by the colder and harsher winters with less precipitation in this period. This cold spell also showed by the oxygen isotope records from other lakes across the Eastern Mediterranean and from the evidence of the frozen Bosphorus and parts of the Black Sea through the 8th and 13th centuries.²³⁶ On an environmental level, a severe earthquake followed by

²³² Bakker, Kaniewski, Verstraeten, De Laet, and others, pp. 433–34.

²³³ This discussion takes place in the following chapter when ceramic and zooarchaeological evidence is also presented.

²³⁴ See, Agnieszka Pidek, Piotrowska, and Kasprzyk.

²³⁵ Waelkens and others, CLXXI.

²³⁶ Vural Yavuz, Naki Akçar, and Christian Schlüchter, 'The Frozen Bosphorus and Its Paleoclimatic Implications Based on a Summary of the Historical Data', in *The Black Sea Flood*

unfavorable conditions of weather in this period can explain the greatly diminished evidence for arboriculture and a possible switch to pastoral production in the region.²³⁷ Though later in this period, an intense increase in the sedimentation deposit rate is visible. Analysis of the sedimentation shows that this corresponds to a fire episode around AD 910 which may have been caused by human activity.²³⁸ Certainly fire could occur for other reasons, but the recurrence of fire activity in places of human presence does give the possibility for this event to be a human induced one.²³⁹ Perhaps the increased reliance on cattle and sheep grazing in the region required the clearing of forests for pastureland and that's why such a fire event exists. This is possible, but the lack of further substantiation leaves this possibility as only a speculative one. The following Medieval Wet period immediately exhibits pollen count of cereal similar to that of the late Roman Wet period at c. AD 950, but with half the cultivated arboreal pollen of the former.²⁴⁰ Data shows low tree/shrub density which rises to highest vegetation density of the core at AD 1300. Since wetter conditions overall prevailed. Particularly the beginning of this period indicates anthropogenic interest into the valley as moisture accumulated and a streamlet possibly ran across the valley creating favorable arable soil.²⁴¹

Question: Changes in Coastline, Climate, and Human Settlement, ed. by Valentina Yanko-Hombach and others (Springer, 2007), pp. 633–49 (p. 646).

²³⁷ Waelkens and others, CLXXI.

²³⁸ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 435.

²³⁹ Katarzyna Marcisz and others, 'Long-Term Hydrological Dynamics and Fire History over the Last 2000 Years in CE Europe Reconstructed from a High-Resolution Peat Archive', *Quaternary Science Reviews*, 112 (2015), 138–52.

²⁴⁰ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 435.

²⁴¹ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 436.

This period can be split into two zones with AD 940-1100 having the wetter and cereal production zone while 1100-1280 holds low to none cereal with cultivated tree pollen that reduces and eventually stagnates visibly until the beginning of the current millennium. Throughout this period, *Plantago lanceolata* and *Sanguisorba minor* show consistent increased presence with *Rumex acetosa* showing higher values in the second zone of this period. *Rumex acetosa* can be an indicator for both fallow lands, exposed sandy soil, and for winter cereal production.²⁴² The absence of cereal pollen doesn't necessarily mean that there wasn't a production of cereal. It is highly likely that cereal was being used in the mixed farming practices and planted in either rotation or with other plants in the same land.²⁴³ The temporary moisture availability may have allowed cereals to grow on the side but considered less favorable when moisture reduced. In this case, the *Rumex acetosa* may be indicators of fallow land or exposed limestone that were previously suitable for farming due to the diverted streamlet in the first zone of this period. This can be particularly true if the cereal produced is wheat and not barley as the former demands less alkaline soils which are common in the Mediterranean.²⁴⁴ Since the published data doesn't distinguish between the different types of cereals, this judgement also remains a speculative one.

The final relevant phase after the Medieval Wet period is the Post-Medieval Dry period. As its name suggests, this part of the core is marked by drier

²⁴² Behre, 'The Interpretation of Anthropogenic Indicators in Pollen Diagrams', p. 236.

²⁴³ Decker and others, pp. 205-6.

²⁴⁴ Naum Jasny, 'Competition Among Grains in Classical Antiquity', *The American Historical Review*, 47.4 (1942), 747-64 (p. 753).

conditions and high density of trees/shrubs. Though reduced to the lowest level of the previous phase, there is still arboriculture practice, but with peaking values of *Asteraceae*, it is likely that a shift towards the grazing and herding of cattle took priority through this period. The discussion of this core's priority over others has largely been due to it being new and using complex mathematical models for presenting the pollen data. There are however other pollen records of the area that can be used to build on the information presented by core SA06EP1.



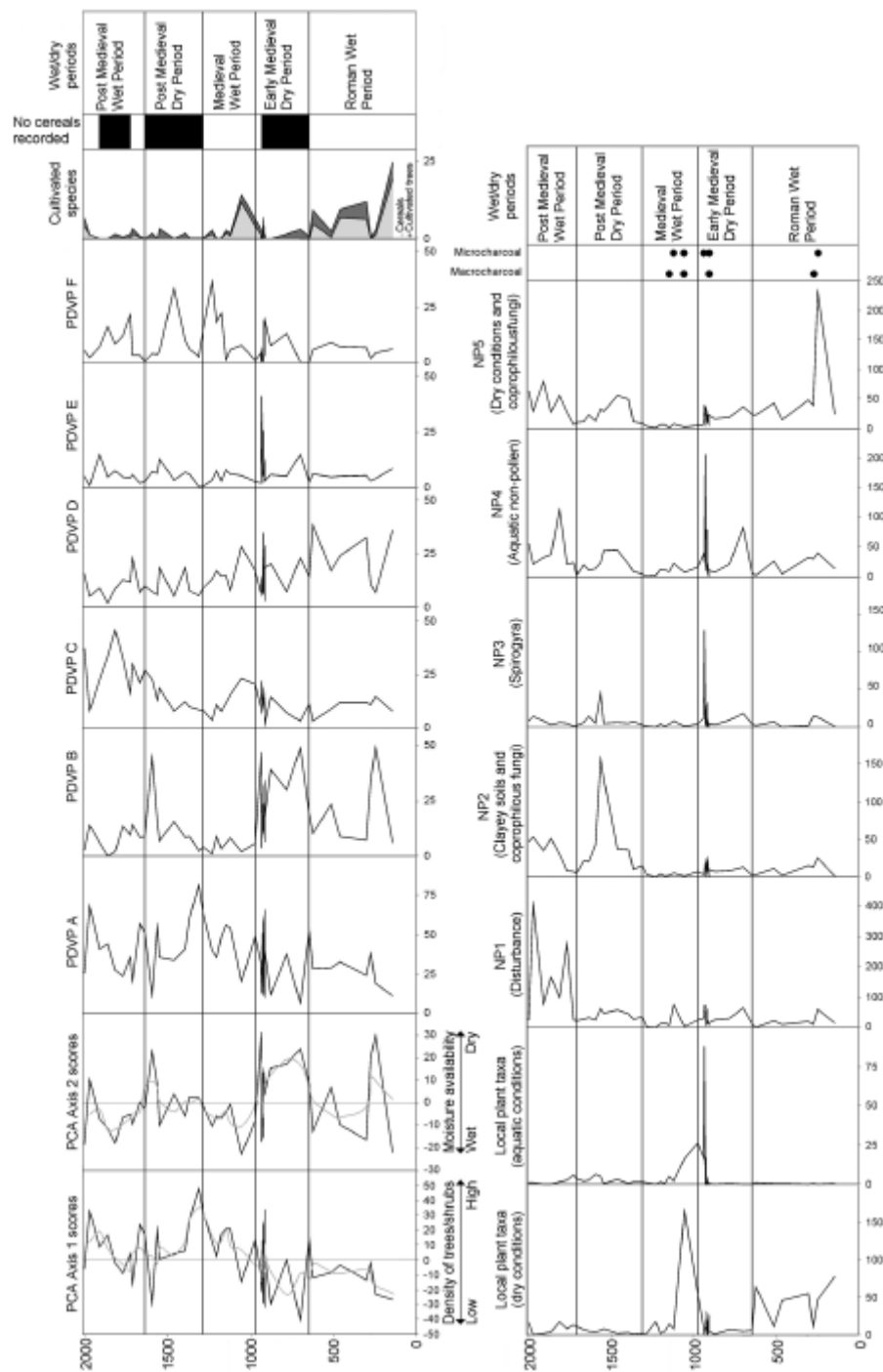


Figure 2. PCA and PDVP representations in the Gravgaz core.

Ref: Johan Bakker, David Kaniewski, Gert Verstraeten, Véronique De Laet, and others,

'Numerically Derived Evidence for Late-Holocene Climate Change and Its Impact on Human Presence in the Southwest Taurus Mountains, Turkey', *The Holocene*, 22.4 (2012), 432.

The older cores of the Gravgaz marsh include those drilled in 1996 and again in 1999. Both cores were dated using AMS carbon dating and deviate at an average of ± 50 years.²⁴⁵ A 50-year deviation is of course not entirely favorable for making historical claims with precision, but it nevertheless allows for a general comparison of the larger environmental trends in the area. A further complication relates to the separation of the time frames in the discussion of these two cores. While core SA06EP1's dates are converted to calendar years (BC-AD), the pollen diagrams of the Gravgaz cores are left in their radiocarbon dates. Additionally, no clear separation of dry-wet phases exists in the discussion though they are mentioned within discussions of the separate zones. Though the core has a deeper chronology, the relevant zones for this thesis include zones G2-A, G2-B, and G3. The zone of G2-A starts between BC 453-361 for Gravgaz 1996 and between BC 338-222 for the Gravgaz 1999 core. The following zone G2-B starts between BC 100-AD 60 for the core of 1999 with no dating for the 1996 core. G3 starts at the 1996 core at AD 670-810 and at AD 540-640 in the 1999 core. Here the ages of the G2 zones differ in about a century or more for the two cores with better proximity between the two cores at zone G3. In core G96, a continuous and noticeable presence of cultivated trees like *Juglans regia*, *Fraxinus ornus*, *Olea europaeae* and *Vitis vinifera* starts at approximately BC 320 and continues until a decline at around AD 650.²⁴⁶ The period ending corresponds to a gradual rise in *Pinus* pollen not soon after, indicating the end of such high cultivation. The remainder of the core shows

²⁴⁵ Vermoere and others, p. 572.

²⁴⁶ Vermoere and others, p. 573.

almost to none revival of the arboriculture. While no revival of arboriculture seems present, cereal cultivation seems to have made a revival around AD 950 and stops at AD 1150. During this time, *Pinus* values show a decrease and again gradually increase once the cereal pollen diminishes.²⁴⁷ The carbon dates for the G99 core allow us to make even easier dating of when the pollen percentages change as the average dating shows a deviation of ± 50 . The BOP phase of the core seems to start here at BC 330 and ends at AD 570. Essentially this means that the dates fall between BC 380-280 to AD 520-620. This trend of tree cultivation matches with that of the 1996 core quite well and assuming a ± 50 deviation for G96 leaves at large decadal differences between the two cores. Interestingly, the cereal pollen of the G99 core shows the same trends as core G96 but not to the same intensity. *Pinus* values in this diagram also increase and spike like in core G96, decreasing in the short-lived revival of the cereal phase and only returning once the cereal phase ends again. In both cases, values of *Q. cerris* and *Q. coccifera* are reduced in zone G3 and show slight revival only with the secondary-cereal phase.²⁴⁸ It is clear from the pollen record that the land is dominated mostly by *Pinus* trees in the G3 period. The agreement of both cores on the domination of high pine pollen percentages and the disappearance of oak pollen here can be indicative of an opened landscape due to degradation and overgrazing of the area. While the intensity of representations differs between cores G96 and G99, the trends they indicate are largely the same with only slightly different chronologies.

²⁴⁷ Izdebski, XVIII, pp. 158–59.

²⁴⁸ Vermoere and others, pp. 573–74.

The initial comparison of the two older Gravgaz cores supports the hypothesis that after the end of the BOP in the G2 phase, there was only a minor revival of agriculture which doesn't even come close to the production of the BOP. The core of G96, which has better cereal pollen representation shows a change in percentages from 2.9% to 0.9% between the G2 and G3 periods.²⁴⁹ Though the percentage changes may seem small for the cereal and walnut pollen, they indicate a serious reduction of agricultural production in the post-BOP period. Comparatively however, this is only the story of two cores and an incorporation of more data shows that a lack of revival wasn't the norm everywhere and that local variations would also have mattered. When comparing the older Gravgaz cores with that of SA06EP1 core, there is a noticeable difference for the end of the BOP phase. In the older cores, this seems to fall around the year intervals of AD 520-620 without interruption whereas the spike of reduced cereal and arboriculture in the SA06EP1 core suggests that there, it may have actually ended in AD 250 and picked up to values reduced but close to the BOP phase. If we discount this spike for the sake of an anomaly, arboriculture without cereal seems to continue in core SA06EP1 until AD 940, still surpassing the older Gravgaz phases. In these older cores, the pollen percentages of the cultivated trees at AD 1000 are significantly low and not as abundant as in the SA06EP1 core. While the coring sites are less than 500m away from each other at most, the results they portray are rather different. This is perhaps due to an immediately local difference between the two sites as the G96 core lays slightly southeast of the SA06EP1 core, and rests between two

²⁴⁹ Vermoere and others, p. 577.

mounds, possibly reducing some pollen transfer while the site of G99 rests closer but at the foot of a mound to its east.²⁵⁰

In terms of agricultural revival, both pollen diagrams point to a revival of cereal production after the BOP phases though the time and intensity in both cores differ substantially. The Gravgaz cores show a small revival of mostly cereal and some olive and manna ash cultivation starting at some point between AD 600-700 after which no other revival can be seen. The SA06EP1 core points to a serious revival of cereal and some arboriculture between the years of AD 940-1100 after which, cereal pollen largely disappears from the diagrams but arboriculture continues.

The seasonal lake of Çanaklı,²⁵¹ despite its lack of radiocarbon dates and less precise dating, also provides the same evidence as the Gravgaz cores.²⁵² While the SA06EP1 core shows a reduced but stagnant continuation of the arboriculture practices, the Gravgaz and Çanaklı cores show very little continuation of such practices after the end of their BOP phases somewhere between AD 520-620.²⁵³ Whether the fire event of AD 940 in SA06EP1 helped to register more pollen is a question left unanswered by the publishers of the data. If that is the case, then the revival of cereal practice and an interest in anthropogenic activity as visible in SA06EP1 between AD 940-1100 may not be

²⁵⁰ The different locations of the two cores is complicated by the fact that the early Gravgaz cores don't have coordinate values like SA06EP1. Luckily, they are locatable through hand drawn maps in the publication and compared as such. The present-day location of the SA06EP1 core is in functioning fields of agriculture and is in a more open area not directly between mounds or at the foot of one like cores G99 and G96.

²⁵¹ This seasonal lake is also published alongside the older Gravgaz cores and is located approximately 15-20km from the Gravgaz cores and 30km from the site of Sagalassos. See Vermoere and others.

²⁵² Izdebski, XVIII, p. 157.

²⁵³ Vermoere and others, p. 580.

as vigorous as expected. The lithological study of core G99 shows the existence of a black peat rich in plant material around the same time frame as the indicated fire, whether it was this peat that burned in the fire is also a question left untouched by environmental scientists of this area. Due to the differences in the cores, what can conclusively be said about the Gravgaz valley is certainly difficult. Both cores point to an evidence of a strong olive-oriented and cereal coupled BOP phase which seems to have diminished significantly in ratio by sometime around AD 600. Only core SA06EP1 supports the presence of arboriculture between AD 600 to AD 950 while all cores agree on the lack of cereal pollen in this period.

While the intensity of the revival is shown to diverge, it is an important factor to consider for the later periods between the 10th and 11th centuries especially since it represents a final cultivational interest in the region. A serious fire in AD 950 and an earthquake in the 7th century seems to have affected the agricultural regime of the Gravgaz valley, especially in the older cores which clearly show the end of the BOP phase in this period. Interestingly, however, the agricultural revival in the 10th century for core SA06EP1 seems to suggest that favorable humidity and weather conditions can incite anthropogenic activity similar to that of values near the low BOP phases. While evidence from the earthquake in the 7th century strongly supports the partial relocation of the area, core SA06EP1 shows a gradually declining but continuation of the arboriculture and an eventual return to cultivation at most a century and a half later when climatic conditions were more favorable.²⁵⁴ Due to local variance

²⁵⁴ Waelkens and others, CLXXI, p. 377.

however, this may not prove to be the case at other locations and this requires the examination of further data.²⁵⁵

The next set of data for the region of Sagalassos comes further than the Gravgaz cores in the Bereket basin. The site is located 10km to the southwest of the Gravgaz cores and approximately 25km to the ancient site of Sagalassos. The deviation in the dating of the core are at an average of ± 40 years with a deviation of ± 30 for some dated charred materials.²⁵⁶ The vegetational setting of the site is quite similar to the Gravgaz marsh with *Q. cocciifera* and *Juniperus excelsa* forming parts of the degraded woodland.²⁵⁷ Luckily, the Bereket basin has been studied by the same team who cored SA06EP1 at Gravgaz and therefore consistency between the discussion of Gravgaz and Bereket marshes is available together. The discussion of the Bereket marsh, much like the Gravgaz marsh, is separated into four different wet-dry phases; AD 250-650 (wet period), AD 650-950 (dry period), AD 950-1250 (wet period), and the 1250-present day (dry period).²⁵⁸ Much like Gravgaz, the pollen values of the Bereket core shows a diminishing practice of arboriculture at the second half of the 3rd century with the only major difference that at Bereket, olive cultivation ends in this period.²⁵⁹ As Gravgaz shows a resurgence of arboriculture and cereal after the decline at AD 250, the values of arboriculture in Bereket remain around 1-2% with only a slightly higher cereal representation of cereal. It is interesting to see that in this period, despite the favorable weather conditions,

²⁵⁵ Izdebski, XVIII, p. 157.

²⁵⁶ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 64.

²⁵⁷ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 61..

²⁵⁸ Bakker, Paulissen, Kaniewski, Poblome, and others, pp. 75–78.

²⁵⁹ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 70.

commonly known as the Roman Warm Period, stretching until the mid-7th century, BOP phase cultivation ends as early as mentioned. According to Bakker, this is possible the result of a regional or local environmental change, where moisture availability may have encroached upon arable lands. While this isn't the case in the Gravgaz record, the Bereket record shows a short revival of arboriculture pollen between AD 630-655 though cultivated trees in this time frame are not highly represented. For both the Gravgaz and the Bereket record, the mid-7th to mid-10th centuries presents a period of aridity with only slight, fluctuating cereal representation. In the Bereket basin, increasing signs of secondary afforestation and the large values of *Pinus* records towards the mid-10th century indicate the lacking cultivational interest that existed in the previous period.²⁶⁰ This period corresponds to the aforementioned Early Medieval Dry period in the discussion with the Gravgaz core and points to overall unfavorable weather conditions of harsher winters and drier summers.²⁶¹

²⁶⁰ Bakker, Paulissen, Kaniewski, Poblome, and others.

²⁶¹ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 435.

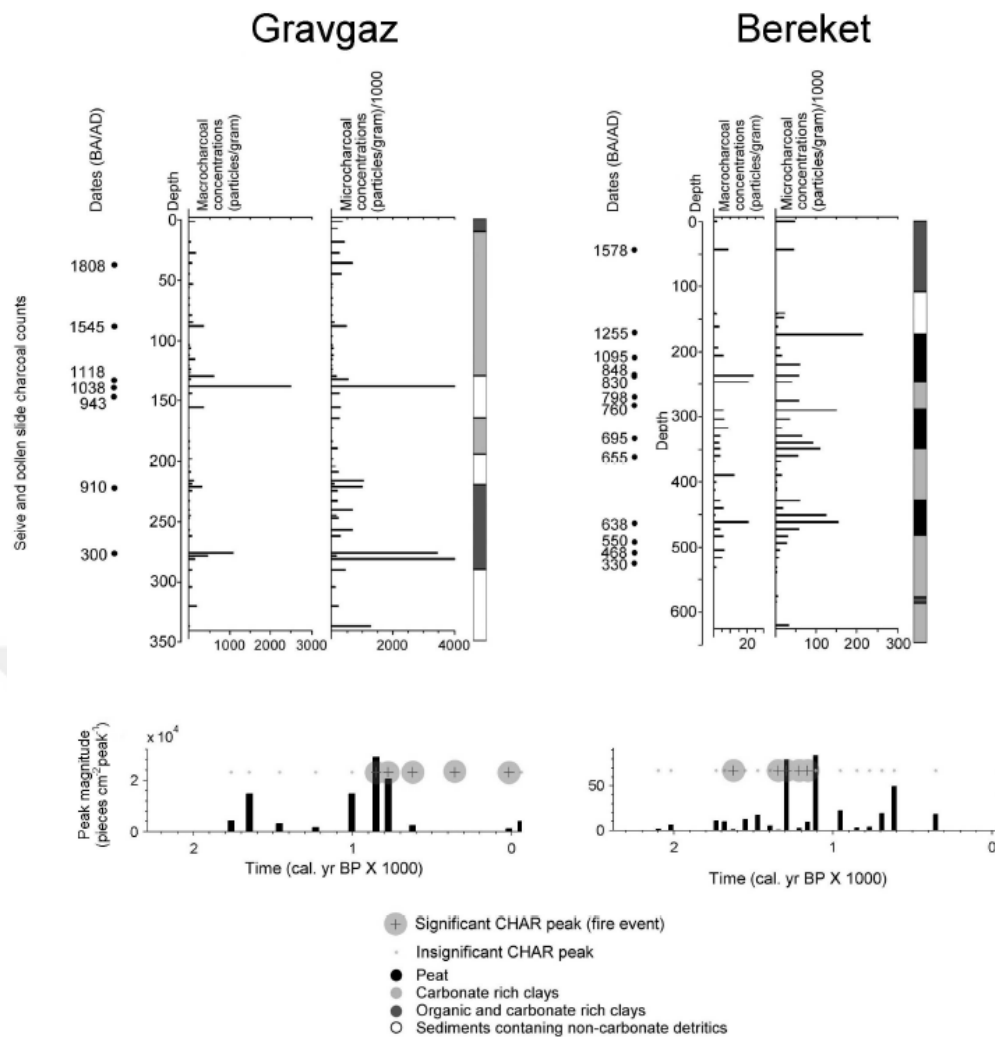


Figure 3. Comparison of the Bereket and Gravgaz Cores in Pollen Percentage.

Ref: Fuller and others; Johan Bakker, Etienne Paulissen, David Kaniewski, Jeroen Poblome, and others, 'Climate, People, Fire and Vegetation: New Insights into Vegetation Dynamics in the Eastern Mediterranean since the 1st Century AD', *Climate of the Past*, 9.1 (2013), 72.

One such proxy for understanding these general weather conditions are lake-level studies from the Dead Sea in Israel. High lake level values starting at around BC 100 seem to move to lower levels at approximately the mid-7th

century and show moderate to low levels again in the 12th century.²⁶² In fact, the stop in sudden anthropogenic indicators is also present in the same time period for the Dead Sea pollen records, suggesting a uniformity for the aridification for the environment.²⁶³ While this may be true for the Dead Sea, other proxies don't yield the same results in such uniformity. Ring tree data taken from various parts of European Alps and from the Russian Altai indicate that while c. AD 0-530 indicate the Roman Warm period, the 6th century moving forwards to the 11th century present the coldest time periods, the coldest time period being AD 536 to around 660.²⁶⁴ Though overall representing colder and unfavorable conditions referred to as the Late Antique Little Ice Age, the time frame with data from Sagalassos and the Dead Sea is a century younger than those of the tree ring data, indicating the regional difference for the study site. Even with proxies within Anatolia, the regional differences for indicating year-to-year variability for snow and rainfall must be under consideration.²⁶⁵ Often times, reconstructions of paleoclimate are done through analyses of the proportions of oxygen isotopes in carbonites ($d^{18}O$). Decreasing proportions of this value indicate that there was more rainfall in a given period.²⁶⁶ At Lake Nar, where $d^{18}O$ values can be considered as a proxy for regional water balance, show that the period between AD 301-561 corresponds with a time of lower

²⁶² Suzanne A G Leroy, 'Pollen Analysis of Core DS7-1SC (Dead Sea) Showing Intertwined Effects of Climatic Change and Human Activities in the Late Holocene', *Journal of Archaeological Science*, 37.2 (2010), 306–16 (p. 309).

²⁶³ Leroy.

²⁶⁴ Büntgen and others, p. 233.

²⁶⁵ Matthew D Jones, Melanie J Leng, and others, 'A Coupled Calibration and Modelling Approach to the Understanding of Dry-Land Lake Oxygen Isotope Records', *Journal of Paleolimnology*, 34.3 (2005), 391–411 (p. 401).

²⁶⁶ Izdebski, XVIII, p. 401.

water balance indicating drier summers and more winter-based precipitation.²⁶⁷

The time frame between AD 561-801 suggests that while there were significantly less summer droughts than in the previous period, significant winter snow was still present.²⁶⁸ Besides the indication of a stronger winter, the values which would indicate aridity are lower at the point between the mid-7th century to the mid-10th century than they appear in the Sagalassos region. In fact, besides a short dry event in AD 250, the regional vegetation at both Gravgaz and Bereket indicate high moisture availability up until AD 650 which the Nar record considers as period with the lowest water balance.²⁶⁹ This can indicate two things for the relationship between records from Sagalassos and the Nar lake. One such indication might be that Nar lake and the region of Sagalassos were experiencing quite different climatic events between the periods of AD 0 until 950 after which a convergence occurs. The second possibility may be that while the Sagalassos region also underwent similar weather conditions, production and cultivation of anthropogenic vegetation was still somehow manageable. While both are considerable suggestions, it is likely that the former is more possible since the climate of Sagalassos does match with other locations containing $d^{18}\text{O}$ data.

One such location for finding $d^{18}\text{O}$ values aside from lakes come from speleothem records found within caves. The Soreq cave in Israel is one of particular importance because of its proximity to the Dead Sea. Together they

²⁶⁷ Jonathan R Dean and others, 'Palaeo-Seasonality of the Last Two Millennia Reconstructed from the Oxygen Isotope Composition of Carbonates and Diatom Silica from Nar Gölü, Central Turkey', *Quaternary Science Reviews*, 66 (2013), 35-44 (p. 42).

²⁶⁸ Dean and others.

²⁶⁹ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 435.

act as regional indicators of weather in the eastern Mediterranean since the data from the Soreq cave is more accurate and frequently distributed spatially. With respect to data from Gravgaz and Bereket, the Soreq cave indicates that the amount of rainfall received began reducing significantly around AD 625, though water levels in the Dead Sea began lowering at AD 500, and entered their pre-dropped values somewhere in the 10th AD.²⁷⁰ This data fits better into the narrative of the Gravgaz and Bereket records as the mid-7th century until the mid-10th century corresponds to the substantial recession of anthropogenic activity in the Sagalassos region.²⁷¹ Likewise, the interest in anthropogenic activity in the mid-10th century is understandable since the Dead Sea, Soreq and Nar lake records point to better rainfall with more humid environments. The tree ring data in Europe also substantiates this evidence for favorable weather by showing less temperature anomalies in the period after the mid-10th century.²⁷² Climatic reconstructions denote this period as the Medieval Climate Anomaly (AD 850-1300), where significant changes in weather took place towards wetter climate conditions across Byzantine lands.²⁷³ In the Anatolian case, the favorable conditions of wetter climate last until the 12th century, after which $d^{18}O$ data begin to indicate the shift to drier weather climates.²⁷⁴ In the Sagalassos region, the implications of the Medieval Climate Anomaly (MCA) are also visible. The beginning of the MCA in the Bereket valley shows the

²⁷⁰ Ian J Orland and others, 'Climate Deterioration in the Eastern Mediterranean as Revealed by Ion Microprobe Analysis of a Speleothem That Grew from 2.2 to 0.9 Ka in Soreq Cave, Israel', *Quaternary Research*, 71.1 (2009), 27–35 (p. 32).

²⁷¹ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 76.

²⁷² Büntgen and others, p. 233.

²⁷³ Xoplaki and others, p. 246.

²⁷⁴ Xoplaki and others, p. 247.

resurgence of some cultivated trees (mostly being *Fraxinus ornus*) and cereal production. Though the total pollen percentage of the trees and cereals individually don't exceed 8%, it is a clear revival from the previous period.²⁷⁵ In the Gravgaz valley, the revitalization of the agriculture focuses significantly towards the production of cereals. Here, the values of cereal do exceed 10% and despite the amount of cultivated trees being certainly lower, there are still representations of *Olea*, *Juglans regia*, and *Castanea sativa*.²⁷⁶ This limited resurgence in the mid-10th century indicate that while an interest into cultivation did occur, it was likely that the larger focus was on livestock herding with limited cereal growth.²⁷⁷ The limited resurgence observed in the Bereket valley and at Gravgaz however end rather abruptly in the mid-12th century. The moisture proxies in this period don't indicate that there was a significant weather shift and for this reason, it can be assumed that this abrupt end is related more to extra-environmental factors which will be discussed in the following chapter.²⁷⁸

²⁷⁵ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 73.

²⁷⁶ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 432,434.

²⁷⁷ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 78.

²⁷⁸ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 82.

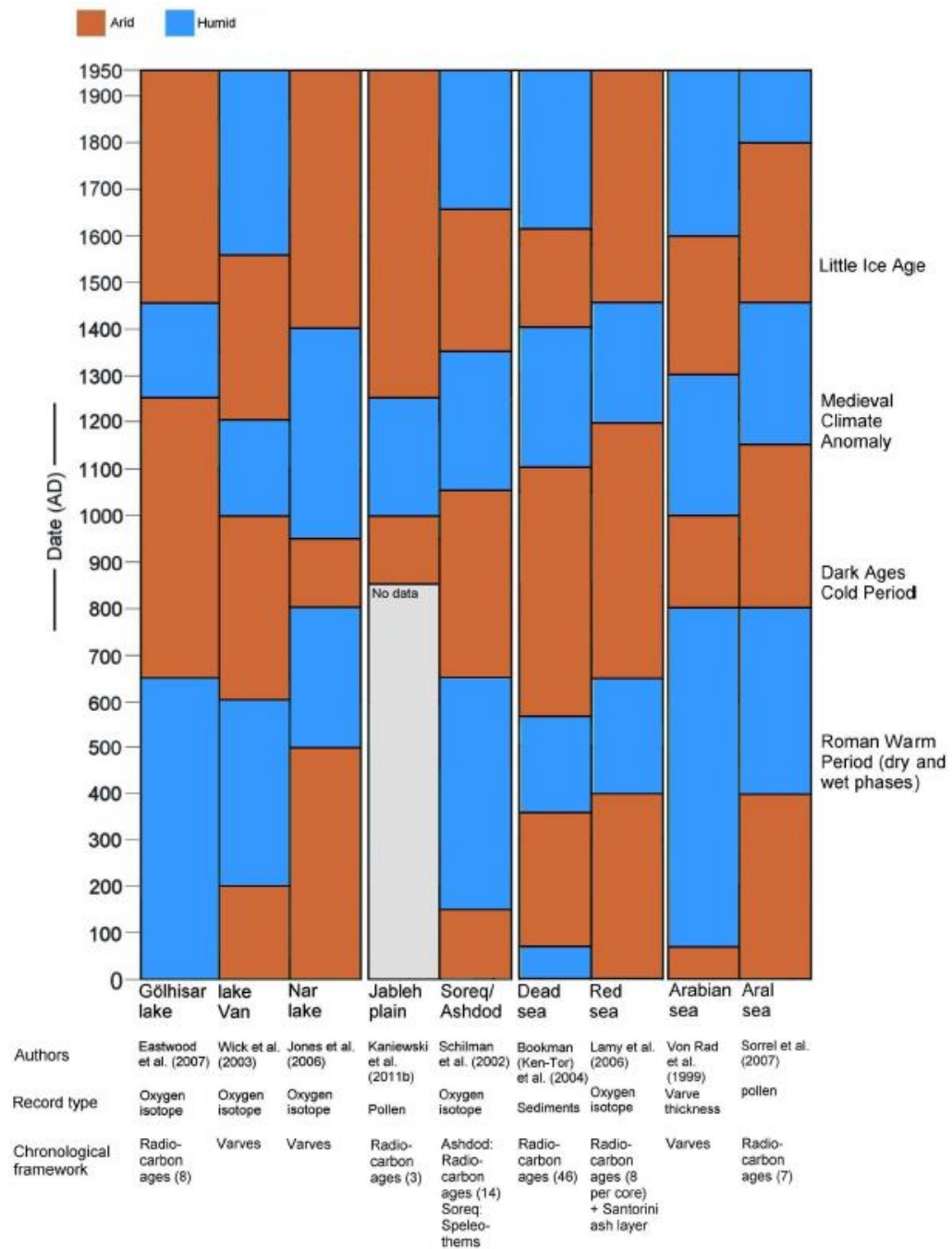


Figure 4. Comparison of the Warm and Wet Phases of Weather across the Mediterranean.

Ref: Fuller and others; Johan Bakker, Etienne Paulissen, David Kaniewski, Jeroen Poblome, and others, 'Climate, People, Fire and Vegetation: New Insights into Vegetation Dynamics in the Eastern Mediterranean since the 1st Century AD', *Climate of the Past*, 9.1 (2013), 60.

So far, the Bereket basin and the Gravgaz marsh produce some of the better dated and studied cores for the area of Sagalassos. While there are other cores in the general area of southwestern Turkey, they are not as suitable for such use in this thesis. The shortcomings of these cores are often due to their distance from the site, their understudied nature and sometimes the lack of carbon-dating which doesn't provide much information historically.²⁷⁹ Nevertheless, those cores that do have interpretable records ought to be discussed to illustrate some differences of anthropogenic activity with respect to the Sagalassos region. In the modern province of Antalya, there are three records from the lakes of Avlan, Elmalı, Söğüt, and Ova.²⁸⁰ While all of their data are available in the European Pollen Database (EPD), only the records from Söğüt and Ova are graphed and analyzed for better dating.²⁸¹ With regards to the Avlan and Elmalı cores, a lack of radiocarbon dates only allows for the understanding of vegetational changes that occurred in time. Especially in the records of Elmalı, higher values of cultivated trees like *Juglans* and manna ash are recorded for what would be the BOP phase.²⁸² This cultivational phase is followed by a rise in steppic indicators which later moves to the regeneration of *Pinus* and *Cedrus* forests. Adam Izdebski believes that this initial transition to steppic indicators may indicate

²⁷⁹ This is information taken from the EPD catalogs. See, 'European Pollen Database'.

²⁸⁰ This information is taken from the European Pollen Database which holds all of the pollen records of the cores as well as detailing information as to where the core was taken from. See <http://www.europeanpollendatabase.net/index.php>.

²⁸¹ 'European Pollen Database'.

²⁸² Roberts, 'Human-Induced Landscape Change in South and Southwest Turkey during the Later Holocene', p. 59.

the implementation of a pastoral phase tentatively dated to the late Antique or early Medieval period.²⁸³ Due to the lack of any dating however, when this agricultural shift happened is only speculative and based on regional trends so far observed.

The record from Ova lake is difficult to utilize for the Byzantinist since the dates fall for carbon date to the Hellenistic period and the other to the 12th century with low resolution. What can be observed is that at some point between AD 17-82 the BOP phase seems to end with the later Late Antique period showing small fluctuations of cereal pollen.²⁸⁴ The small size of the lake as well as its remoteness to possible settlements may indicate why the lake records so little information overall. Additionally, the place is likely to have been abandoned after the Hellenistic period in favor of other nearby settlements. In the province of Muğla, the lake of Köyceğiz, 95km northwest of Lake Ova also represents another agricultural regime in a coastal region of southwestern Turkey. This lake, unlike Ova however, has exceptionally relevant radiocarbon dates falling to the Late Antique and to the Late Medieval period. In the records, *Juglans* and *Olea* make a considerable presence among the cultivated along with values of cereal.²⁸⁵ The reduction of all three values falls somewhere between AD 131-271 indicating the end of the BOP phase at around the 3rd century. While cereal pollen remains consistent through the diagram, the values after the BOP phase only increase once over 1% at the start of the 7th century with

²⁸³ Izdebski, XVIII, pp. 177-78.

²⁸⁴ Izdebski, XVIII, p. 168.

²⁸⁵ Izdebski, XVIII, p. 173.

limited *Olea* revival.²⁸⁶ The lake itself is large and would therefore reflect a larger area in its agricultural trends. Possibly like the earthquake or fire at Sagalassos, an event may have relocated the inhabitants more to the hinterland and could explain such a late short revival in the 7th century. The production of cereal with limited olive and walnut could also indicate the same shift towards pastoralism that data has shown in the discussed analyses so far.

Lakes Elmalı, Avlan, Ova and Köyceğiz, with the exception of the first, represent the coastal area of southwestern Turkey, the common trend among them being that the BOP phases end sooner than as suggested in Bereket, Ağlasun and the Gravgaz marsh. Luckily, there are also records from cores in the hinterland closer to Sagalassos which can be used to see how they differ from the coastal ones discussed. Two such records come from the lakes of Söğüt and Gölhisar which are approximately 25km apart and approximately a 115km to the ancient site of Sagalassos.²⁸⁷ The chronology of Lake Gölhisar is long and most recent research has focused on the Holocene as a whole. For this reason, it is only possible to say that the BOP phase ends in this lake around the middle of the 7th or possibly earlier 8th century.²⁸⁸ Though not so visible in the pollen charts with high accuracy, the production surrounding this lake seems to have been focused around the production of cereals, possibly wheat and barley, as well as *Olea*.²⁸⁹ The same trend is visible for Lake Söğüt even though the date at

²⁸⁶ Izdebski, XVIII.

²⁸⁷ Roberts, 'Human-Induced Landscape Change in South and Southwest Turkey during the Later Holocene', p. 59.

²⁸⁸ Warren J Eastwood and others, 'Holocene Climate Change in the Eastern Mediterranean Region: A Comparison of Stable Isotope and Pollen Data from Lake Gölhisar, Southwest Turkey', *Journal of Quaternary Science*, 22.4 (2007), 327–41 (p. 330).

²⁸⁹ Roberts, 'Human-Induced Landscape Change in South and Southwest Turkey during the Later Holocene', p. 59.

which the BOP phase ends here is sooner than at Lake Gölhisar, between AD 400-450.²⁹⁰ A slight revival of cereal around the 9th century and a very limited reappearance of *Olea* is visible around the 11th century after which other anthropogenic indicators like *Vitis* occurs. Though finishing earlier in the BOP phase, the trends of cultivation in the earlier periods and after a hiatus in the Late Antique period match those of Sagalassos. The rise of *Plantago lanceolata* between the end of the BOP and the resurgence of cereal is also a possible indicator for pastoralism in this period.²⁹¹

Between the lakes of Gölhisar and Söğüt towards Sagalassos is the lake of Pınarbaşı, which is approximately 45km to the ancient site. The end of the BOP period in Pınarbaşı is not as late as in Gölhisar but still around the beginning of the 7th century, closer to the records of Bereket and Gravgaz which ended near the mid-7th century.²⁹² Much like the Bereket and Gravgaz records, a small revival is visible in the early mid-10th century, with slightly rising cereal and walnut values. What's more interesting however is that the pollen records suggest an agricultural regime where partially reforested areas were turned into herded meadows.²⁹³ Considering the cores of southwest Turkey and those in proximity to Sagalassos, only two other cores remain relevant to the site: the Karamık swamp and the Hoyran lake.²⁹⁴ The Karamık swamp is located nearly 90km north of the ancient city, but sadly, no study on its BOP phase or pollen

²⁹⁰ Izdebski, XVIII, p. 165.

²⁹¹ Izdebski, XVIII.

²⁹² Roberts, 'Human-Induced Landscape Change in South and Southwest Turkey during the Later Holocene', p. 60.

²⁹³ Izdebski, XVIII, p. 162.

²⁹⁴ Van Zeist, Woldring, and Stapert.

records has properly been done. Lake Hoyran, despite its one radiocarbon date is also not particularly helpful other than the information about the BOP phase ending somewhere between the 4th and 6th centuries.²⁹⁵

III.3 Conclusions (provisional)

Clearly, the study of these lakes has seen less attention than the cores of Gravgaz, Ağlasun and the Bereket valley. With limited lithological study and even with the lack of graphics and dates for the most of them, it is hard to make clear historical suggestions in the interplay between anthropogenic activity and their environment. Nevertheless, the preliminary studies conducted so far do enable some general understanding of the shifts in agricultural regimes in southwestern Turkey.²⁹⁶ An initial interesting trend that's easy to visualize is that agricultural production in the hinterlands continued for longer periods than in the coastal areas. Even with a large lake, like that of Lake Köyceğiz, the BOP phase ends in the 3rd century.²⁹⁷ This coastal pattern is even more evident when we consider Lake Ova, whose BOP phase is indicated to end even earlier at some point in the 1st century.²⁹⁸ A similar trend is also observed for the case of Avlan and Elmalı. When the cores move towards the hinterland, there is a

²⁹⁵ John F. Haldon and Arlene Rosen, 'Society and Environment in the East Mediterranean ca 300--1800 CE. Problems of Resilience, Adaptation and Transformation. Introductory Essay', *Human Ecology*, 46.3 (2018), 275–90 (p. 286).

²⁹⁶ Some examples of this are the work of Neil Roberts. See, Roberts, 'Revisiting the Beyşehir Occupation Phase: Land-Cover Change and the Rural Economy in the Eastern Mediterranean During the First Millennium AD'; Leroy and others.

²⁹⁷ Izdebski, XVIII, p. 173.

²⁹⁸ Izdebski, XVIII, p. 168.

clear change in the ending of the BOP phase to later periods. In the Bereket valley for instance, the end of the BOP phase ends near the mid-4th century.²⁹⁹ Lake Hoyran, far from the coastal areas has a BOP end date sometime between the 4th to the 6th century.³⁰⁰ The BOP phase in the cores of Gravgaz end in the mid-7th century, and the core from Ağlasun ends even later in the 11th century, though this may be the result of a limited chronology.³⁰¹ In this light, Lake Gölhisar presents an interesting case for here in fact the BOP ends in the 8th century, despite the near lake of Söğüt ending in the 5th century.

In the coastal areas, the vegetation patterns after the BOP indicate that human activity mostly abandoned the areas and let reforestation take its course; this is definitely the case in Avlan and Ova while Köyceğiz shows small signs of cereal revival later. The hinterland though shows an interesting shift towards pastoral activities once the BOP phases end. At Pınarbaşı, this grazing is indicated by a noticeable switch to forested meadows.³⁰² At Ağlasun, this is indicated by oak woodlands which are places where pig grazing is done.³⁰³ Some places, like at Gölhisar, this pastoral activity cannot be seen and gives way to reforestation indicating abandonment of agricultural activity.³⁰⁴ To varying degrees, this phase of pastoral activities is followed by a revival of the more complicated BOP-like agricultural regimes in the mid-10th centuries. Again, local variance is of importance as some places enter this phase earlier than

²⁹⁹ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 73.

³⁰⁰ Haldon and Rosen, p. 286.

³⁰¹ Bakker, Paulissen, Kaniewski, De Laet, and others, p. 259.

³⁰² Izdebski, XVIII, p. 162. 162.

³⁰³ Bakker, Paulissen, Kaniewski, De Laet, and others, p. 258.

³⁰⁴ Eastwood and others, p. 330.

indicated, as is the record of Söğüt in the ninth and tenth centuries.³⁰⁵ The ending of this revival phase in the area of southwestern Turkey indicates a clear and long end to the complicated agriculture that once took form in the BOP phase. In Söğüt, where this phase lasts the longest, this end is calculated sometime between the years of AD 1227-1365.³⁰⁶ In the Gravgaz and Bereket basin, this end is dated to the mid-13th century.³⁰⁷

Though hard to pinpoint with accuracy, a number of climate events have already been described to explain why these agricultural shifts may have occurred. In the Sagalassos region, a large earthquake in the seventh century would certainly have impacted the anthropogenic imprint in the region. A reduction of arboriculture at a fire event in AD 910 following a revival would also suggest that this fire may have been to support the pastoral activities at Gravgaz in this period.³⁰⁸ The resurgence of cultivated trees and more complex agriculture in the mid-10th century also corresponds to a more humid and favorable climate as indicated by the Soreq cave in Israel.³⁰⁹

Though we can clearly observe expansions and reductions of anthropogenic activity related to the setting of the contemporary environment, this relationship is not always as parallel as expected. As these are discrepancies that need explanation, the study of the historical and social events provide insight that environmental data cannot. For instance, one can easily observe that agricultural practices were largely abandoned in favor of pastoral ones despite

³⁰⁵ Izdebski, XVIII, p. 168.

³⁰⁶ Izdebski, XVIII.

³⁰⁷ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 74.

³⁰⁸ Bakker, Kaniewski, Verstraeten, De Laet, and others, p. 435.

³⁰⁹ Orland and others, p. 32.

no change in the favorable environment. This begs the question of how important environmental factors really are in determining social behavior. While the mid-7th century earthquake was in fact disruptive to the life in the city, an earlier earthquake in the 6th century did not hold the same weight.³¹⁰ In this light, a comprehensive environmental history must also account for those changes reflected in the environment which have their roots in social or political causes. It is indeed towards these to which I will now move to as the following chapter will be dedicated to sketching the possible non-environmental causes the society of Sagalassos underwent. I hope to show that a switch to agricultural practices did not necessarily indicate a decline in the prosperity of Sagalassos. Rather, that the switch was a conscious choice of the community to re-orient the economy of Sagalassos possibly more to its countryside.³¹¹ Additionally, the chapter will focus on how Sagalassos, despite unfavorable circumstances like the sixth century, was resilient and adaptive of their ecology.

³¹⁰ See, Luke Lavan, 'The Agora of Sagalassos in Late Antiquity: An Interpretive Study', *Late Antique Archaeology*, 9.1 (2012), 289–353.

³¹¹ Though argued fully later on, the numbers of livestock specimen presented in time of the earthquake are testimony to the re-orientation of the economy. See, Fuller and others.

Chapter Four:

Environmental History at Sagalassos

*“Ab Sagalasso Conditā”*³¹²

IV.1 Surveying Sagalassos’s environment

The excavations at the site of Sagalassos began in 1990 with the Katholiek Universiteit Leuven under the direction of Marc Waelkens.³¹³ Since its inception, the project has had a conscious goal to realize an excavation that would encompass a holistic approach through the use of multidisciplinary archaeology.³¹⁴ Included within this multi-strategy is the use of excavational and survey archaeology, archaeobotany, zooarchaeology, ceramology, and of course palynological studies. As a result of such extensive work in as wide a remit as encompassed by the project, the literature on Sagalassos, especially archaeological, is quite abundant and extant.³¹⁵ Fortunately, the abundance of such research presents an opportunity to expand upon the knowledge that environmental analysis of Sagalassos has to offer. In this light, the purpose of this chapter is to add further insight into the environmental narrative of the

³¹² “From the Founding of Sagalassos”

³¹³ Lavan, p. 289.

³¹⁴ Poblome, Braekmans, Waelkens, and others, p. 527.

³¹⁵ Some of these include; Waelkens, 1; Walkens and Poblome; Waelkens, ‘Sagalassos, Archaeology Of; Inge Uytterhoeven and others, ‘Late Antique Private Luxury: The Mosaic Floors of the Urban Mansion of Sagalassos (Ağlasun, Burdur – Turkey)’, in *Jahreshefte Des Österreichischen Archäologischen Institutes in Wien*, ed. by Erich Kistler, Birgit Öhlinger, and Marion Steger, 2013, pp. 373–407.

case of Sagalassos, but with a special focus on the more social and human elements not yet discussed.

The environmental case of Late Antique Sagalassos is particularly interesting for the fact that it includes two kinds of visible changes. The first of these changes are those that directly relate to environmental factors, such as the adaptation of the society to the effects of a detrimental earthquake or the presence of increased farming during favorable weather conditions.³¹⁶ The second of these changes however are based off of conscious social decisions less related to environmental concerns though they affect the environment nevertheless. In the case of Sagalassos, examples of this second kind exist in the changing of urban settlement patterns, the practice of pastoralism over intense arboriculture and even the preference of pig consumption over cattle and sheep at different periods in Late Antiquity.³¹⁷ While such shifts may originally be influenced by causes beyond control, they are often the result of changes pertaining more to political, social or market variables. Since this chapter also aims to incorporate and explain these second type of changes in Sagalassos, it relies on a better understanding of the archaeology of Sagalassos and its *chora* so as to relate to those political, social and market practices which influence these changes.

³¹⁶ Manuel Sintubin and others, 'Seismic Catastrophes at the Ancient City of Sagalassos (SW Turkey) and Their Implications for Seismotectonics in the Burdur--Isparta Area', *Geological Journal*, 38.3–4 (2003), 359–74 (p. 359).

³¹⁷ The issue of cattle, sheep and ovacaprines raising is an important one for Sagalassos due to the large number of faunal remains found on site. See, Delphine Frémondeau and others, 'Diversity in Pig Husbandry from the Classical-Hellenistic to the Byzantine Periods: An Integrated Dental Analysis of Düzen Tepe and Sagalassos Assemblages (Turkey)', *Journal of Archaeological Science: Reports*, 11 (2017), 38–52.

Emphasis is therefore placed under those projects of Sagalassos that relate to these three fields most closely.³¹⁸ As such, the most relevant topics of discussion for this research are the ceramological, zooarchaeological, settlement archaeological, and excavational finds related to the reshaping of the landscape for adaptation and those that display social resilience. Incorporating the research from these fields together will not only provide a more comprehensive understanding of Late Antique Sagalassos but also one that supports a narrative of the dynamic changes that the Late Antique society underwent.³¹⁹ Each field of research designated above will be mentioned in relation to the chronological progression of the chapter, beginning from the earliest period of the settlement to the major shift of settlement in the mid seventh century. Afterwards, a more general discussion will hold so that the changes the city underwent with respect to those fields is better understood.

IV.2 A History of Sagalassos and its *chora*

The territory of Sagalassos rests in what is known today as the Ağlasun Valley. Systematic settlement in this valley, including the settlement of Sagalassos and Düzen Tepe (an earlier settlement 1.8km apart from the former) is assumed to

³¹⁸ Fuller and others; Poblome, Braekmans, Waelkens, and others; Inge Uytterhoeven and others, 'Urban Housing in the Pisidian Town of Sagalassos (Burdur, Turkey)' (Österreichische Akademie der Wissenschaften; Vienna, 2010), xviii.

³¹⁹ Dries Daems and Jeroen Poblome, 'Adaptive Cycles in Communities and Landscapes: The Case of Sagalassos and Düzen Tepe during the Classical–Hellenistic Period', *Archaeological Review from Cambridge*, 31.2 (2016), 91–107.

have started around the latter 5th century BCE.³²⁰ Like Düzen Tepe, it is possible that Sagalassos may also have formed at an earlier date than the Classical period though most evidence based on ceramics show that the Classical and Hellenistic pottery are those the most represented.³²¹ Incidentally, this parallels well with most of the existing literary sources of Sagalassos which pertain largely to the Classical and Antique periods and become rather scarce after the early imperial period.

What we do know of Sagalassos in the literary sources though is that it appears for the first time in the pretext of Alexander the Great conquests in Asia Minor. The *Anabasis* of Arrian writes that during the conquering of Phrygia, “[Alexander] moved on to Sagalassos, also a fairly large city, inhabited by Pisidians, the most warlike of this warlike tribe.”³²² While only a brief mention, the post-Alexandrian finds of Corinthian capitals in the site show that Sagalassos was certainly visited by Alexander and had come under Seleucid influence until 188 BCE. After this period, a number of different cultural influences, particularly visible in architecture, indicate a change of rule from Seleucid to that of the Attalids. Indeed, Attalid cultural influence can certainly be seen through the use of sculpting styles found within Sagalassos.³²³ Roughly a century and a half later, we know that the Roman client king Amyntas, created by Marc Antony for ruling of Galatia, had control of the city between 39-25 BCE and promoted an urban expansion to the south and to newer eastern

³²⁰ Waelkens, ‘Sagalassos, Archaeology Of’, p. 3.

³²¹ Waelkens, ‘Sagalassos, Archaeology Of’, p. 3.

³²² Arrian, *Arrian, with an English Translation By E. Iliff Robson. Anabasis Alexandri (Books I - IV)*, ed. by E. Iliff Robson (Massachusetts: Harvard University Press, 1929), I, p. 115.

³²³ Waelkens, I.

residencies. Here, as proof of Amyntas' rule, we rely on the words of Strabo's *Geography* which writes that, "Sagalassus is under the command of the same Roman governor, to whom all the kingdom of Amyntas is subject [...] It has the name also of Selgessus. It was taken by Alexander."³²⁴ From the period starting from the rule of Amyntas, the practice of issuing bronze coins continued throughout the Roman Imperial period when Emperor Augustus incorporated Sagalassos and Galatia into the empire from 25 BCE.³²⁵ Sources on Sagalassos in this period also shed light on the question of Sagalassos' loyalty to the Romans. Titus Livy, in the *Ab Urbe Condita* recalls an episode with regards to the stubborn nature of Sagalassos' recognition of a Roman consul. Livy writes,

"Its Pisidian inhabitants are by far the best soldiers in that part of the world. Their military superiority, the fruitfulness of their soil, their large population, and the situation of their exceptionally strong city make them a brave people. As no envoys appeared when the consul reached their frontiers, he sent out plundering parties into their fields. At last, as they saw their crops carried off and their cattle driven away, their stubbornness yielded."³²⁶

Likewise, the only other direct mention of Sagalassos in this period is by Polybius in his *Histories*. Albeit a little more detail is added to Livy's account whereby the consul (Cnaeus Manlius Vulso) makes peace with the locals only after "accepting a compliment of fifty talents, twenty thousand *medimni* of barley, and twenty thousand of wheat."³²⁷ After this point, Sagalassos no longer seems to appear in any of the literary sources directly. The only exception

³²⁴ Strabo, *The Geography of Strabo*, ed. by Hans Claude Hamilton and Falconer William, *Henry G. Bohn* (London: H. G. Bohn, 1857), I, p. 12.6.5.

³²⁵ Waelkens, 'Sagalassos, Archaeology Of', p. 7.

³²⁶ Titus Livius, *The History of Rome*, ed. by Canon Roberts (London: J. M. Dent & Sons, 1905), p. 38.15.

³²⁷ Polybius, *The Histories of Polybius: Translated from the Text of F. Hultsch*, ed. by Evelyn S. Shuckburgh (Cambridge: Cambridge University Press, 2012), II, p. 21.36 <<https://doi.org/10.1017/CBO9781139333757>>.

becomes Ptolemy's mention, in his *Geography* (circa AD 150), of Sagalassos as being a settlement in the Lycian region (border to Pisidia).³²⁸ What we know nevertheless is that Sagalassos did not disappear as a settlement but actually grew quite rapidly. Its mentions within the text of the Classical and Antique sources are helpful in highlighting the attention that Sagalassos received from Imperial oversight. While the scarcity of sources after the Imperial period do present certain problems, it works in favor of what this thesis tries to achieve. Despite the lack of literary sources, with the *De Thematribus*, a 10th century source detailing the origins of the Byzantine provinces, virtually being the last one generally mentioning Pisidia,³²⁹ the use of archaeological evidence, environmental data, and material culture is what really sheds light in the case of Sagalassos. The following section will show how active and resilient urban life at Sagalassos was despite the absence of sources and will show that not only did Sagalassos not disappear after the Imperial period, but on the contrary, continued to grow well into Late Antiquity and beyond.

IV.3 Material culture and urban fabric

By referring not only to the literary sources, and therefore the discrepancies that revolve around their absence, this thesis aims to avoid the traditional yet

³²⁸ The only place that I had access to for the work of Ptolemy both translated and containing the contents of Book V was this online repository; See; Bill Thayer, 'Ptolemy's Geography — Book V, Chapter 3' <https://penelope.uchicago.edu/Thayer/E/Gazetteer/Periods/Roman/_Texts/Ptolemy/5/3*.html> [accessed 16 November 2020].

³²⁹ Porphyrogenitus, III.

unproductive debate of continuity and discontinuity in late antique cities.³³⁰

While it is easy to make the inference that the lack of sources means that Sagalassos received less attention than before, this would clearly become a problem once the material culture and archaeological remains are discussed. As such, considering questions of settlement pattern (both rural and urban) in the *longue durée* and especially avoiding historiographical simplistic definition of “crisis and decline” (like the seventh to ninth century Dark Ages) requires us to use novel concepts of transition, marked by a change of the settlement’s functions, and resilience, as a measure of societal adaptation to provide more fruitful discussions.³³¹ Once the focus has shifted more on assessing what has changed, rather than what has gone, different methodologies, like that of environmental history can better make their contribution into discussions of historical narratives. In this light, the following discussion of Sagalassos will take place through lens of archaeological, material and environmental investigations.

Archaeologically we can see that Augustus’ incorporation of Sagalassos into the empire gave way to a phase of major monumental building campaign and economic boom that placed Sagalassos as one of the greater cities of Pisidia.³³² The quickly growing and enlargement phase that followed after the incorporation of Sagalassos into the *provincia Galatia* owes itself to population

³³⁰ Decker, *The Byzantine Dark Ages*, p. 117.

³³¹ Forthcoming; Luca Zavagno, ‘A Lost World Than Never Died.’ *Islands and Their Urban Landscapes in Byzantine Western Mediterranean in the Passage from Late Antiquity to the Middle Ages*, 2021, p. 11; Decker, *The Byzantine Dark Ages*, pp. 81–154.

³³² Eva Kaptijn and others, ‘Societal Changes in the Hellenistic, Roman and Early Byzantine Periods. Results from the Sagalassos Territorial Archaeological Survey 2008 (Southwest Turkey)’, *Anatolian Studies*, 63 (2013), 75–95 (p. 90).

growth and consequently, market demand. The increasing population in Sagalassos is an estimation based on a number of *coloniae* (settlements) that Augustus gifted his veterans in the Anatolian region of Pisidia.³³³ While we don't have an exact reference to Sagalassos, the *Res Gestae Divi Augusti* does have a reference to Augustus' efforts in promoting colonies in Pisidia and other Anatolian regions.³³⁴

Though there are many difficulties when assessing population rates for settlements in Late Antiquity, a safe estimate for the population of both the urban and rural settlers in Imperial Sagalassos falls somewhere between 6,000 - 25,000 people.³³⁵ Under optimal subsistence production though, it is estimated that the area could have easily sustained up to 40,000 people in number.³³⁶ The clear land use at Sagalassos as indicated by the pollen data of the previous chapter supports the possibility that higher numbers are indeed a legitimate possibility.³³⁷ Besides the agricultural indicators, growing population is also reflected by the pottery evidence. Such an influx of people into the region would undoubtedly have promoted the wide-spread production and sale of the Sagalassos table wares. As such, the large number of ceramic finds indicates an increased interest in Sagalassos' pottery by a larger demographic. These products, which have been labelled as Sagalassos Red Slip Ware (SRSW), had

³³³ Waelkens, 'Sagalassos, Archaeology Of'.

³³⁴ Caesar, p. 28.

³³⁵ Rinse Willet and Jerome Poblome, 'The Scale of Sagalassos Red Slip Ware Production - Reconstructions of Local Need and Production Output of Roman Imperial Tableware', *Adalya*, 18 (2015), 133-57 (p. 139).

³³⁶ Willet and Poblome, p. 139.

³³⁷ Bakker, Paulissen, Kaniewski, Poblome, and others.

likely become the major export of the economy in the reign of Augustus.³³⁸

Possibly, production grew to such extents that it required the migration of ware production from the older Hellenistic kiln to another area of the site known appropriately as the Potter's Quarter.³³⁹ In short, this rise in demographic, imperial attention, and rising market demands greatly expanded the city both economically and in physical size.

From the 1st century AD onwards, Sagalassos nearly quadrupled in surface area to around 31.5 ha, expanding to the south and to the east where a whole new residential quarter was planned out.³⁴⁰ Many buildings, which were modified or rebuilt in the Late Antique period have also been regarded as originally built in the 1st century. For instance, the impressive palatial mansion with as many as 50 rooms in one courtyard of Sagalassos is thought to have been reused from a 1st century AD civic building.³⁴¹ Another example is that of a suburban clubhouse (*schola*), again with public function erected in the mid-1st century AD.³⁴² The Odeon close to the old Hellenistic kiln also began its construction in this period and could account for one reason why the kiln was

³³⁸ See also for their distribution range; Jeroen Poblome, Patrick Degryse, Willy Viaene, and others, 'The Concept of a Pottery Production Centre. An Archaeometrical Contribution from Ancient Sagalassos', *Journal of Archaeological Science*, 29.8 (2002), 873–82.

³³⁹ The older Hellenistic kiln is in poor condition so little information about its size and output are hard to determine. Nevertheless, the pottery there is mostly dated to Classical and Hellenistic pieces possibly making it the oldest kiln on site. See, Jeroen Poblome, Dennis Braekmans, Branko Music, and others, 'A Pottery Kiln underneath the Odeon of Ancient Sagalassos. The Excavation Results, the Table Wares and Their Archaeometrical Analysis', in *Networks in the Hellenistic World According to the Pottery in the Eastern Mediterranean and Beyond*, ed. by Nina Fenn and Römer-Strehl Christiane (Archaeopress, 2013), pp. 193–204.

³⁴⁰ Uytterhoeven and others, xviii, p. 295.

³⁴¹ Marc Waelkens and others, 'Two Late Antique Residential Complexes at Sagalassos', in *Housing in Late Antiquity*, ed. by Luke Lavan, Lale Özgenel, and Alexander Sarantis, Late Antique Archaeology (Brill, 2007), 3.2, 495–513 (p. 495).

³⁴² Claeys and Poblome, p. 5.

also abandoned.³⁴³ In addition to such buildings and amenities, a lot of effort was meticulously spent on urban infrastructures. The expansion to the south and the east in this period required the building of roads and promoted monumentalized walkways.³⁴⁴ Among these projects were also initiatives to set up shops along these walkways which act as good indicators of the rising economic importance of Sagalassos.³⁴⁵ Additional infrastructural buildings included two new aqueducts dated to the Augustinian period for supplying the southern and eastern expansions of the city.³⁴⁶ For aesthetic purposes, three porticoes were also erected to the east, south and west of a square leading towards the Upper Agora.³⁴⁷ Though following periods in Sagalassos also saw major expenses spent on behalf of the city during *Pax Romana*, the first century AD really sets the foundation for the larger urban site that Sagalassos had become.

From the 1st to the 5th century, large building projects of fountains, aqueducts, roads and pavement programs continued, reaching their peak after the rule of Emperor Hadrian (117-138) in the beginning of the 2nd century AD. This building boom is believed to have been caused by Emperor Hadrian's acceptance of Sagalassos as the *neokoros* (a rank dedicated to cities with temples for the imperial cults of Rome) of Pisidia and honored the city as the "first city of Pisidia, friend and ally of the Romans."³⁴⁸ Such an honor was one that the city

³⁴³ Poblome, Braekmans, Music, and others, p. 193.

³⁴⁴ Waelkens, 'Sagalassos, Archaeology Of', p. 7.

³⁴⁵ Femke Martens, 'Late Antique Urban Streets at Sagalassos', in *Technology in Transition A.D. 300-650*, ed. by Luke Lavan, Zanini Enrico, and Alexander Sarantis (Brill, 2008), iv, 321-65 (p. 329).

³⁴⁶ Waelkens, 'Sagalassos, Archaeology Of', p. 8.

³⁴⁷ Talloen and Poblome, p. 130.

³⁴⁸ Waelkens, 'Sagalassos, Archaeology Of', p. 14.

took seriously so much that they imprinted it onto their coins until the 5th century.³⁴⁹ The impact of imperial support on Sagalassos is well represented by all of the statues, arches and nymphaea dedicated to the emperors by the local elites.³⁵⁰ It must have been through such local funding in the region, partly since Roman troops were at the Syrian border by the 3rd century and Sagalassos could have aided them, that the expense of such building was paid for.³⁵¹

Like in many other cities, these projects were commissioned by the local elites. As some of these reconstructions required the destruction of older monuments and replacing them, it is clear that the elites of Sagalassos highly considered their urban space as more than just a place of living but also for flaunting their wealth.³⁵² Since there is also no evidence of any reduction in the rural settlement patterns at Sagalassos during the "3rd Century Crisis," it is assumed that the continuing success and prosperity of Sagalassos resumed.³⁵³ This rising prosperity lasted until the latter 5th century, when a number of important changes occurred both on site and in the Sagalassos region.

Shortly, arguments have stressed that the region of Sagalassos from the 4th century to the 6th century witnessed to "a reduction in the overall number of sites, an increased tendency toward nucleated settlement, a new emphasis on strategically located settlements, and the establishment of rural churches."³⁵⁴

³⁴⁹ Marc Waelkens, 'Hadrian and the "Neokoria" of Sagalassos', in *Pisidia Yazıları Hacı Ali Ekinci Armağanı: Pisidian Essays in Honour of Hacı Ali Ekinci*, ed. by Hüseyin Metin and others (Ege Yayınları, 2015), pp. 177–214 (p. 190).

³⁵⁰ See of example; Waelkens, 'Hadrian and the "Neokoria" of Sagalassos'.

³⁵¹ Hannelore Vanhaverbeke and others, 'Late Antiquity in the Territory of Sagalassos', *Late Antique Archaeology*, 2.1 (2004), 247–79 (p. 251).

³⁵² Waelkens, 'Hadrian and the "Neokoria" of Sagalassos', p. 191.

³⁵³ Poblome, p. 102.

³⁵⁴ Vanhaverbeke and others, p. 247.

Though these changes in settlement pattern may seem to present a narrative of decline or a period in stark contrast to that of Classical prosperity, this would be a misconception in the case of Sagalassos. The beginning of this chapter proposed two kinds of visible change patterns at urban environment. In the 5th century, it is clear that Sagalassos shows a conscious choice towards the reduction of its sites and establishment towards nucleated settlements. A strong argument for the continuing stability, as opposed to the decline of Sagalassos, however, can be seen through three differing examples: the extensive rebuilding projects of the city, the revival of pottery diversity, and a switch to a more pastoral economy based on a social rather than an environmental decision.

In the very beginning of the 6th century, geological evidence shows that the area was hit by a sizeable earthquake which damaged a number of large monuments.³⁵⁵ Though not all of the reconstructions necessarily relate to this earthquake, a number of fairly large ones in the Lower Agora do. Here, a large rebuilding process of the main staircase with limestone and general maintenance around the porticoes were found.³⁵⁶ Additionally, the eastern portico shops also seem to have been rebuilt around this period though the date is less certain. The Roman Baths and the so-called Palatial mansion which were also damaged had also undergone major repairs alongside some of the earlier mentioned nymphaea in the city.³⁵⁷ Although one could argue that the repairing and building glamour of the first to fifth centuries in Sagalassos were certainly not as present, these examples still suggest that there was continuity of urban

³⁵⁵ Waelkens and others, CLXXI, p. 377.

³⁵⁶ Lavan, p. 296.

³⁵⁷ Vanhaverbeke and others, p. 252.

settlement into the late 6th century. Beyond just the repairing of the city was also a clear attempt by the local elites to redecorate their forums and walkways by reusing statues and collections from other urban settings as well as their personal homes.³⁵⁸ In this light, it may be more appropriate to think of these changes at Sagalassos through a perspective of the urban functions.³⁵⁹

The transformation of the *bouleuterion* into a new church in the 5th century is of one such example.³⁶⁰ As the intended function of the city changes, so do the constructions which also form the urban landscape of the city. A 5 meter wide white marble staircase to the agora from the atrium of the new church also demonstrates a newer power dynamic in the city; namely, the political engagement of the bishop.³⁶¹ It was possible that because of the change in the urban government where the new leading citizens of a city were no longer just elite citizens but also included the bishop, clergy and landowners, the city's functional interests switched to other directions.³⁶² Meanwhile the removed importance of the title of *neokoros* and of the festivities at Sagalassos may have reduced the importance of Sagalassos as a center of the Pisidian region and may have forced the leaders of Sagalassos to think of their city function with more utility.³⁶³ This theory also seems plausible when viewed from the perspective of the ceramic output at Sagalassos between the 4th and 6th centuries.

³⁵⁸ Ine Jacobs and Lea Stirling, 'Re-Using the Gods: A 6th-c. Statuary Display at Sagalassos and a Re-Evaluation of Pagan Mythological Statuary in Early Byzantine Civic Space', *Journal of Roman Archaeology*, 30 (2017), 196–226 (p. 214).

³⁵⁹ Ine Jacobs, 'From Early Byzantium to the Middle Ages at Sagalassos', in *The Long Seventh Century. Continuity and Discontinuity in an Age of Transition*, ed. by Alessandro Gnasso, Emanuele E Intagliata, and Thomas J MacMaster (Peter Lang, 2015), pp. 163–98; Jacobs and Stirling.

³⁶⁰ Lavan, p. 345. 345.

³⁶¹ Lavan.

³⁶² Vanhaverbeke and others, p. 253.

³⁶³ Waelkens, 'Hadrian and the "Neokoria" of Sagalassos', p. 202.

A study on the production size of the Sagalassos Red Slip Ware (SRSW) found that the production of table wares was not aimed at exporting to markets outside the immediate region, but rather as a market to work closer to the vicinity of Sagalassos.³⁶⁴ Earlier in the chapter, it was made clear that Sagalassos and Düzen Tepe had some form of connection with each other through faunal isotope investigation.³⁶⁵ Naturally, these connections would also have been made with other settlements in the nearby valleys. One such informative connection is that of a ceramological link between Sagalassos and the settlement of Kozluca in the Bereket Valley. Here, ceramic evidence points to a trading link between the two settlements as early as the Hellenistic period. Investigation of the ceramic evidence shows that in Kozluca, the relationship intensified during the production and sale of the SRSW in the 1st century AD.³⁶⁶ Surveys towards the Bereket Valley in a number of sites has also shown that the most common pottery shards of the periods discussed in this paper are from Late Roman to Early Byzantine wares (300-600 AD).³⁶⁷ Besides the obvious trade network, these shards may also indicate arable land in the region for which the Bereket pollen core of the previous chapter discusses.³⁶⁸

Though further surveys might yield differing results, the evidence so far on the production and distributed sale of the SRSW is consistent throughout. As

³⁶⁴ Willet and Poblome, p. 146.

³⁶⁵ Fuller and others, p. 160.

³⁶⁶ Kaptijn and others, p. 90.

³⁶⁷ Ralf Vandam, Patrick Willet, and Jeroen Poblome, 'Living on the Margins: First Results for the Derekoy Archaeological Survey of the Sagalassos Project in the Western Taurus Mountains', in *The Archaeology of Anatolia Vol. 2* (Cambridge, 2017), pp. 316–41 (p. 321).

³⁶⁸ The practice of linking pottery sherds as being mixed with the manure for arable land is a common understanding for the Medieval world. See, Richard Jones, 'Signatures in the Soil: The Use of Pottery in Manure Scatters in the Identification of Medieval Arable Farming Regimes', *Archaeological Journal*, 161.1 (2004), 159–88.

mentioned already, the Sagalassos Red Slip Ware was produced in the Augustinian period from clay found near the Potter's Quarter on the site.³⁶⁹ The production outputs of the SRSW seem to be closely in line with the architectural boom of Sagalassos from the 1st to the 5th century. The success of the SRSW in the earlier period as a monopoly of tablewares in Pisidia may owe itself to a combination of various reasons which diminished and left the trade no longer in control. One of the biggest boosts to the SRSW industry would likely have come from the influx of people sent by Augustus to the newer *coloniae* in Pisidia. With such a population, good impressions of the tablewares may have impressed the nearby regions and with settlements where trade relations had already been set. Additionally, the building boom of this period as well as clear signs of lucrative crop cultivation may have increased the purchasing power enough for more to buy the slip ware if they were slightly expensive. This may be a possibility as the quality of the SRSW continued to be maintained by use of the same good clay type since its first production.³⁷⁰

Furthermore, being a city which hosted festivities of the imperial cult and other imperial attention, it is also likely that the tablewares were sold as neighboring peoples came to the town for such events.³⁷¹ Interestingly, after the boom phase, despite the ongoing production of the SRSW, neighboring communities like the Bereket Valley opt out of buying the products in favor of another form of tableware from an unknown origin referred to as the Red Slip

³⁶⁹ Poblome, Braekmans, Waelkens, and others, p. 532.

³⁷⁰ Poblome, Degryse, Viaene, and others, p. 876.

³⁷¹ Willet and Poblome, p. 146.

Ware (RSW).³⁷² This shift in the mid-4th century in which the Bereket valley stops purchasing the Sagalassos wares is a period in the pollen diagrams which reflects the immediate shift from agricultural to pastoral activities in that area.³⁷³ In the representations of shards from urban excavated finds, this also corresponds to the lowest density of Phase 6 (AD 300–350/75) and Phase 7 (AD 350/75–450/75) wares.³⁷⁴ Under initial impression of this data, one might make the conclusion that production in Sagalassos greatly decreased and that the Bereket valley opted out of buying for such lack of supply. Upon further analysis though, one can see that the urban survey data of Sagalassos (as opposed to the excavated) shows that this period contains the second highest density of shards.³⁷⁵ In this regard, the choice of rural communities, like that of the Bereket valley, opting out of the SRSW may be less indicative of Sagalassos' production numbers and more indicative of the active choice of rural communities to buy other wares. After all, ceramic finds reveal that the SRSW was produced in the city of Sagalassos until the middle of the 6th century and later moved to another unknown location until the last major occupational phase of the city.³⁷⁶ While the previous chapter has shown that the switch to pastoral economies take place in later periods, around the 6th-7th centuries, the Bereket valley does so at a much earlier date.³⁷⁷

³⁷² Kaptijn and others, p. 91.

³⁷³ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 73.

³⁷⁴ Jeroen Poblome, Rinse Willet, Nalan Firat, and others, 'Tinkering with Urban Survey Data. How Many Sagalassos-Es Do We Have?', in *Archaeological Survey and the City* (Oxbow Books, 2013), pp. 146–74 (p. 152).

³⁷⁵ Poblome, Willet, Firat, and others.

³⁷⁶ Waelkens, 'Sagalassos, Archaeology Of', p. 24.

³⁷⁷ Kaptijn and others, p. 92.

The visible shift to pastoral activities in the Bereket valley in the mid-4th century as the date in which wares are no longer bought indicates an important dynamic between the city and the rural settlements. Though difficult to claim with certainty, production at Sagalassos may not have been the primary factor for the rural communities in stopping their purchases. If indeed the end of the BOP phase indicates a lesser influx of wealth, then the purchasing power of those in the Bereket valley may have limited them from buying the Sagalassos wares. A complication to this story however, rests in the fact that it is really the mid-4th century SRSW wares which are the least datable with precision and a paucity of materials is notable.³⁷⁸ In this sense, a clear picture isn't presented as to how normal or abnormal the situation was for Sagalassos.

Nevertheless, despite not having an exact date, an effort was also made around the 4th century to launch a new set of tablewares including wine amphorae. Seeing as the rural communities bought these amphorae as opposed to other wares from Sagalassos, this could even be seen as an effort to revitalize and cater to those nearby markets.³⁷⁹ Even when considering the 4th century as a difficult time for Sagalassos, the building projects and some monumentalization as well as the ongoing production and initiative of launching new wares is testimony to a story of Sagalassos that is better focused on resilience and stability. While there is ground for making the claim that the 4th century presented a difficult time for Sagalassos, it is unclear with the evidence at hand to claim how difficult and abnormal this was for the city. The continued

³⁷⁸ Poblome, Willet, Firat, and others, p. 169.

³⁷⁹ Kaptijn and others, p. 92.

production of the SRSW in the city after the 4th century is a factor that one should consider when trying to dismiss the idea that this was a more stable time than what may have been expected.

IV. 4 What happened to Sagalassos at the end of Late Antiquity? When environmental studies meet history and archaeology.

So far, the archaeological record of rebuilding and evidence from ceramics has shown that the city continued in stability despite some problems it may have faced in the 4th and 6th century. Another method by which one could trace the continuation of the city is through the zooarchaeological investigations carried out at Sagalassos. As the previous chapter had shown, post-BOP phase activities near the Sagalassos region often consisted of a switch from agricultural to pastoral practices.³⁸⁰ Though it may be true that one practice may be more dominant than the other at a given time, these practices are better thought of as coexisting, where livestock raising is accompanied by various forms of cultivation. Through the identification of seeds in charred materials, the team has consistently recovered the presence of pea, lentil, millet, wheat, bread-wheat, hulled barley, unknown cereals, and barley in the everyday diets of Sagalassos until the 13th century.³⁸¹ Additionally, "macroscopic seeds of cereal grains, lentils, beans, figs, walnuts, plums, grapes, and inner parts of spices,

³⁸⁰ Waelkens and others, CLXXI.

³⁸¹ Fuller and others, p. 162.

probably coriander and dill,” were also found in mineralized form originating from human waste in an excavated public latrine.³⁸²

Much like how the proportion of vegetable finds change over time at Sagalassos, the same is visible for the proportion of livestock. The exceptionally low number of 323 specimen are dated to the Middle Byzantine Period (AD 800-1200) at which point the city was largely abandoned because of the major earthquake in the mid-7th century. Besides this outlier however, the difference between the next lowest period from 25 BCE to 300 AD as 12046 specimen to the highest of 18281 in the Late Imperial Period (AD 300-450) is around 6000 specimen. The Early Byzantine period (AD 450-600) has 15695.³⁸³ A sizeable collection of the specimens come from contexts where the pieces were found in dumps. One such example is of an area of the eastern *suburbium* near the Potters Quarter. Here, next to an unidentified building which may have served as a communal house or a convention hall, a large dump of cattle, sheep/goat, and pig bones were found.³⁸⁴ It is possible that this place was eventually used as a kind of “soup-kitchen” as the bones of the animals and the ceramic dumps indicate that the parts used by the animals reflect soup or broth production.³⁸⁵

Other finds reflect the working of bone at Sagalassos as an industry, especially for that of cattle bones. For instance, a fill in a part of the Neon library probably placed in the 4th century was found to contain approximately 700kg of

³⁸² Jan Baeten and others, ‘Faecal Biomarker and Archaeobotanical Analyses of Sediments from a Public Latrine Shed New Light on Ruralisation in Sagalassos, Turkey’, *Journal of Archaeological Science*, 39.4 (2012), 1143–59 (p. 1155).

³⁸³ Fuller and others, p. 160.

³⁸⁴ Bea De Cupere, Jeroen Poblome, and others, ‘Communal Dining in the Eastern Suburbium of Ancient Sagalassos: The Evidence of Animal Remains and Material Culture’, *HEROM. Journal on Hellenistic and Roman Material Culture*, 4.2 (2015), 173–97 (p. 192).

³⁸⁵ Claeys and Poblome, p. 21.

cattle bones.³⁸⁶ Such work of the bones is a good indicator that there were bone working centers, like butchers, around Sagalassos. This makes sense when one considers how important livestock was to Sagalassos as subsistence and commodity throughout the settlement of the city. In the case of cattle, tests on the metapodials and phalanges of the bones have shown deformations that relate to their use for power and work possibly carrying and transporting goods.³⁸⁷ Their slaughter at old age and the evidence from deformations indicate that the cattle were used quite commercially as draught. The remains of pigs at Sagalassos indicate that the pigs were slaughtered younger at times nearing a year old or at any time below 2 years of age.³⁸⁸ This would mean that they were primarily used as meat sources. As piglets grow quickly and can be used for salted meat, they are thought to have been raised at the household or farm areas in small quantities. Therefore, their share in the selection of livestock in the Byzantine Empire is often small to medium in comparison with cattle and ovacaprines.³⁸⁹

Since the remains of the pigs point to their youth, this can be a good indicator that they were brought from nearby settlements where they were bred and sold to Sagalassos. Evidence to support this claim comes from the isotopic values found within the pigs, sheep and cattle relative to each other and of human skeletal remains at Sagalassos. By measuring the values of stable isotopes of

³⁸⁶ Walkens and Poblome, p. 245.

³⁸⁷ De Cupere, Lentacker, and others, p. 259.

³⁸⁸ Fuller and others, p. 167.

³⁸⁹ Henriette Baron, 'An Approach to Byzantine Environmental History: Human-Animal Interactions', in *A Most Pleasant Scene and an Inexhaustible Resource: Steps Towards a Byzantine Environmental History*, ed. by Henriette Baron and Falko Daim (Veröffentlichungen des Leibniz-WissenschaftsCampus Mainz, 2017), vi, 171–99 (p. 174).

carbon in the remains of the animals, environmental scientists can compare the values and determine how the livestock were grazed or fed. This is because stable isotopes can reflect how much the value of C3, C4 and CAM using photosynthesis plants contributed to the isotope value.³⁹⁰ With the addition of stable isotope values of nitrogen, this can determine whether the animals were fed with larger quantities of protein or plant-based nutrients. Additionally, similarities in the stable isotope values would indicate whether the animals (and humans) were from the same or different environment. In the Early to Middle Imperial Period (BC 25-300 AD) the mean values of the cattle and sheep indicate that they were grazed or fed in similar places. While the value for pigs is different, likely because of their diets in eating human refuse, goats have a significant deviation suggesting they were fed and kept in a different place than that of the other livestock.³⁹¹

Tests on the specimen for chemical traces can indicate whether the animals lived closer or further from the city by consideration of how much pollution can be found within the bones. Recent investigations at Sagalassos have both uncovered quarries of mineralized iron and the presence of ore and metal working stations at Sagalassos suggesting that this method of pollution testing could work.³⁹² Though the tests were completed only on goat remains, this has revealed an interesting detail about their livelihood. While the stable isotopes

³⁹⁰ Thomas W Boutton and others, '\$\delta^{13}C\$ Values of Soil Organic Carbon and Their Use in Documenting Vegetation Change in a Subtropical Savanna Ecosystem', *Geoderma*, 82.1-3 (1998), 5-41 (p. 5).

³⁹¹ Fuller and others, p. 161.

³⁹² Patrick Degryse, Ph Muchez, and others, 'Identification of Ore Extraction and Metal Working in Ancient Times: A Case Study of Sagalassos (SW Turkey)', *Journal of Geochemical Exploration*, 77.1 (2003), 65-80 (p. 79).

indicate that goats were grazed and fed separately, chemical traces of their remains show a high degree of pollution by Mn, Pb, Cu, and Zn suggesting that the animals were kept close to the city in this period.³⁹³ Judgment without the assessment of the other livestock would only be suggestive, but this information could mean that while goats and pigs were closer to the city, cattle and sheep were grazed and cared for away from the city until the 4th century AD.

Unlike the ceramic evidence, the mid-4th century is a period in the faunal remains that points to the largest number of specimens. In fact, cattle remains make up approximately 53% of the livestock ratio with sheep/goats being significantly reduced and pigs remaining at similar levels between 300-450 AD.³⁹⁴ Additionally, isotopic records in this period indicate that the husbandry practices became more specialized in nature with more unique diets for the livestock in the form of fodder.³⁹⁵ Chemical traces of the goats in this period indicate that they were grazed away from the city due to low levels of pollution. The As (arsenic) values indicate that they were still however from the territory of Sagalassos despite being further from the city.³⁹⁶ The stable isotope values indicate that the sheep may have sometimes stayed with the goats and with cattle at varying periods though the overall trend however is that special grazing areas were dedicated to each of the livestock.³⁹⁷ This marks an interesting contrast against the assumption that this was a period of general instability at Sagalassos. It seems clear from the discussion so far that an active choice was

³⁹³ Degryse, Philippe Muchez, and others, p. 2831.

³⁹⁴ Fuller and others, p. 160.

³⁹⁵ Fuller and others, p. 163.

³⁹⁶ Degryse, Philippe Muchez, and others, p. 2831.

³⁹⁷ Fuller and others, p. 163.

taken by the people of Sagalassos to focus on pastoral activities with greater care. This newer function of the city may have been more lucrative to the city given it lost some of its popularity since the Imperial period. Furthermore, the focus of the populations of Sagalassos towards pastoral activities could be a reason for the small reduction of the density in the city. Whatever the reasons that dictated the choice of a switch to serious pastoral practices may be, the evidence points to an active thought-out choice as opposed to one caused by instability. The high proportion of cattle remains in relation to preceding and following periods are a testament to the wealth of the city in this period.

From the mid-5th to the 7th century, the reliance in livestock shifts from that of cattle towards the ovacaprines.³⁹⁸ The reduction in the number of cattle specimen supports the idea that the wealth of the city was overall reduced and that the reliance on ovacaprines in the 5th century with the building of a wall reflects a "less secure situation."³⁹⁹ This is why animals like the goats and sheep could have been brought to the city and grazed together to avoid the less secure environment that would exist outside the city.⁴⁰⁰ The reduction in pig sizes as well as their consumption at younger ages may also demonstrate that there was a decrease in the meat demand at Sagalassos due to a reduction in the population.⁴⁰¹ Clearly, evidence points to a reduction in the density of the settlement in the city of Sagalassos by the 6th century.

³⁹⁸ Fuller and others, p. 160.

³⁹⁹ Degryse, Philippe Muchez, and others, p. 2831.

⁴⁰⁰ Fuller and others, p. 163.

⁴⁰¹ Frémondeau and others, p. 44.

Much like the previous discussions however, the concern is that this lack of density is attributed to a more hostile and less secure environment than what it really may have been. As Jeroen Poblome accurately writes about the portrayal of Sagalassos in this period, "the traditional cocktail contained the Justinianic Plague possibly inducing famine, an earthquake, Arab raids and climatic deterioration, resulting in de-urbanization/ruralization and loss of productive activities."⁴⁰² Poblome continues to say that while these explanations may have some merit, they remove the agency of the population at Sagalassos to overcome these issues and continue on via different functions with gradual decline as opposed to larger periods of instability.⁴⁰³ So far, this has been the argument as illustrated by both the archaeological and environmental records. In the aftermath of the earthquake of the 6th century, a massive rebuilding initiative on a monumental scale was set across the city. The amount of work and resources spent into these repairs is a great testament to the ongoing effort and will of the local elites to restore the city.⁴⁰⁴

Additionally, arguments have been put forward proposing the "increased tendency towards nucleated settlements" as a way to describe a decline in the settlement pattern at Sagalassos.⁴⁰⁵ This hypothesis was based on the proportion of villages around Sagalassos to those of estate centers. Recent investigations and reevaluations of the data regarding villages however offers an alternative view against this nucleation.⁴⁰⁶ Furthermore, the Gaussian

⁴⁰² Poblome, p. 106.

⁴⁰³ Poblome, Braekmans, Music, and others, p. 106.

⁴⁰⁴ Waelkens, 'Sagalassos, Archaeology Of', p. 20.

⁴⁰⁵ Vanhaverbeke and others, p. 247.

⁴⁰⁶ Poblome, p. 104.

representation of pottery from the urban excavation data show that from the 5th century to at least until the mid-6th century, the second highest count of pottery sherds could be found since the peak in the Imperial period.⁴⁰⁷ Certainly, this information doesn't contest the idea that by the middle 6th century, urban and social life had very much transformed at Sagalassos, but rather to imply that the changes were gradual and more often than not, by volition. Eventually, by the late 6th and early 7th century, many municipal functions, like waste disposal, came to a halt and public places that were abandoned became waste dumps.⁴⁰⁸ The late 6th century also marks the highest number of villages abandoned around the Sagalassos area.⁴⁰⁹ Additionally, archaeological investigations surrounding the rebuilding projects of the 6th century show that the efforts came to a sudden stop around the mid-6th century. Furthermore, public streets which most likely were no longer used, eventually were encroached by private buildings and while life continued, as evidence by the reuse of many public buildings for bone working, turning into kilns or as waste spaces, the city made little effort to restore its former glory again.⁴¹⁰ After a devastating earthquake around the first quarter to the mid-7th century, the town was largely relocated to a *kastron* in the south of the city known as Alexander's Hill and was occupied until the first half of the 13th century.⁴¹¹

Again, one should be careful as evidence of occupational activity still went on at Sagalassos but to less concentrated extents. There wasn't a period of

⁴⁰⁷ Poblome, Willet, Firat, and others, p. 153.

⁴⁰⁸ Waelkens, 'Sagalassos, Archaeology Of', p. 23.

⁴⁰⁹ Poblome, p. 104.

⁴¹⁰ Waelkens, 'Sagalassos, Archaeology Of', p. 23.

⁴¹¹ Vionis and others, p. 425.

abandonment in the sense that the site and its vicinity were completely disregarded. While certain villages and hamlets disappeared, other ones in less obvious areas took their place and pastoralism alongside some cereal crops and lower amounts of olive cultivation took form.⁴¹² As evidence and thorough research is still lacking, post-earthquake Sagalassos deserves special attention that won't be discussed within this thesis. What suffices though, much like the argument that has been proposed so far, is that the Byzantine Dark Ages at Sagalassos may not have been as dark and even been a period of continued occupation and activity albeit with different priorities.⁴¹³

In the case of Sagalassos, the implementation of environmental science has helped to uncover important insight regarding the changes that took place in the city and its environment from Antiquity to the Early Byzantine period. The first type of insight it has provided are from events which directly relate to the environment. The large rebuilding projects initiated in the 6th century were the outcomes of an earthquake which tested the resiliency of the area around Sagalassos.⁴¹⁴ In this sense, environmental studies in Sagalassos has provided an example of the coping mechanism of societies in the Late Antique period. The second type of insight, which has been highly valuable, are indirect environmental clues which help to reevaluate the gaps of knowledge pertaining to narratives of the city. For Sagalassos, the most relevant studies have come from both zooarchaeological and palynological investigations. Palynological data has shown that in the 4th century, the reduced import of SRSW in the

⁴¹² Vanhaverbeke and others, XLIII, p. 185.

⁴¹³ Vanhaverbeke and others, XLIII, p. 188.

⁴¹⁴ Waelkens, 'Sagalassos, Archaeology Of', p. 20.

neighboring communities of Sagalassos, like the Bereket valley, likely had more to do with the end of the BOP phase activities in those rural areas rather than production in the city.⁴¹⁵

Without the palynological data supplementing the existing ceramic evidence, narratives surrounding Sagalassos would likely continue to revolve around the idea that production had become limited due to instability around the Sagalassos area. Zooarchaeological investigations of the faunal remains in the city have also helped to counter assumptions of sheer economic and demographic decline. By use of stable isotopes and osteological investigations, better insight into the diets and grazing activities of the livestock have been obtained.⁴¹⁶ The value of this is clearly connected to how the interest towards pastoralism at Sagalassos was an active and deliberate change by the community which related more to stability rather than instability through external factors. This is additionally supported by the palynological and climatological data which show that there would not have been any environmental need to convert to pastoralism until later into mid-7th century.⁴¹⁷ Where archaeological evidence at Sagalassos was lacking in clarity, environmental studies have been able to provide a perspective, in terms of commercial and agricultural change which might otherwise have been neglected. In this light, the environmental insight received through the excavations at Sagalassos has been both foundational and irreplaceable in creating a narrative which focuses more on the resilience and stability of a

⁴¹⁵ Kaptijn and others, p. 92.

⁴¹⁶ Fuller and others.

⁴¹⁷ Kaptijn and others, p. 92.

society as opposed to one which is wrongly attributed to decline. As such, the case study of Sagalassos has clearly demonstrated the value of using environmental science to produce multi-disciplinary and comprehensive interpretation of the trajectories of urban settlement pattern.



Chapter Five:

Conclusion

*“Ultimi Nuntia”*⁴¹⁸

The use of environmental science, as presented within this thesis, holds considerable weight in both the construction and reconsideration of historical narratives at Sagalassos. As a case study, Sagalassos matches a number of requisites which help to illuminate the value of incorporating environmental science to historical studies of the past. The first requisite that Sagalassos provides is through its abundance of environmental data which can, with considerable resolution, help to attribute anthropogenic influences on the local ecology. These include like the presence of pollen used in agriculture, finds of animal remains, and studies of micro-assemblages.⁴¹⁹ Secondly, while Sagalassos is moderately rich in archaeological evidence, it is rather lacking in literary evidence for the post-classical and antique period. Though this may initially seem problematic, it is partially the reason by which a foundation for utilizing different methodologies in better understanding the periods of transition and resilience at Sagalassos exists. Without the combined assessments from palynology, archaeozoology, and ceramic evidence at Sagalassos, it becomes highly appealing to resort to labeling the situation of the civic and economic life at Sagalassos as ‘declining’, though this is hardly the case.

⁴¹⁸ “Final Remarks”

⁴¹⁹ Fuller and others; Bakker, Paulissen, Kaniewski, Poblome, and others; Bakker, Kaniewski, Verstraeten, De Laet, and others.

Lastly, the settlement duration at Sagalassos encompassed periods of both ecological and socio-political distress. Whereby multiple records of natural disasters, namely earthquakes and a possible fire, as well as a time frame where Arab raids occurred in inner parts of Anatolia. This last point is a critical one since it reorients the focus of this thesis from questions of continuity and discontinuity to more inquisitive and flexible notions of transition, marked by a change of the settlement's functions, and resilience, as a measure of how the society at Sagalassos showed adaptation to unfavorable conditions.

The major underlying assumption in this study of Sagalassos from the first to the seventh century has been that crises do not always result in the decline that has traditionally been expected of them. As such, the first point of focus in understanding Sagalassos in this thesis has been to support the idea of resilience as opposed to that of discontinuity caused by the aforementioned crises. While there is evidence to yield the conclusion that Sagalassos did indeed find hardship and needed recovery, the other side of this story which points to resilience also deserves merit. The first example of such resilience at Sagalassos can be attributed to the city's response to a sizeable earthquake in the 6th century that damaged a number of large monuments within the city.⁴²⁰ Despite also being a time in which the lucrative Sagalassos Red Slip Ware had largely stopped being produced or sold, the city still undertook significant repair projects of its staircases, porticoes, shops, baths and the larger buildings like the palatial mansion.⁴²¹ This resilience can also be seen once again through the finds

⁴²⁰ Waelkens and others, CLXXI, p. 377.

⁴²¹ Lavan, p. 296; Vanhaverbeke and others, p. 252.

of the SRSW dating to the middle of the fourth century. While finds of the SRSW do indicate a continuation in production those of the middle fourth century are indeed the ones with the least precision to date.⁴²² Surely this complicates the picture of how the economy of Sagalassos may have been, especially considering that its most lucrative product is represented with ambiguity in archaeological finds. Nevertheless, there is yet again evidence at Sagalassos that instead of abandoning the project altogether, newer wares were produced and sold in an attempt to revitalize the trade.⁴²³ While production did not reach those of the imperial period, they did rise to an eminent point before the trade seems to have stopped altogether after the 6th century.⁴²⁴ The environmental contribution to this argument also highlights that the reduction of the SRSW may have had less to do with production issues, but more so reflecting the purchasing power of nearby rural communities as pollen records of the Bereket valley indicate a switch from lucrative agricultural production to that of pastoral activity.⁴²⁵

As argued, earthquakes and other crises, while definitely playing a role in the decision-making processes at Sagalassos, did not necessarily constitute the downfall of the settlement. While resilience has shown Sagalassos' ambition to persevere despite economic instability and natural disasters, the idea of transition has helped to understand the ways in which Sagalassos considered periods of trouble and redefined the functions of its city and society. Certainly, archaeological evidence of this is rather present throughout Sagalassos in the

⁴²² Poblome, Willet, Firat, and others, p. 169.

⁴²³ Kaptijn and others, p. 92.

⁴²⁴ Poblome, Braekmans, Waelkens, and others.

⁴²⁵ Bakker, Paulissen, Kaniewski, Poblome, and others, p. 73.

form of reusing public spaces and buildings for newer purposes. One such example discussed is of the earlier *bouleuterion* that had become a church in the fifth century.⁴²⁶ Likewise, the reuse of a room in the abandoned baths as the new area for waste disposal provides yet another example.⁴²⁷

The most profound insight about periods of transition at Sagalassos is marked by the change of agricultural activities to those predominantly of specialized pastoral ones. This is an interesting change to witness as no sign of environmental factors or political instability seem to have limited those at Sagalassos from not continuing their agricultural production.⁴²⁸ Faunal remains at Sagalassos only lower significantly after the major earthquake in the seventh century onwards.⁴²⁹ Before this however, the mid-4th century is a period in which the faunal remains represent the largest number of specimens.⁴³⁰ The switch seems to have happened around the same time when the SRSW seems to have become reduced in production size. While this may seem like a haphazard response to crisis, isotopic records of the animals show that the husbandry practices had become more specialized with unique diets for the livestock in the form of fodder and grazing practices.⁴³¹ Such a shift, as I have tried to argue is one that could easily indicate a proactive choice to pursue pastoral activities as opposed to a change that's in responding to crisis.

While environmental science in history does have its shortcomings, and while many of the conclusions drawn are speculations, it still nevertheless

⁴²⁶ Lavan, p. 345.

⁴²⁷ Baeten and others, p. 1155.

⁴²⁸ Bakker, Paulissen, Kaniewski, Poblome, and others, pp. 75–78.

⁴²⁹ Fuller and others.

⁴³⁰ Fuller and others, p. 160.

⁴³¹ Fuller and others, p. 163.

contributes a great deal for understanding the relationship between society and the environment in the past. At Sagalassos, the use and incorporation of environmental sciences has added new perspective to the resilience of those within the region of Sagalassos and has shed light on the various ways in which societies actively choose to deal with crises. Furthermore, the use of this multi-disciplinary approach has provided numerous cases to doubt narratives which consider changes in societies as evidence of discontinuity and unrest and has provided a framework to reevaluate such cases. As a relatively new and growing field, this work aims to be a valuable contribution to the works of environmental history in the Mediterranean and beyond.

Bibliography

- Agnieszka Pidek, Irena, Krystyna Piotrowska, and Idalia Kasprzyk, 'Pollen-Vegetation Relationships for Pine and Spruce in Southeast Poland on the Basis of Volumetric and Tauber Trap Records', *Grana*, 49.3 (2010), 215–26 <<https://doi.org/10.1080/00173134.2010.514006>>
- Ahrweiler, Hélène, 'L'histoire et La Géographie de La r Égion de Smyrne Entre Les Deux Occupations Turques (1018 – 1307) Particulièrement Au XIIIe Siècle', *TM*, 1 (1965), 1–204
- Amesbury, Matthew J., Dan J. Charman, Rewi M. Newnham, Neil J. Loader, Jordan Goodrich, Jessica Royles, and others, 'Can Oxygen Stable Isotopes Be Used to Track Precipitation Moisture Source in Vascular Plant-Dominated Peatlands?', *Earth and Planetary Science Letters*, 430 (2015), 149–59 <<https://doi.org/10.1016/j.epsl.2015.08.015>>
- Arrian, *Arrian, with an English Translation By E. Iliff Robson. Anabasis Alexandri (Books I - IV)*, ed. by E. Iliff Robson (Massachusetts: Harvard University Press, 1929), I
- Ashburner, Walter, 'The Farmer's Law', *The Journal of Hellenic Studies*, 30.1 (1910), 85–108 <<https://doi.org/10.2307/624264>>
- Atalay, Ibrahim, Recep Efe, and Münir Öztürk, 'Ecology and Classification of Forests in Turkey', *Procedia - Social and Behavioral Sciences*, 120.2 (2014), 788–805
- Baeten, Jan, Elena Marinova, Véronique De Laet, Patrick Degryse, Dirk De Vos, and Marc Waelkens, 'Faecal Biomarker and Archaeobotanical Analyses of Sediments from a Public Latrine Shed New Light on Ruralisation in Sagalassos, Turkey', *Journal of Archaeological Science*, 39.4 (2012), 1143–59
- Bakker, Johan, David Kaniewski, Gert Verstraeten, Véronique De Laet, and Marc Waelkens, 'Numerically Derived Evidence for Late-Holocene Climate Change and Its Impact on Human Presence in the Southwest Taurus Mountains, Turkey', *The Holocene*, 22.4 (2012), 425–38
- Bakker, Johan, Etienne Paulissen, David Kaniewski, Véronique De Laet, Gert Verstraeten, and Marc Waelkens, 'Man, Vegetation and Climate during the Holocene in the Territory of Sagalassos, Western Taurus Mountains, SW Turkey', *Vegetation History and Archaeobotany*, 21.4–5 (2012), 249–66
- Bakker, Johan, Etienne Paulissen, David Kaniewski, Jeroen Poblome, Véronique De Laet, Gert Verstraeten, and others, 'Climate, People, Fire and Vegetation: New Insights into Vegetation Dynamics in the Eastern Mediterranean since the 1st Century AD', *Climate of the Past*, 9.1 (2013), 57–87
- Barker, John W., 'The Agrarian History of Byzantium: From the Origins to the Twelfth Century . Paul Lemerle ', *Speculum*, 58.1 (1983), 202–4 <<https://doi.org/10.2307/2846644>>
- Baron, Henriette, 'An Approach to Byzantine Environmental History: Human-Animal Interactions', in *A Most Pleasant Scene and an Inexhaustible Resource: Steps Towards a Byzantine Environmental History*, ed. by Henriette Baron and Falko Daim (Veröffentlichungen des Leibniz-WissenschaftsCampus Mainz, 2017), vi, 171–99
- Batt, C., S. Fear, and C. Heron, 'The Role of Magnetic Susceptibility as a

- Geophysical Survey Technique: A Site Assessment at High Cayton, North Yorkshire', *Archaeological Prospection*, 2.4 (1995), 179–96
[https://doi.org/10.1002/1099-0763\(199512\)2:4<179::AID-ARP6140020402>3.0.CO;2-K](https://doi.org/10.1002/1099-0763(199512)2:4<179::AID-ARP6140020402>3.0.CO;2-K)
- Behre, Karl-Ernst, *Some Reflections on Anthropogenic Indicators and the Record of Prehistoric Occupation Phases in Pollen Diagrams from the Near East* (Balkema, 1990)
- , 'The Interpretation of Anthropogenic Indicators in Pollen Diagrams', *Pollen et Spores*, 23.2 (1981), 225–45
- Blumentritt, Dylan J, and Ioan Lascu, 'A Comparison of Magnetic Susceptibility Measurement Techniques and Ferrimagnetic Component Analysis from Recent Sediments in Lake Pepin (USA)', *Geological Society*, 414 (2015), 197–207
- Bottema, Sytze, 'A Late Quaternary Pollen Diagram from Lake Urmia (Northwestern Iran)', *Review of Palaeobotany and Palynology*, 47.3–4 (1986) <[https://doi.org/10.1016/0034-6667\(86\)90039-4](https://doi.org/10.1016/0034-6667(86)90039-4)>
- , 'A Pollen Diagram from the Syrian Anti Lebanon', *Paléorient*, 3.1 (1975), 259–68 <<https://doi.org/10.3406/paleo.1975.4201>>
- Bottema, Sytze, and Henk Woldring, 'Anthropogenic Indicators in the Pollen Record of the Eastern Mediterranean', in *Man's Role in the Shaping of the Eastern Mediterranean Landscape: Proceedings of the Symposium on the Impact of Ancient Man on the Landscape of the E Med Region & the Near East: Groningen*, 1989, pp. 231–64
- , 'Late Quaternary Vegetation and Climate of Southwestern Turkey, Part II', *Palaeohistoria*, 26.0 (1984), 123–49
- Boutton, Thomas W, Steven R Archer, Andrew J Midwood, Stephen F Zitzer, and Roland Bol, '\$13C Values of Soil Organic Carbon and Their Use in Documenting Vegetation Change in a Subtropical Savanna Ecosystem', *Geoderma*, 82.1–3 (1998), 5–41
- Braudel, Fernand, *Mediterranean & the Mediterranean World in the Age of Philip*, 1st edn (University of California Press, 1996)
- Brüggemeier, F.-J., 'Environmental History', ed. by Neil J Smelser and Paul B Baltes, *International Encyclopedia of the Social & Behavioral Sciences* (Pergamon, 2001), pp. 4621–27
- Bryer, Anthony, 'Byzantine Agricultural Implements: The Evidence of Medieval Illustrations of Hesiod's "Works and Days"', *Annual of the British School at Athens*, 81 (1986), 45–80
- Büntgen, U, V S Myglan, F C Ljungqvist, M McCormick, N Di Cosmo, M Sigl, and others, 'Cooling and Societal Change during the Late Antique Little Ice Age from 536 to around 660 AD', *Nature Geoscience*, 6 (2016), 231–36
- Caesar, Augustus, *Res Gestae Divi Augusti (The Achievements of the Divine Augustus)*, ed. by P. A. Brunt and J. M. Moore (Oxford: Oxford University Press, 1969)
- Cappers, R T J, K der Ploeg, and M Schepers, 'Bibliography of Wim van Zeist', *Palaeohistoria*, 57–58 (2016), 4–10
- Claeys, Johan, and Jeroen Poblome, 'The 2011 to 2016 Excavation Campaigns at Site PQ2, Sagalassos. Dissecting a Suburban Club House (Schola)', *Anatolica*, 43 (2017), 1–36

- Cronon, William, *Changes in the Land: Indians, Colonists, and the Ecology of New England* (New York: Hill & Wang, 1983)
- , 'The Uses Of Environmental History', *Environmental History Review*, 17.3 (1993), 1–22
- Crosby, Alfred W., *Ecological Imperialism: The Biological Expansion of Europe, 900–1900, Second Edition, Ecological Imperialism: The Biological Expansion of Europe, 900-1900* (Cambridge University Press, 2010)
<<https://doi.org/10.1017/CBO9780511805554>>
- , 'The Past and Present of Environmental History', *American Historical Review*, 100.4 (1995), 1177–89
- De Cupere, Bea, An Lentacker, Wim Van Neer, Marc Waelkens, and Laurent Verslype, 'Osteological Evidence for the Draught Exploitation of Cattle: First Applications of a New Methodology', *International Journal of Osteoarchaeology*, 10 (2000), 254–67
- De Cupere, Bea, Jeroen Poblome, Sheila Hamilton-Dyer, and Sven Van Haelst, 'Communal Dining in the Eastern Suburbium of Ancient Sagalassos: The Evidence of Animal Remains and Material Culture', *HEROM. Journal on Hellenistic and Roman Material Culture*, 4.2 (2015), 173–97
- Daems, Dries, and Jeroen Poblome, 'Adaptive Cycles in Communities and Landscapes: The Case of Sagalassos and Düzen Tepe during the Classical–Hellenistic Period', *Archaeological Review from Cambridge*, 31.2 (2016), 91–107
- Dalby, Andrew, *Geoponika - Farm Work: A Modern Translation of the Roman and Byzantine Farming Handbook* (Prospect Books, 2011)
- Dalby, Andrew, \=Elias Anagn\=ostak\=es, Chryssi Bourbou, Johannes Koder, and Maria Leontsin\=e, *Flavours and Delights: Tastes and Pleasures of Ancient and Byzantine Cuisine* (Armos Publications, 2013)
- Dayem, Katherine E., Peter Molnar, David S. Battisti, and Gerard H. Roe, 'Lessons Learned from Oxygen Isotopes in Modern Precipitation Applied to Interpretation of Speleothem Records of Paleoclimate from Eastern Asia', *Earth and Planetary Science Letters*, 295.1–2 (2010), 219–30
<<https://doi.org/10.1016/j.epsl.2010.04.003>>
- Dean, Jonathan R, Matthew D Jones, Melanie J Leng, Hilary J Sloane, C Neil Roberts, Jessie Woodbridge, and others, 'Palaeo-Seasonality of the Last Two Millennia Reconstructed from the Oxygen Isotope Composition of Carbonates and Diatom Silica from Nar Gölü, Central Turkey', *Quaternary Science Reviews*, 66 (2013), 35–44
- Decker, Michael J., *The Byzantine Dark Ages* (Bloomsbury, 2016)
- , 'The Current State of Byzantine Archeology', *History Compass*, 16.9 (2018), e12459 <<https://doi.org/10.1111/hic3.12459>>
- Decker, Michael, and others, *Tilling the Hateful Earth: Agricultural Production and Trade in the Late Antique East*, 1st edn (Oxford University Press, 2009)
- Degryse, Patrick, Ph Muchez, Simon Six, and Marc Waelkens, 'Identification of Ore Extraction and Metal Working in Ancient Times: A Case Study of Sagalassos (SW Turkey)', *Journal of Geochemical Exploration*, 77.1 (2003), 65–80
- Degryse, Patrick, Philippe Muchez, Bea De Cupere, Wiu Van Neer, and Marc Waelkens, 'Statistical Treatment of Trace Element Data from Modern and

- Ancient Animal Bone: Evaluation of Roman and Byzantine Environmental Pollution', *Analytical Letters*, 37.13 (2004), 2819–34
- Dincauze, Dena F., *Environmental Archaeology: Principles and Practice* (New York: Cambridge University Press, 2000)
- Eastwood, Warren J, Melanie J Leng, Neil Roberts, and Basil Davis, 'Holocene Climate Change in the Eastern Mediterranean Region: A Comparison of Stable Isotope and Pollen Data from Lake Gölhisar, Southwest Turkey', *Journal of Quaternary Science*, 22.4 (2007), 327–41
- Eastwood, Warren J, Neil Roberts, and Henry F Lamb, 'Palaeoecological and Archaeological Evidence for Human Occupance in Southwest Turkey: The Bey{\c{s}}ehir Occupation Phase', *Anatolian Studies*, 48 (1998), 69–86
- Eisenberg, Merle, David J Patterson, Jamie Kreiner, Ellen F Arnold, and Timothy P Newfield, 'The Environmental History of the Late Antique West: A Bibliographic Essay', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2019), pp. 31–50
- Elias, Scott, ed., *Encyclopedia of Quaternary Science* (Elsevier, 2007)
- Ellenblum, Ronnie, *The Collapse of the Eastern Mediterranean: Climate Change and the Decline of the East, 950–1072* (Cambridge University Press, 2012)
- 'European Pollen Database'
<<http://www.europeanpollendatabase.net/index.php>> [accessed 7 June 2020]
- Faegri, Knut, Johs Iversen, Knut Krzywinski, and Peter Emi Kaland, *Textbook of Pollen Analysis*, 4th edn (The Blackburn Press, 2000)
- Fontaine, Maximilien, Raf Aerts, Kür\csad Özkan, Ahmet Mert, Serkan Gülsoy, Halil Süel, and others, 'Elevation and Exposition Rather than Soil Types Determine Communities and Site Suitability in Mediterranean Mountain Forests of Southern Anatolia, Turkey', *Forest Ecology and Management*, 247.1–3 (2007), 18–25
- Frémondeau, Delphine, Bea De Cupere, Allowen Evin, and Wim Van Neer, 'Diversity in Pig Husbandry from the Classical-Hellenistic to the Byzantine Periods: An Integrated Dental Analysis of Düzen Tepe and Sagalassos Assemblages (Turkey)', *Journal of Archaeological Science: Reports*, 11 (2017), 38–52
- Fuller, Benjamin T, Bea De Cupere, Elena Marinova, Wim Van Neer, Marc Waelkens, and Michael P Richards, 'Isotopic Reconstruction of Human Diet and Animal Husbandry Practices during the Classical-Hellenistic, Imperial, and Byzantine Periods at Sagalassos, Turkey', *American Journal of Physical Anthropology*, 149.2 (2012), 157–71
- Gaillard, Marie-José, Shinya Sugita, M Jane Bunting, Richard Middleton, Anna Broström, Christopher Caseldine, and others, 'The Use of Modelling and Simulation Approach in Reconstructing Past Landscapes from Fossil Pollen Data: A Review and Results from the POLLANDCAL Network', *Vegetation History and Archaeobotany*, 17.5 (2008), 419–43
- Gogou, Alexandra, Maria Triantaphyllou, Elena Xoplaki, Adam Izdebski, Constantine Parinos, Margarita Dimiza, and others, 'Climate Variability and Socio-Environmental Changes in the Northern Aegean (NE Mediterranean) during the Last 1500 Years', *Quaternary Science Reviews*, 136 (2016), 209–28 <<https://doi.org/10.1016/j.quascirev.2016.01.009>>

- Göktürk, Ozan M, Dominik Fleitmann, Seraina Badertscher, H Cheng, R L Edwards, M Leuenberger, and others, 'Climate on the Southern Black Sea Coast during the Holocene: Implications from the Sofular Cave Record', *Quaternary Science Reviews*, 30.19–20 (2011), 2433–45
- Goosse, Hugues, Elisabeth Crespin, Svetlana Dubinkina, Marie France Loutre, Michael E. Mann, Hans Renssen, and others, 'The Role of Forcing and Internal Dynamics in Explaining the "Medieval Climate Anomaly"', *Climate Dynamics*, 39.12 (2012), 2847–66 <<https://doi.org/10.1007/s00382-012-1297-0>>
- Griggs, Carol, Arthur DeGaetano, Peter Kuniholm, and Maryanne Newton, 'A Regional High-Frequency Reconstruction of May--June Precipitation in the North Aegean from Oak Tree Rings, A.D. 1089--1989', *International Journal of Climatology*, 27.8 (2007), 1075–89
- Haldon, John, Merle Eisenberg, Lee Mordechai, Adam Izdebski, and Sam White, 'Lessons from the Past, Policies for the Future: Resilience and Sustainability in Past Crises', *Environment Systems and Decisions*, 40.2 (2020), 287–97 <<https://doi.org/10.1007/s10669-020-09778-9>>
- Haldon, John F., 'Euchaïta: From Late Roman and Byzantine Town to Ottoman Village', in *Archaeology and Urban Settlement in Late Roman and Byzantine Anatolia*, ed. by John F. Haldon, Hugh Elton, and James Newhard (Cambridge University Press, 2018), pp. 210–54 <<https://doi.org/10.1017/9781108557757.010>>
- , 'Introduction', *Human Ecology* (Springer New York LLC, 2018), 273–74 <<https://doi.org/10.1007/s10745-018-9998-6>>
- Haldon, John F., Neil Roberts, Adam Izdebski, Dominik Fleitmann, Michael McCormick, Marica Cassis, and others, 'The Climate and Environment of Byzantine Anatolia: Integrating Science, History, and Archaeology', *Journal of Interdisciplinary History*, 45.2 (2014), 113–61
- Haldon, John F., and Arlene Rosen, 'Society and Environment in the East Mediterranean ca 300--1800 CE. Problems of Resilience, Adaptation and Transformation. Introductory Essay', *Human Ecology*, 46.3 (2018), 275–90
- Harvey, Alan, *Economic Expansion in the Byzantine Empire 900-1200* (Cambridge University Press, 1989)
- Hassan, Fekri A., 'Sediments in Archaeology: Methods and Implications for Palaeoenvironmental and Cultural Analysis', *Journal of Field Archaeology*, 5.2 (1978), 197 <<https://doi.org/10.2307/529452>>
- Hendy, Michael F., *Studies in the Byzantine Monetary Economy c.300–1450*, *Studies in the Byzantine Monetary Economy c.300–1450* (Cambridge University Press, 1985) <<https://doi.org/10.1017/cbo9780511896750>>
- Hudson, James R, 'Braudel 's Ecological Perspective', *Sociological Forum*, 2.1 (1987), 146–65
- Hughes, Johnson Donald, *An Environmental History of the World : Humankind's Changing Role in the Community of Life* (Routledge, 2009)
- , *Ecology in Ancient Civilizations* (University of New Mexico Press, 1975)
- , *The Mediterranean : An Environmental History*, ed. by Mark R Stoll (ABC-CLIO, 2005)
- , *What Is Environmental History?*, 2nd edn (Polity, 2006)
- Isenberg, Andrew C, ed., *The Oxford Handbook of Environmental History* (Oxford

- University Press, 2014)
- Izdebski, Adam, *Rural Economy in Transition: Asia Minor from Late Antiquity Into the Early Middle Ages* (Journal of Juristic Papyrology, 2013), xviii
- , 'Setting the Scene for an Environmental History of Late Antiquity', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski and Michael Mulryan (Brill, 2019), pp. 3–13
- , 'The Economic Expansion of the Anatolian Countryside in Late Antiquity: The Coast Versus Inland Regions', *Late Antique Archaeology*, 10.1 (2013), 343–76
- Izdebski, Adam, Karin Holmgren, Erika Weiberg, Sharon R Stocker, Ulf Buentgen, Assunta Florenzano, and others, 'Realising Consilience: How Better Communication between Archaeologists, Historians and Natural Scientists Can Transform the Study of Past Climate Change in the Mediterranean', *Quaternary Science Reviews*, 136 (2016), 5–22
- Izdebski, Adam, and Michael Mulryan, eds., *Environment and Society in the Long Late Antiquity*, *Environment and Society in the Long Late Antiquity* (Brill, 2019) <<https://doi.org/10.1163/9789004392083>>
- Izdebski, Adam, Jordan Pickett, Neil Roberts, and Tomasz Waliszewski, 'The Environmental, Archaeological and Historical Evidence for Regional Climatic Changes and Their Societal Impacts in the Eastern Mediterranean in Late Antiquity', *Quaternary Science Reviews*, 136 (2016), 189–208
- Jacobs, Ine, 'From Early Byzantium to the Middle Ages at Sagalassos', in *The Long Seventh Century. Continuity and Discontinuity in an Age of Transition*, ed. by Alessandro Gnasso, Emanuele E Intagliata, and Thomas J MacMaster (Peter Lang, 2015), pp. 163–98
- Jacobs, Ine, and Lea Stirling, 'Re-Using the Gods: A 6th-c. Statuary Display at Sagalassos and a Re-Evaluation of Pagan Mythological Statuary in Early Byzantine Civic Space', *Journal of Roman Archaeology*, 30 (2017), 196–226
- Jasny, Naum, 'Competition Among Grains in Classical Antiquity', *The American Historical Review*, 47.4 (1942), 747–64
- John Ljungkvist, Stephan Barthel, Göran Finnveden and Sverker Sörlin, 'The Urban Anthropocene: Lessons for Sustainability from the Environmental History of Constantinople', in *The Urban Mind: Cultural and Environmental Dynamics*, ed. by Paul J.J. Sinclair, Gullög Nordquist, Frands Herschend, and Christian Isendahl (Uppsala: African and Comparative Archaeology, 2010), pp. 367–94
- Jones, Matthew D, Melanie J Leng, C Neil Roberts, Murat Türkeş, and Rana Moeed, 'A Coupled Calibration and Modelling Approach to the Understanding of Dry-Land Lake Oxygen Isotope Records', *Journal of Paleolimnology*, 34.3 (2005), 391–411
- Jones, Matthew D, C Neil Roberts, Melanie J Leng, and Murat Türkeş, 'A High-Resolution Late Holocene Lake Isotope Record from Turkey and Links to North Atlantic and Monsoon Climate', *Geology*, 34.5 (2006), 361–64
- Jones, Richard, 'Signatures in the Soil: The Use of Pottery in Manure Scatters in the Identification of Medieval Arable Farming Regimes', *Archaeological Journal*, 161.1 (2004), 159–88
- Kaplan, Michel, *Les Hommes et La Terre à Byzance Du VIe Au XIe Siècle: Propriété et Exploitation Du Sol* (Publications de la Sorbonne, 1995)

- Kaptijn, Eva, Jeroen Poblome, Hannelore Vanhaverbeke, Johan Bakker, and Marc Waelkens, 'Societal Changes in the Hellenistic, Roman and Early Byzantine Periods. Results from the Sagalassos Territorial Archaeological Survey 2008 (Southwest Turkey)', *Anatolian Studies*, 63 (2013), 75–95
- Kneller, Margaret, 'Pollen Analysis', in *Encyclopedia of Earth Sciences Series* (Springer Netherlands, 2009), pp. 390–98 <https://doi.org/10.1007/978-1-4020-4411-3_192>
- Knipping, Maria, Marc Müllenhoff, and Helmut Brückner, 'Human Induced Landscape Changes around Bafa Gölü (Western Turkey)', *Vegetation History and Archaeobotany*, 17.4 (2008), 365–80 <<https://doi.org/10.1007/s00334-007-0132-8>>
- Koder, Johannes, 'Historical Geography', in *The Archaeology of Byzantine Anatolia: From the End of Late Antiquity Until the Coming of the Turks*, ed. by Philipp Niewohner (Oxford University Press, 2017), pp. 9–27
- Kroll, Henriette, 'Animals in the Byzantine Empire: An Overview of the Archaeozoological Evidence', *Archeologia Medievale*, 39 (2012), 93–121
- Ku, T. L., and H. C. Li, 'Speleothems as High-Resolution Paleoenvironment Archives: Records from Northeastern China', *Proceedings of the Indian Academy of Sciences, Earth and Planetary Sciences*, 107.4 (1998), 321–30 <<https://doi.org/10.1007/BF02841598>>
- Kuniholm, Peter Ian, 'Dendrochronology and Other Applications of Tree-Ring Studies in Archaeology', in *Handbook of Archaeological Sciences*, ed. by Donald Reginald Brothwell and A M Pollard (John Wiley & Sons, 2001), pp. 1–11
- Kuzucuoğlu, Catherine, Walter Dörfler, Stéphane Kunesch, and Franck Goupille, 'Mid- to Late-Holocene Climate Change in Central Turkey: The Tecer Lake Record', *Holocene*, 21.1 (2011), 173–88 <<https://doi.org/10.1177/0959683610384163>>
- LaFontaine, C Vada, Reid A Bryson, and Wayne M Wendland, 'Airstream Regions of North Africa and the Mediterranean', *Journal of Climate*, 3.3 (1990), 366–72
- Laiou, Angeliki, 'The Agrarian Economy, Thirteenth-Fifteenth Centuries', in *The Economic History of Byzantium from the Seventh Trough the Fifteenth Century*, ed. by Angeliki Laiou (Dumbarton Oaks Studies, 2002), III, 311–75
- Laiou, Angeliki E, *Peasant Society in the Late Byzantine Empire: A Social and Demographic Study* (Princeton University Press, 1977)
- , ed., *The Economic History of Byzantium: From the Seventh Through the Fifteenth Century*, 39th edn (Dumbarton Oaks Studies, 2002), I
- Lavan, Luke, 'The Agorai of Sagalassos in Late Antiquity: An Interpretive Study', *Late Antique Archaeology*, 9.1 (2012), 289–353
- Lefort, Jacques, 'Rural Economy and Social Relations in the Countryside', *Dumbarton Oaks Papers*, 47 (1993), 101–13
- , 'The Rural Economy, Seventh-Twelfth Centuries', in *The Economic History of Byzantium from the Seventh Trough the Fifteenth Century*, ed. by Angeliki Laiou (Dumbarton Oaks Studies, 2002), III, 231–310
- Lemerle, Paul, *The Agrarian History of Byzantium from the Origins to the Twelfth Century: The Sources and Problems* (Galway University Press, 1979)
- Leroy, S., N. Kazanci, Ö Ileri, M. Kibar, O. Emre, E. McGee, and others, 'Abrupt

- Environmental Changes within a Late Holocene Lacustrine Sequence South of the Marmara Sea (Lake Manyas, N-W Turkey): Possible Links with Seismic Events', *Marine Geology*, 190.1–2 (2002), 531–52
<[https://doi.org/10.1016/S0025-3227\(02\)00361-4](https://doi.org/10.1016/S0025-3227(02)00361-4)>
- Leroy, Suzanne A.G., Markus J. Schwab, and Pedro J.M. Costa, 'Seismic Influence on the Last 1500-Year Infill History of Lake Sapanca (North Anatolian Fault, NW Turkey)', *Tectonophysics*, 486.1–4 (2010), 15–27
<<https://doi.org/10.1016/j.tecto.2010.02.005>>
- Leroy, Suzanne A G, 'Pollen Analysis of Core DS7-1SC (Dead Sea) Showing Intertwined Effects of Climatic Change and Human Activities in the Late Holocene', *Journal of Archaeological Science*, 37.2 (2010), 306–16
- Li, Yi Yin, Li Ping Zhou, and Hai Ting Cui, 'Pollen Indicators of Human Activity', *Chinese Science Bulletin*, 53.9 (2008), 1281–93
<<https://doi.org/10.1007/s11434-008-0181-0>>
- Livius, Titus, *The History of Rome*, ed. by Canon Roberts (London: J. M. Dent & Sons, 1905)
- Mann, Michael E., Zhihua Zhang, Scott Rutherford, Raymond S. Bradley, Malcolm K. Hughes, Drew Shindell, and others, 'Global Signatures and Dynamical Origins of the Little Ice Age and Medieval Climate Anomaly', *Science*, 326.5957 (2009), 1256–60 <<https://doi.org/10.1126/science.1177303>>
- Marcisz, Katarzyna, Willy Tinner, Daniele Colombaroli, Piotr Kołaczek, Barbara Słowiński Michał and Fiałkiewicz-Kozieł, Edyta Łokas, and others, 'Long-Term Hydrological Dynamics and Fire History over the Last 2000 Years in CE Europe Reconstructed from a High-Resolution Peat Archive', *Quaternary Science Reviews*, 112 (2015), 138–52
- Martens, Femke, 'Late Antique Urban Streets at Sagalassos', in *Technology in Transition A.D. 300-650*, ed. by Luke Lavan, Zanini Enrico, and Alexander Sarantis (Brill, 2008), iv, 321–65
- Martin, Jean-Marie, 'Città Campagna: Economia e Società (Sec. VII-XIII)', in *Storia Del Mezzogiorno: Alto Medioevo*, ed. by Giuseppe Galasso and Rosario Romeo (Edizioni del Sole, 1993), iii, 259–382
- McMahon, Lucas, and Abigail Sargent, 'The Environmental History of the Late Antique Eastern Mediterranean: A Bibliographic Essay', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2019), pp. 17–30
- Mordechai, Lee, 'Antioch in the Sixth Century: Resilience or Vulnerability? In: Environment and Society in the Long Late Antiquity', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2019), pp. 207–23
- Neef, Reinder, 'Introduction, Development and Environmental Implications of Olive Culture: The Evidence from Jordan', in *Man's Role in the Shaping of the Eastern Mediterranean Landscape. Balkema, Rotterdam*, ed. by Sytze Bottema, G Entjes-Nieborg, and William Van Zeist, *The Impact of Ancient Man on the Landscape of the Eastern Mediterranean Region and the Near East* (A.A. Balkema, 1990), pp. 295–306
- Newfield, Timothy P, 'Mysterious and Mortiferous Clouds: The Climate Cooling and Disease Burden of Late Antiquity', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2019), pp. 89–115

- Niewohner, Philipp, *The Archaeology of Byzantine Anatolia: From the End of Late Antiquity until the Coming of the Turks*, 1st edn (Oxford University Press, 2017)
- O'Connor, James, 'What Is Environmental History? Why Environmental History?', *Capitalism, Nature, Socialism*, 8.2 (1997), 3–29
- Ocakoğlu, Faruk, Emel Oybak Dönmez, Aydın Akbulut, Cemal Tunoğlu, Osman Kır, Sanem Açıkalın, and others, 'A 2800-Year Multi-Proxy Sedimentary Record of Climate Change from Lake Çubuk (Göynük, Bolu, NW Anatolia)', *The Holocene*, 26.2 (2016), 205–21
<<https://doi.org/10.1177/0959683615596818>>
- Ontiveros, Miguel Ángel Cau, and Catalina Mas Florit, eds., *Change and Resilience: The Occupation of Mediterranean Islands in Late Antiquity*, Joukowsky Institute Publication (Oxbow Books, 2019), ix
- Orland, Ian J, Miryam Bar-Matthews, Noriko T Kita, Avner Ayalon, Alan Matthews, and John W Valley, 'Climate Deterioration in the Eastern Mediterranean as Revealed by Ion Microprobe Analysis of a Speleothem That Grew from 2.2 to 0.9 Ka in Soreq Cave, Israel', *Quaternary Research*, 71.1 (2009), 27–35
- Ostrogorsky, Georg, 'Agrarian Conditions in the Byzantine Empire in the Middle Ages', in *The Cambridge Economic History of Europe: Agrarian Life of the Middle Ages*, ed. by M M Postan (Cambridge University Press, 1966), 1, 205–34
- Öztürk, Münir, Güven Görk, Yusuf Gemici, and Özcan Seçmen, *Aegean Region Turkey: Plants and Landscape ; Izmir, Pergamon, Ephesus, Priene, Miletos, Didyma, Aphrodisias, Pamukkale, Kusadasi, Manisa, Aydin, Denizli ; Ege Bölgesi Bitki Örtüsü* (Aegean Tourism Association, 1990)
- Papantoniou, Giorgos, and Athanasios Vionis, 'Landscape Archaeology and Sacred Space in the Eastern Mediterranean: A Glimpse from Cyprus', *Land*, 6.2 (2017), 40 <<https://doi.org/10.3390/land6020040>>
- Poblome, Jeroen, 'Life in the Late Antique Countryside of Sagalassos', in *Pisidia Yazıları Hacı Ali Ekinci Armağanı: Pisidian Essays in Honour of Hacı Ali Ekinci*, ed. by Hüseyin Metin, B Ayça Polat Becks, Ralf Becks, and Murat Fırat (Ege Yayinlari, 2015), pp. 99–110
- Poblome, Jeroen, Dennis Braekmans, Branko Music, Mark Van Der Enden, Bert Neyt, Bart De Graeve, and others, 'A Pottery Kiln underneath the Odeon of Ancient Sagalassos. The Excavation Results, the Table Wares and Their archaeometrical Analysis', in *Networks in the Hellenistic World According to the Pottery in the Eastern Mediterranean and Beyond*, ed. by Nina Fenn and Römer-Strehl Christiane (Archaeopress, 2013), pp. 193–204
- Poblome, Jeroen, Dennis Braekmans, Marc Waelkens, Nalan Firat, Hannelore Vanhaverbeke, Femke Martens, and others, 'How Did Sagalassos Come to Be? A Ceramological Survey', in *K. Levent Zoroğlu'na Armağan: Studies in Honour of K. Levent Zoroğlu*, ed. by Mehmet Tekocak (Suna & Inan Kiraç Research Institute on Mediterranean Civilizations, 2013), pp. 527–40
- Poblome, Jeroen, Patrick Degryse, Willy Viaene, Raoul Ottenburgs, Marc Waelkens, Roland Degeest, and others, 'The Concept of a Pottery Production Centre. An Archaeometrical Contribution from Ancient Sagalassos', *Journal of Archaeological Science*, 29.8 (2002), 873–82

- Poblome, Jeroen, Rinse Willet, Nalan Firat, Femke Martens, and Philip Bes, 'Tinkering with Urban Survey Data. How Many Sagalassos-Es Do We Have?', in *Archaeological Survey and the City* (Oxbow Books, 2013), pp. 146–74
- Polybius, *The Histories of Polybius: Translated from the Text of F. Hultsch*, ed. by Evelyn S. Shuckburgh (Cambridge: Cambridge University Press, 2012), II <<https://doi.org/10.1017/CBO9781139333757>>
- Porphyrogenitus, Constantinus, 'De Thematis et De Administrando Imperio', in *Corpus Scriptorum Historiae Byzantinae*, ed. by Barthold Georg Niebuhr (Impensis Ed. Weberi, 1836), III, 544
- Preiser-Kapeller, Johannes, 'A Collapse of the Eastern Mediterranean? New Results and Theories on the Interplay between Climate and Societies in Byzantium and the Near East, ca. 1000-1200 AD', *Jahrbuch Der Österreichischen Byzantinistik*, 65 (2015), 195–242
- 'Quaternary Science Reviews' <<https://www.journals.elsevier.com/quaternary-science-reviews>> [accessed 7 June 2020]
- Ramsay, Jennifer, 'Trade or Trash: An Examination of the Archaeobotanical Remains from the Byzantine Harbour at Caesarea Maritima, Israel', *International Journal of Nautical Archaeology*, 39.2 (2010), 376–82 <<https://doi.org/10.1111/j.1095-9270.2010.00267.x>>
- Riva, Matteo Jucker, Ioannis N Daliakopoulos, Sandra Eckert, Elias Hodel, and Hanspeter Liniger, 'Assessment of Land Degradation in Mediterranean Forests and Grazing Lands Using a Landscape Unit Approach and the Normalized Difference Vegetation Index', *Applied Geography*, 86 (2017), 8–21
- Roberts, C Neil, Giovanni Zanchetta, and Matthew D Jones, 'Oxygen Isotopes as Tracers of Mediterranean Climate Variability: An Introduction', *Global and Planetary Change*, 71.3–4 (2010), 135–40
- Roberts, Neil, 'Human-Induced Landscape Change in South and Southwest Turkey during the Later Holocene', in *Man's Role in the Shaping of the Eastern Mediterranean Landscape*, ed. by Sytze Bottema, G Entjes-Nieborg, and William Van Zeist, *The Impact of Ancient Man on the Landscape of the Eastern Mediterranean Region and the Near East* (A.A. Balkema, 1990), pp. 53–67
- , 'Revisiting the Beyşehir Occupation Phase: Land-Cover Change and the Rural Economy in the Eastern Mediterranean During the First Millennium AD', in *Environment and Society in the Long Late Antiquity*, ed. by Adam Izdebski (Brill, 2015), pp. 53–68
- , *The Holocene: An Environmental History*, 2nd edn (Wiley-Blackwell, 1998)
- Roberts, Neil, Marica Cassis, Owen Doonan, Warren Eastwood, Hugh Elton, John Haldon, and others, 'Not the End of the World? Post-Classical Decline and Recovery in Rural Anatolia', *Human Ecology*, 46.3 (2018), 305–22 <<https://doi.org/10.1007/s10745-018-9973-2>>
- Sessa, Kristina, 'The New Environmental Fall of Rome: A Methodological Consideration', *Journal of Late Antiquity*, 12.1 (2019), 211–55 <<https://doi.org/10.1353/jla.2019.0008>>
- Sheffer, Efrat, 'A Review of the Development of Mediterranean Pine--Oak Ecosystems after Land Abandonment and Afforestation: Are They Novel

- Ecosystems?', *Annals of Forest Science*, 69.4 (2012), 429–43
- Simms, D. L., and Johnson Donald Hughes, *Pan's Travail: Environmental Problems of the Ancient Greeks and Romans, Technology and Culture* (Johns Hopkins University Press, 1995), xxxvi <<https://doi.org/10.2307/3106378>>
- Sintubin, Manuel, Philippe Muchez, Dominique Similox-Tohon, Griet Verhaert, Etienne Paulissen, and MARC Waelkens, 'Seismic Catastrophes at the Ancient City of Sagalassos (SW Turkey) and Their Implications for Seismotectonics in the Burdur--Isparta Area', *Geological Journal*, 38.3–4 (2003), 359–74
- Stathakopoulos, Dionysios, 'Death in the Countryside: Some Thoughts on the Effects of Famine and Epidemics', *Antiquite Tardive*, 20 (2012), 105–14 <<https://doi.org/10.1484/J.AT.1.103096>>
- , 'Reconstructing the Climate of the Byzantine World: State of the Problem and Case Studies', in *People and Nature in Historical Perspective*, ed. by József Laszlovszky and Péter Szabó (Central European University & Archaeolingua, 2003), pp. 247–61
- Strabo, *The Geography of Strabo*, ed. by Hans Claude Hamilton and Falconer William, *Henry G. Bohn* (London: H. G. Bohn, 1857), I
- Szczepanek, Kazimierz, Dorota Myszkowska, Elżbieta Worobiec, Katarzyna Piotrowicz, Monika Ziemianin, and Zuzanna Bielec-Bąkowska, 'The Long-Range Transport of Pinaceae Pollen: An Example in Kraków (Southern Poland)', *Aerobiologia*, 33.1 (2017), 109–25 <<https://doi.org/10.1007/s10453-016-9454-2>>
- Talloon, Peter, and Jeroen Poblome, 'The 2014 and 2015 Control Excavations on and around the Upper Agora of Sagalassos: The Structural Remains and General Phasing', *Anatolica*, 42 (2016), 111–50
- Teall, John L, 'The Byzantine Agricultural Tradition', *Dumbarton Oaks Papers*, 25 (1971), 33–59
- , 'The Grain Supply of the Byzantine Empire, 330-1025', *Dumbarton Oaks Papers*, 13 (1959), 87–139
- Thayer, Bill, 'Ptolemy's Geography — Book V, Chapter 3' <https://penelope.uchicago.edu/Thayer/E/Gazetteer/Periods/Roman/_Texts/Ptolemy/5/3*.html> [accessed 16 November 2020]
- 'The Holocene - Journal Description' <<https://journals.sagepub.com/description/HOL>> [accessed 7 June 2020]
- Thommen, Lukas, *An Environmental History of Ancient Greece and Rome* (Cambridge University Press, 2012)
- Thompson, Donald A, 'Land Degradation in Mediterranean Environments of the World: Nature and Extent, Causes and Solutions, Edited by AJ Conacher and M. Sala. Wiley, Chichester, 1998.', *Land Degradation & Development*, 11.2 (2000), 195–97
- Tomaselli, Ruggero, 'The Degradation of the Mediterranean Maquis', *Ambio*, 6.6 (1977), 356–62
- Treadgold, Warren, 'Les Hommes et La Terre a Byzance Du VI Au XI Siecle: Propriete et Exploitation Du Sol.', *The American Historical Review*, 99.4 (1994), 1296 <<https://doi.org/10.2307/2168805>>
- Türkeş, M, and Ecmel Erat, 'Influences of the North Atlantic Oscillation on Precipitation Variability and Changes in Turkey', *Nuovo Cimento Della*

- Società Italiana Di Fisica*, 29.1 (2006), 117–35
- Ülgen, Umut Bar\i\cs, Sven Oliver Franz, Demet Biltekin, M Nam\ik Çagatay, Patricia Angelika Roeser, Lisa Doner, and others, 'Climatic and Environmental Evolution of Lake Iznik (NW Turkey) over the Last~ 4700 Years', *Quaternary International*, 274 (2012), 88–101
- Uytterhoeven, Inge, Hande Kökten, Markku Corremans, Jerome Poblome, and Marc Waelkens, 'Late Antique Private Luxury: The Mosaic Floors of the Urban Mansion of Sagalassos (Ağlasun, Burdur – Turkey)', in *Jahreshefte Des Österreichischen Archäologischen Institutes in Wien*, ed. by Erich Kistler, Birgit Öhlinger, and Marion Steger, 2013, pp. 373–407
- Uytterhoeven, Inge, Femke Martens, Branko Mušič, and Marc Waelkens, 'Urban Housing in the Pisidian Town of Sagalassos (Burdur, Turkey)' (Österreichische Akademie der Wissenschaften; Vienna, 2010), XVIII
- Vandam, Ralf, Patrick Willet, and Jeroen Poblome, 'Living on the Margins: First Results for the Derekoy Archaeological Survey of the Sagalassos Project in the Western Taurus Mountains', in *The Archaeology of Anatolia Vol. 2* (Cambridge, 2017), pp. 316–41
- Vanhaverbeke, Hannelore, Femke Martens, Marc Waelkens, and Jeroen Poblome, 'Late Antiquity in the Territory of Sagalassos', *Late Antique Archaeology*, 2.1 (2004), 247–79
- Vanhaverbeke, Hannelore, Athanasios K Vionis, Jeroes Poblome, and Marc Waelkens, 'What Happened After the 7th Century A.D.? A Different Perspective on Post-Roman Rural Anatolia', in *Archaeology of the Countryside in Medieval Anatolia*, ed. by Tasha Vorderstrasse and Jacob Roodenberg (Nederlands Instituut voor het Nabije Oosten, 2009), XLIII, 177–90
- Vermoere, Marleen, Sytze Bottema, Lieven Vanhecke, Marc Waelkens, Etienne Paulissen, and Eric Smets, 'Palynological Evidence for Late-Holocene Human Occupation Recorded in Two Wetlands in SW Turkey', *The Holocene*, 12.5 (2002), 569–84
- Vionis, Athanasios K, and Giorgos Papantoniou, 'Central Place Theory Reloaded and Revised: Political Economy and Landscape Dynamics in the Longue Durée', *Land*, 8.2 (2019), 1–21
- Vionis, Athanasios K, Jeroen Poblome, Bea De Cupere, and Marc Waelkens, 'A Middle-Late Byzantine Pottery Assemblage from Sagalassos: Typo-Chronology and Sociocultural Interpretation', *Hesperia: The Journal of the American School of Classical Studies at Athens*, 79.3 (2010), 423–64
- Waelkens, Marc, 'Hadrian and the "Neokoria" of Sagalassos', in *Pisidia Yazıları Hacı Ali İkinci Armağanı: Pisidian Essays in Honour of Hacı Ali İkinci*, ed. by Hüseyin Metin, B Ayça Polat Becks, Ralf Becks, and Murat Fırat (Ege Yayınları, 2015), pp. 177–214
- , 'Sagalassos, Archaeology Of', in *Encyclopedia of Global Archaeology*, ed. by Smith Claire (Cham: Springer International Publishing, 2018), pp. 1–32 <https://doi.org/10.1007/978-3-319-51726-1_1121-3>
- , *Sagalassos I: First General Report on the Survey (1986-1991) and Excavations (1990-1991)* (Leuven University Press, 1993), I
- Waelkens, Marc, and Patrick Degryse, *Sagalassos VI: Geo- and Bio-Archaeology at Sagalassos and in Its Territory, Sagalassos VI* (Leuven University Press,

- 2019) <<https://doi.org/10.2307/j.ctt9qdxzk.3>>
- Waelkens, Marc, Etienne Paulissen, Marleen Vermoere, Patrick Degryse, David Celis, Kristof Schroyen, and others, 'Man and Environment in the Territory of Sagalassos, a Classical City in SW Turkey', *Quaternary Science Reviews*, 18.4–5 (1999), 697–709 <[https://doi.org/10.1016/S0277-3791\(98\)00105-X](https://doi.org/10.1016/S0277-3791(98)00105-X)>
- Waelkens, Marc, Toon Putzeys, Inge Uytterhoeven, Thijs Van Thuyne, Wim Van Neer, Jeroen Poblome, and others, 'Two Late Antique Residential Complexes at Sagalassos', in *Housing in Late Antiquity*, ed. by Luke Lavan, Lale Özgenel, and Alexander Sarantis, *Late Antique Archaeology* (Brill, 2007), 3.2, 495–513
- Waelkens, Marc, Manuel Sintubin, Philippe Muchez, and Etienne Paulissen, 'Archaeological, Geomorphological and Geological Evidence for a Major Earthquake at Sagalassos (SW Turkey) around the Middle of the Seventh Century AD', in *The Archaeology of Geological Catastrophes*, ed. by W J McGuire, D R Griffiths, P L Hancock, and P L Stewart (Geological Society of London, 2000), CLXXI, 373–83
- Waelkens, Marc, and Jeroen Poblome, eds., *Sagalassos IV: Report on the Survey and Excavation Campaigns of 1994 and 1995* (Leuven University Press, 1997)
- Weiner, Douglas, Carolyn Merchant, and Lisa Mighetto, 'American Society for Environmental History - History' <<https://aseh.org/history>> [accessed 7 June 2020]
- Willet, Rinse, and Jerome Poblome, 'The Scale of Sagalassos Red Slip Ware Production - Reconstructions of Local Need and Production Output of Roman Imperial Tableware', *Adalya*, 18 (2015), 133–57
- Worster, Donald, 'Appendix: Doing Environmental History', in *The Ends of the Earth: Perspectives on Modern Environmental History*, ed. by Michael Williams and Donald Worster (Cambridge University Press, 1990), pp. 289–307
- , *Nature's Economy: A History of Ecological Ideas (Studies in Environment and History)* (Cambridge University Press, 1994)
- , *Rivers of Empire: Water, Aridity, and the Growth of the American West - Donald Worster - Google Kitaplar* (Oxford: Oxford University Press, 1992)
- Wyckoff, Don G., 'Secondary Forest Succession Following Abandonment of Mesa Verde', *KIVA*, 42.3–4 (1977), 215–31
<<https://doi.org/10.1080/00231940.1977.11757877>>
- Xoplaki, Elena, Dominik Fleitmann, Juerg Luterbacher, Sebastian Wagner, John F. Haldon, Eduardo Zorita, and others, 'The Medieval Climate Anomaly and Byzantium: A Review of the Evidence on Climatic Fluctuations, Economic Performance and Societal Change', *Quaternary Science Reviews*, 136 (2016), 229–52
- Xueqin, Mei, 'In Memoriam: J. Donald Hughes (1932–2019)', *Environmental History*, 24.3 (2019), 459–62
- Yavuz, Vural, Naki Akçar, and Christian Schlüchter, 'The Frozen Bosphorus and Its Paleoclimatic Implications Based on a Summary of the Historical Data', in *The Black Sea Flood Question: Changes in Coastline, Climate, and Human Settlement*, ed. by Valentina Yanko-Hombach, Allan S Gilbert, Nicolae Panin,

- and Pavel M Dolukhanov (Springer, 2007), pp. 633–49
- Zanini, Enrico, 'Macro-Economy, Micro-Ecology, and the Fate of Urbanized Landscape in Late Antique and Early Byzantine Crete', in *Change and Resilience: The Occupation of Mediterranean Islands in Late Antiquity*, ed. by Miguel Ángel Cau Ontiveros and Catalina Mas Florit (Oxbow Books, 2019), pp. 139–62
- Zavagno, Luca, *'A Lost World Than Never Died.' Islands and Their Urban Landscapes in Byzantine Western Mediterranean in the Passage from Late Antiquity to the Middle Ages*, 2021
- , 'At the Edge of Two Empires: The Economy of Cyprus between Late Antiquity and the Early Middle Ages (650s-800s CE)', *Dumbarton Oaks Papers*, 65/66 (2012), 121–55
- , *Cities in Transition: Urbanism in Byzantium between Late Antiquity and the Early Middle Ages (AD 500-900)* (BAR Publishing, 2009)
- , 'Coinage and Economy in Cyprus in the Age of Transition (c. 600-850 A.D.)', in *First International Congress of Anatolian Monetary History and Numismatics* (Offprint, 2013), pp. 715–26
- , *Cyprus between Late Antiquity and the Early Middle Ages (ca. 600-800): An Island in Transition*, *Cyprus Between Late Antiquity and the Early Middle Ages (ca. 600-800): An Island in Transition* (Taylor and Francis, 2017) <<https://doi.org/10.4324/9781315277363>>
- Zavagno, Luca, and Bülent Kızılduman, 'Countryside in Transition The Galinoporni Kaleburnu Plain (Cyprus) in the Passage from Late Antiquity', *Památky Archeologické*, 2018, 1–14
- van Zeist, Willem, 'Paleobotanical Results of the 1970 Season at Çayönü, Turkey', *Helinium*, 12.1 (1972), 3–19
- Van Zeist, Willem, 'Plant Remains from Girikihacıyan, Turkey', *Anatolica*, 7 (1979), 75–89
- van Zeist, Willem, and Jah Bakker-Heeres, 'Prehistoric and Early Historic Plant Husbandry in the Altınova Plain, Southeastern Turkey', in *Korucutepe*, ed. by M N Van Loon (North Holland Publishing Company, 1975), 1, 221–57
- Van Zeist, Willem, and Sytze Bottema, 'A Palynological Study of the Acheulian Site of Gesher Benot Ya'aqov, Israel', *Vegetation History and Archaeobotany*, 18.2 (2009), 105–21 <<https://doi.org/10.1007/s00334-008-0167-5>>
- van Zeist, Willem, Ria W Timmers, and Sytze Bottema, 'Studies of Modern and Holocene Pollen Precipitation in Southeastern Turkey', *Palaeohistoria*, 14 (1970), 19–39
- Van Zeist, Willem, H Woldring, and D Stapert, 'Late Quaternary Vegetation and Climate of Southwestern Turkey', *Palaeohistoria*, 17 (1975), 53–143
- Zohary, Michael, *Geobotanical Foundations of the Middle East* (Taylor & Francis, 1973), I–II