

Contents lists available at [SciVerse ScienceDirect](http://www.sciencedirect.com)

Quaternary International

journal homepage: www.elsevier.com/locate/quaint

Integrated centrality analysis: A diachronic comparison of selected Western Anatolian locations

Daniel Knitter^{a,b,*}, Hartmut Blum^c, Barbara Horejs^d, Oliver Nakoinz^{a,e}, Brigitta Schütt^{a,b}, Michael Meyer^{a,f}^a Excellence Cluster Topoi, Research Area A-I-21, Hittorfstraße 18, 14195 Berlin, Germany^b Freie Universität Berlin, Department of Earth Sciences, Physical Geography, Malteserstraße 74-100, 12249 Berlin, Germany^c Eberhard Karls Universität Tübingen, Department of Ancient History, Wilhelmstraße 36, 72074 Tübingen, Germany^d Austrian Archaeological Institute, ERC Project Prehistoric Anatolia, ERC-Starting Grant 263339, Franz Klein-Gasse 1, 1190 Vienna, Austria^e Christian-Albrechts-Universität zu Kiel, Graduate School Human Development in Landscapes, Johanna-Mestorf-Straße 2-6, 24118 Kiel, Germany^f Freie Universität Berlin, Department of History and Cultural Studies, Prehistoric Archaeology, Altensteinstraße 15, 14195 Berlin, Germany

ARTICLE INFO

Article history:

Available online xxx

ABSTRACT

The importance of an archaeological site is determined by its centrality, a measure of the interaction at the site. Interactions are assessed by different central functions that are important on different spatial scales. With this integrated approach, applying the knowledge of geography, prehistoric archaeology and classical archaeology, the surroundings of present-day Bergama and Selçuk in Western Anatolia are analysed with regard to their centrality. The diachronic approach shows the different developments of both areas throughout time, indicating the importance of different environmental and social factors that create the level of centrality. Two kinds of centrality can be distinguished: (1) a natural centrality that is mainly based on the location of a site in relation to its local hinterland as well as supra-regional landscape characteristics and (2) a politically controlled centrality that is caused by human efforts to assemble central functions. While in the second case deterioration starts when the required effort can no longer be afforded, deterioration in the first type of centrality is caused by the natural landscape dynamics. This interdisciplinary, diachronic analysis allows a holistic assessment of centrality. Furthermore it shows that (1) local, natural or social factors alone are not able to give a full and sufficient explanation of the differences in a location's centrality as well as (2) the evident need for integrated research frameworks in the analysis of human–environmental relationships throughout time.

© 2013 Elsevier Ltd and INQUA. All rights reserved.

1. Introduction

During antiquity, Western Anatolia was a major area of cultural development. Two of the most prominent sites of that time were Ephesos, near present-day Selçuk, and Pergamon, modern Bergama (Fig. 1). Archaeologists have indicated that the importance of both sites varied during prehistory, even depicting the region around Bergama as marginal (Horejs, 2010, p. 64), whereas the vicinity of Selçuk was more central and better integrated into supra-regional communication and trade networks (Şahoğlu, 2005, p. 352;

Horejs et al., 2011, pp. 47–48, 50). We aim to sketch the history of both areas, to explore the environmental and socio-economic factors that caused their importance based on a concept of centrality for selected time slices.

2. Conceptual framework

A location is characterized by its topology, its chorology and its chronology (Hettner, 1905, p. 557). The topological characteristics are covered by the term *site*. It refers to the study of the relationship between human and environment on the local level (Ullman, 1980, p. 13). The chorological perspective is termed *situation*, which refers to the connections between areas, leading to interdependencies, diffusion or centralization (Ullman, 1980, p. 13). Our attempt is similar to Ullman's in that we "(...) try to make explicit that which has only been implicit (...)" (Ullman, 1980, p. 27). Using selected time slices we analyse the location's site and

* Corresponding author. Freie Universität Berlin, Department of Earth Sciences, Physical Geography, Malteserstraße 74-100, 12249 Berlin, Germany.

E-mail addresses: daniel.knitter@topoi.org (D. Knitter), hartmut.blum@uni-tuebingen.de (H. Blum), barbara.horejs@oeai.at (B. Horejs), oliver.nakoinz@gmail.com (O. Nakoinz), Brigitta.Schuett@fu-berlin.de (B. Schütt), michael.meyer@fu-berlin.de (M. Meyer).

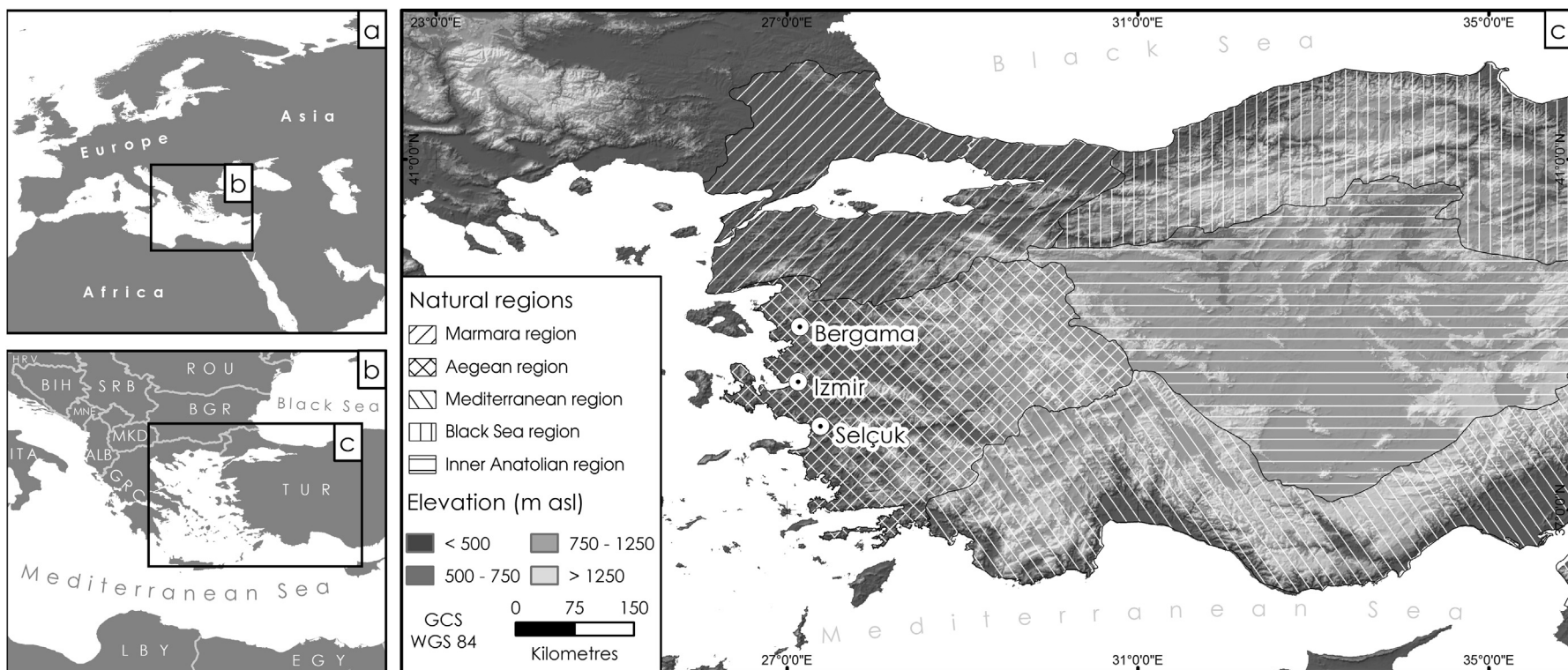


Fig. 1. Geographical overview of the research area. (c) Natural regions of Western and Central Anatolia. The focused sites, Bergama and Selçuk, belong to the Aegean natural region, whose characteristics are stated in the text (Natural regions Erol, 1982a,b; Base map Natural Earth Data, 2011; elevation: Jarvis et al., 2008).

situation based on a concept of interaction, because it is interactions, as drivers of cultural and historical processes, which lead to the formation of prominent – central places. Following Taylor et al. (2010), two theoretical models are necessary: a) central place theory, to describe relations between a location and its corresponding hinterland, i.e. *site* as well as b) central flow theory to describe the horizontal spatial structures of non-local interactions, i.e. *situation*.

It was Walter Christaller who developed the term central place and the relating concept of centrality. He discovered the underlying “laws” of the number, size and distribution of central places (Christaller, 1968, p. 252). In this regard, the main law of settlements distribution is a perfect, transport cost optimized, supply of its participating elements with central functions (Christaller, 1968, pp. 77, 138–140, 254). A central place is a location that has a surplus of meaning, due to the central functions offered for its hinterland (Christaller, 1968, p. 31; Beavon, 1977, p. 18; Heinritz, 1979, p. 14). A central place does not need to be a settlement. It can be understood as a cluster of institutions that offers goods, commodities or services to a limited market area (Blotevogel, 2005, p. 1307). To understand changes in the importance of a location, central place theory is not enough, since it covers just the local affairs; hence it is inherently non-dynamic as an economic process. “(...) [E]conomic expansion [i.e. an increasing importance due to more interactions] does not occur as a result of servicing a hinterland, however, large. Therefore no small central place ever grew to become a metropolitan economy through external relations limited to its own hinterland” (Taylor et al., 2010, pp. 2811–2812). Understanding a location's *situation* needs to focus on the sub-nodal points of a regional or supra-regional network, since it is the specific functions and not the locations that produce the network steering different interactions.

Both, central place and central flow theory, are complementary concepts (Taylor et al., 2010; Taylor, 2012). They are applied in this study within a framework of interaction, allowing application of these theories in an archaeological context. People almost always interact. They do it in very different ways, e.g. the exchange of goods equals an interaction between individuals. Where the concentration of interaction is higher than indicated by the population density, centrality emerges. The degree of centrality is the relative concentration of interactions. Thus, a central place is an interaction node, a place of concentrated interaction in a spatial network – on local and regional scales based on central place theory and on supra-regional scale based on central flow theory. The universal nature of interaction enables the analysis of any human occupation regardless of any other premises about the behaviour. Owing to this ubiquitous style of centrality, spatial and chronological comparisons are possible.

To identify interactions that generate central places, the occurrence of central functions as indicating parameters is analysed (Christaller, 1968, pp. 27, 139; Denecke, 1972, pp. 43–47; Gringmuth-Dallmer, 1996, pp. 12–22). As all archaeological evidence is fragmented, central functions are simplified to allow the assessment of a site's importance from prehistory until the Middle Ages (Gringmuth-Dallmer, 1996, p. 8; Table 1). The more central functions are present at a certain location, the more complex is the structure, and thus the higher is the level of centrality (Gringmuth-Dallmer, 1996, pp. 9–11). Furthermore, the central functions do not need to be onsite, but can also be present in the near vicinity, creating a central space around the site (Gringmuth-Dallmer, 2011, pp. 432–436).

Central functions create a hierarchy of sites; regarding their sphere of influence, they are themselves hierarchical, such as markets for everyday goods vs. a special market for rare spices. The maximum extent of the influential sphere constitutes the spatial

Table 1

Central functions with exemplary institutions (based on Denecke, 1972; Gringmuth-Dallmer, 1996).

Central function	Exemplary institutions
Trade	Market, harbour
Security	Refuge castles; institutions that offer asylum; strategic/military institutions to shelter the central place and its hinterland
Administration	Institutions of state; institutions of law, e.g. tribunal
Craft/industry	Institutions of craftsmen such as carpenters, sculptors, blacksmiths, miners; institutions of culture, such as theatres; institutions of science such as academies, gymnasiums
Cult	Cultic institutions such as temples or shrines

scale of a central function: local (supplying the vicinity), regional (the wider hinterland, supplied with not everyday goods) and supra-regional scale (supplying a large region with scarce goods).

According to this theoretical framework, the indicating measures of interaction are diachronically assessed on different spatial scales to discover those factors that caused the centrality of the two focal regions and to show, whether these have changed throughout time.

3. Research area

3.1. Environmental characteristics

The area (Fig. 1c) is characterized by a temperate climate, classified as Cs after Köppen and Geiger (Kottek et al., 2006, p. 261). The winters are humid and temperate due to moist western winds. Summers are hot and dry and characterized by the Etesians (Fig. 2). These general climatic characteristics already occurred during prehistory as the modern atmospheric circulation mode was established during the mid-Holocene (Schulz and Paul, 2002, p. 46; Dusaar et al., 2011, p. 142). From 4000 BC at the latest, the climate became similar to the present-day climate. Temporary aridization appeared around 100 BC to 0 AD (Finné et al., 2011, p. 3164).

The relief of Western Anatolia is highly influenced by tectonic and volcanic activities. Neogene structural movements caused east–west stretching mountain and graben systems to develop (Hütteroth and Höhfeld, 2002, pp. 37–39). The graben structures are filled with alluvial sediments and are presently drained by large river systems. Along the Aegean Sea littoral zone, the graben systems are drowned, while the mountains create isles and peninsulas. The result is a coastline with numerous gulfs that extend far inland, creating good harbour locations (Philippson, 1914b, p. 66; Hütteroth and Höhfeld, 2002, p. 60; Brückner, 2005; Brückner et al., 2005, 2006). Best access to the hinterland is granted at the mouths of the large river systems. However, owing to the high sediment load, the deltas are very actively prograding. In combination with the strong seasonal river regime with high flow during winter and early spring and a low flow during summer and autumn, the rivers are not navigable (Hütteroth and Höhfeld, 2002, pp. 91–92). Furthermore, the graben structures channel the moist western winds, causing relatively greater humidity further inland of the altogether arid central Anatolian plain (Erol, 1983, pp. 81–83).

The common soils in the area are Rubefacient or Chromic Cambisols and Luvisols, mostly relict soils of the Neogene (Walter and Breckle, 1991, pp. 12–14). In the alluvial plains and valleys, fertile Fluvisols occur, whereas the mountainous areas are dominated by Leptosols on the crystalline and magmatic rocks (Erol, 1983, pp. 84–85; European Soil Bureau Network, 2005, p.87, Plate 16).

Owing to the winter rainy season without frost and the summer drought, the region belongs to the *Mediterraneis* (Frey and Lösch, 2010, p. 28). It is characterized by evergreen, micro- and

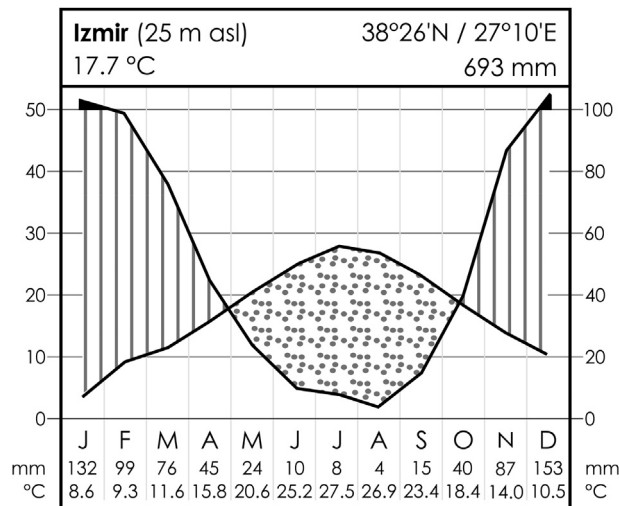


Fig. 2. Climate diagram of Izmir for the period 1961–1990 (based on Sträßer, 1999, nr. 146); during winter humid conditions prevail, while the summer is characterized by arid conditions.

sclerophyllous plants and pine and oak in the mountainous regions (Pott, 2005, pp. 471–472). The widespread dominance of Maquis and Garrigue documents the long-lasting degradation processes due to human exploitation and land use (Chesworth, 2008, p. 67; Frey and Lösch, 2010, pp. 424–427).

3.2. Settlement locations

Five main factors control the location of settlements: the availability of water, arable and grazing land, fuel and building material (Chisholm, 2007, p. 115). Nagle (2004, p. 6) added freedom from flooding, level sites to build on, sunny south facing slopes, potential for trade and commerce, and defensibility to this list.

Considering these parameters, well-drained, gently inclined areas are preferable settlement areas and can be found in the ovas of western Anatolia. These basins have emerged as tectonic depressions since the Miocene (Erol, 1983, p. 33). The western Anatolian ovas are related to graben structures and are drained by large rivers such as Bakırçay, Gediz, Küçük Menderes and Büyük Menderes (Fig. 9). They are filled with alluvial sediments (Kayan, 1999, pp. 542–543). The edges of the ovas occasionally correspond to Neogene terraces and are covered by alluvial fans (Uzel and Sözbilir, 2008, pp. 565, 569). These locations at the transition between the alluvial plains and the mountains are mostly well drained and rarely affected by seasonal flooding, and they connect different ecological zones (Weichhart, 1978, p. 184). Thus, ovas are preferred settlement areas, resulting in a concentration of villages, markets and towns along this geomorphological unit since early history (Erdöğü, 2003, p. 13; Meriç, 2009, plan 3).

The surroundings of Bergama and Selçuk offer these favourable settling conditions (Fig. 3). Comparable conditions are given by their location in the same natural supra-region (Fig. 1c). It is assumed that climatic shifts and environmental dynamics during the Holocene affected both areas similarly. Overall environmental conditions differed strongly from those today because during early cultural history the river alluvia had not entirely filled up the graben with their sediments, allowing the sea to intrude into the valleys. The soils were not yet degraded and eroded by burning or wood cutting (general overview, e.g. Roberts, 2008; more specific, e.g. Hughes, 2005). Evergreen broad-leaved and needle-leaved

forest and, at higher elevations, predominantly deciduous closed forest covered up to 100% of the ground (Bottema and Van Zeist, 1990). As a result of burning and wood cutting, the rivers' sediment loads increased and alluvial deposition was accelerated.

It is hypothesized that the naturally determined settlement activity and centrality is comparable in the surroundings of present-day Bergama and Selçuk. Differences are not the result of different environmental prerequisites but of different socio-cultural conditions during the establishment of the settlement system.

4. Centrality assessment using central functions

In the following, the centrality of Bergama and Selçuk is documented illustrating their socio-economic utilization of and development within their surroundings. With respect to the diachronic approach different cultural epochs are considered as examples sketching the development of centrality (Table 2). Obviously many cultural epochs, important for technical or societal innovation and cultural changes, had to be omitted. Nevertheless, it is the general picture of the development of centrality and people familiar with other periods may notice that integrating periods omitted here will still lead to the same general picture.

Table 2

Name of the research sites during the different cultural epochs.

Study site	Cultural period		
	Bronze age	Antiquity	Today
Bergama	Yeni Yeldegirmentepe	Pergamon	Bergama
Selçuk	Çukuriçi Höyük/Apaşa	Ephesos	Selçuk

4.1. Bronze Age (3000–1150 BC)

First settlements in the upper Küçük Menderes valley date to the Neolithic period in the 7th millennium BC (Lichter, 2006; Galik and Horejs, 2011). No clear Neolithic or Chalcolithic remains have been detected in the Bakırçay valley.

In Early Bronze Age 1 the tell site Çukuriçi Höyük, close to present-day Selçuk, offered the central function of craft with local importance indicated by various metal workshops integrated in settlements (Horejs, 2011, p. 161). Additional obsidian findings underline the importance of the local craft centre (Horejs et al., 2011, pp. 48–49). The obsidian originates predominantly from the Aegean island of Melos, approximately 300 km away. Other obsidian sources in Central Anatolia are at a distance of more than 700 km (Bergner et al., 2009, pp. 251–252). Accordingly, these relations point to a supra-regional network of trade.

Information on administrative functions of Late Bronze Age Hittite texts for the developed 2nd millennium BC indicates that the surroundings of Bergama belonged to the Seha river land, whereas Selçuk's surroundings were part of the kingdom of Arzawa (Seeher, 2005, p. 35). Apaşa, the kingdom's capital, is assumed to correspond to Ayasoluk – modern Selçuk (Heinhold-Kramer, 1977; Seeher, 2005, pp. 23–24; Niemeier, 2007, p. 65; Horejs, 2008). The kingdom of Arzawa is considered to have occupied the area from the Karabel pass south of modern Izmir in the north to the Beşparmak Dağları, the Latmus Mountains of antiquity, in the south (Heinhold-Kramer, 1977; Schachner and Meriç, 2000; Niemeier, 2007, p. 62). Besides this regional importance, Arzawa's ruler is called "King of Kings" and brother by Egyptian pharaoh Amenophis III (1390–1352 BC), indicating the supra-regional importance of this kingdom (Haider, 1999; Klinger, 2007, p. 53; Breyer, 2010, pp. 315–318). From the region around Bergama, no comparable

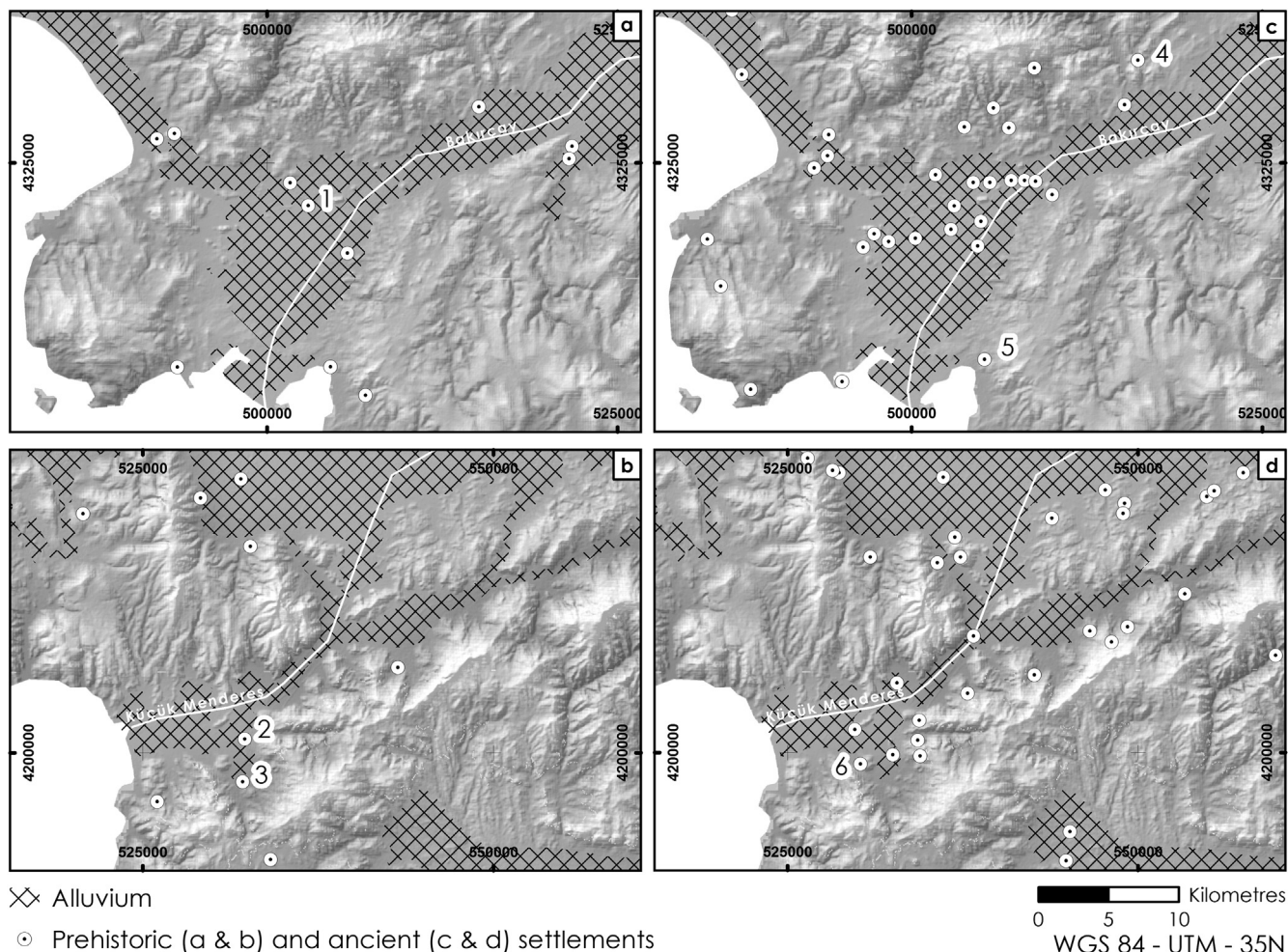


Fig. 3. Actually known prehistoric (Late Chalcolithic to Late Bronze Age period) and ancient (Archaic to Byzantine period) settlement locations in the surroundings of Bergama (a, c) and Selçuk (b, d). The majority of sites are located at the transition between the mountainous areas and the alluvial plains. The maps show the present-day coastline, which was different in prehistory and antiquity as Ephesos and Çukuriçi Höyük were harbour locations (Kraft et al., 2003, 2007; Brückner, 2005). Sites according to the numbers: 1) Yeni Yeldegirmen-tepe, 2) Ajasoluk/Apaşa, 3) Çukuriçi Höyük, 4) Pergamon, 5) Elaia, 6) Ephesos (sites in (a) Horejs, 2010; sites in (b) Horejs et al., 2011; sites in (c) Pirson, 2007, p. 43; sites in (d) Meriç, 2009; alluvium in the surroundings of Bergama Philippon, 1910; alluvium in the surroundings of Selçuk Philippon, 1914a; streams Harita Genel Komutanlığınca Sayışal Olarak Hazırlanmış ve Basılmıştır, 2002. Türkiye Fiziki Haritası. Her Hakkı Saklıdır; base map Jarvis et al., 2008).

administrative functions are known. If Arzawa is assessed as a supra-regional power, hierarchically below those of Egypt and the Hittites, Seha can be seen on a possibly lower hierarchical level with regional significance (Fig. 4). Archaeological remains of the Late Bronze Age are rare in both regions and do not offer any further information (Mountjoy, 1998; Niemeier, 2007). At the current state of the art it is not possible to define cult and security central functions in the vicinity of the studied sites for the prehistoric periods.

4.2. Archaic and classical period

Whereas not much is known about Pergamon in the pre-Hellenistic era other than the fact that it was a fortified town of local political importance, it is quite clear from the earliest written records onward that Ephesos was one of the most important cities in western Asia Minor (Scherrer et al., 1997, pp. 1078–1081; Knibbe, 1998, 72ff.; Radt, 1999, pp. 23–25; Radt et al., 2000, pp. 543–544, 554; Kerschner et al., 2008; Hertel, 2011). During the Archaic and Classical periods, however, Ephesos always seemed to be somewhat overshadowed by Miletus (Magie, 1950, pp. 73–74; Greaves, 2010, 95ff., especially 101–102 and 105–107). From the 7th

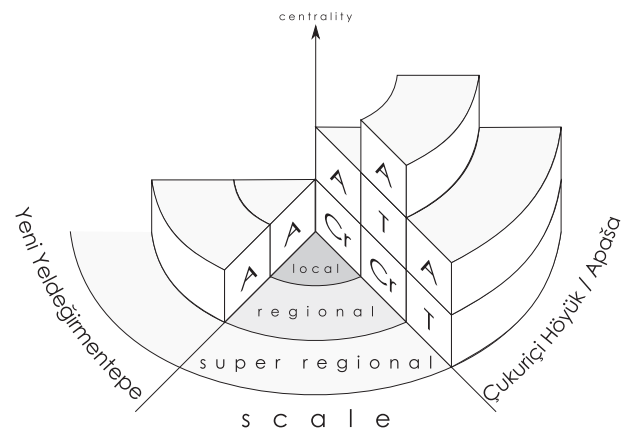


Fig. 4. Centrality assessment using central functions for the Early Bronze Age around Yeni Yeldegirmen-tepe and neighbouring sites and Çukuriçi Höyük and Late Bronze Age Apaşa. Capital letters correspond to central functions: A: Administration; Cr: Craft/Industry; T: Trade.

century BC onward, Miletus served as the base of Ionian colonization of the Black Sea shore (Boardman, 1981, 281ff.; Ehrhardt, 1983; Tsetskhladze, 1998; Greaves, 2010, 120ff.), it was the centre of Ionian early philosophy in the 6th century BC (Huxley, 1966, 93ff.), and at the beginning of the 5th century BC, it spearheaded the Ionian revolt against the Persians (Murray, 1988).

Over the course of the 5th and 4th centuries BC, most of the cities in Asia Minor faded into the background as first Athens, Sparta, Corinth, and Thebes took centre stage, and then later Philip II of Macedon, followed by his son Alexander who conquered the Persian Empire (334–323 BC). After Alexander's death, the Greek world had to reorganize itself and, correspondingly, the map was redrawn in western Asia Minor as well. At this point, Pergamon and Ephesos went through a phase much like a rebirth. Ephesos was re-established on the shore by Lysimachos, one of Alexander's former generals, in 294 BC (Knibbe, 1970, pp. 255–256). Somewhat by chance, Pergamon became the ruling seat of a dynasty with potential when Philetairos, who had been named by Lysimachos as commander of the city, took advantage of Lysimachos' death (281 BC), seized the leader's war treasury for himself and established himself as an independent ruler (Zimmermann, 2011, 19ff.).

4.3. Hellenistic World (280–133/30 BC)

During the Hellenistic era Pergamon and Ephesos seemed to function as complementary opposites (Fig. 5). Geography favoured Ephesos, while politics graced Pergamon. In those areas in which one city took the lead, the other receded (Ladstätter and Pütz, 2007; Pirson, 2011; Pirson and Zimmermann, 2011).

4.3.1. Security

Around 290/280 BC Pergamon and newly founded Ephesos were fortified with strong walls. Under Eumenes II (180 BC onward) Pergamon was further strengthened with a larger ring wall (Halfmann, 2001, p. 7). Ephesos enjoyed geo-strategic importance as a port connected with far-reaching inland routes. Around 200 BC, Ephesos was considered to be the most important stronghold for both naval and inland military operations in western Asia Minor. Possession of the city was a prerequisite for being able to control and defend the coastal cities of western Asia Minor (Polyb. 18,40a in Paton, 1926, pp. 174–175). Consequently, Ephesos was repeatedly a focal point of military conflicts.

4.3.2. Administration

Pergamon established itself as an independent political force in 281 BC under Philetairos, the founder of the Attalid dynasty. It emerged as a mid-sized power in western Anatolia under the first three Attalids until c. 200 BC, but its importance was heavily dependent on the strength of the Seleucid Empire and never extended beyond the regional context (Zimmermann, 2011, pp. 19–33).

This changed fundamentally when the Romans appeared around 215 BC (Bleicken, 2004, pp. 48ff., 164ff.; Marek, 2010, 284ff.). Through its alliance with the Romans, who defeated the most important Hellenistic kingdoms within just a few decades, Pergamon became the strongest power in Asia Minor, after the Seleucid king Antiochos III had to capitulate in 188 BC. As the Romans left wide areas of the Anatolian peninsula under the control of Pergamon, the city became a pivotal political and administrative centre with cross-regional influence (Zimmermann, 2011, p. 34ff.). However, the Roman senate had to be consulted on any political issue (Bleicken, 2004, pp. 175–176). As warrantor of the “new order” established by Rome, Pergamon increasingly lost its political independence. By contrast, Ephesos was less important as a political and administrative centre. Although the city was repeatedly the

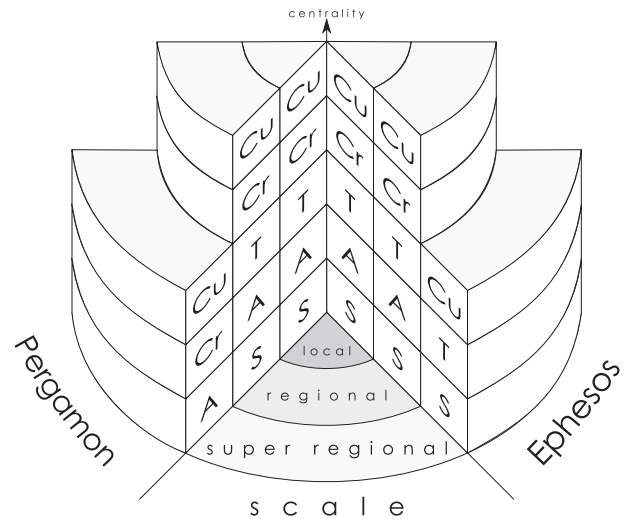


Fig. 5. Centrality assessment using central functions for the Hellenistic era around Pergamon and Ephesos. Capital letters correspond to central functions: A: Administration; Cr: Craft/Industry; Cu: Cult; S: Security; T: Trade.

seat of residence or headquarters of various kings, generals, or governors in the 3rd century and the beginning of the 2nd century BC, Ephesos became part of the kingdom of Pergamon as a kind of district capital (Marek, 2010, p. 318ff.).

4.3.3. Craft/industry

As a result of the Attalid's ascension as a political power, Pergamon was transformed into one of the most beautiful cities in Asia Minor, especially under the reign of Eumenes II (197–158 BC). Eumenes II stretched the boundaries of the city, endowing these newly incorporated areas with many magnificent buildings (Radt, 1999, pp. 53ff., 79–81; Zimmermann, 2011, p. 37ff.). In keeping with the self-image of Hellenistic monarchs, the Attalid kings also ensured that Pergamon became a centre of intellectual and artistic life. Pergamon became one of the primary centres of Greek culture during the Hellenistic era and – at this time – easily competed with the capitals of the great kingdoms and with Athens.

Comparatively little is known about Ephesos in this respect (Calapà, 2009). It is striking that hardly any stately buildings were constructed in Ephesos during the Hellenistic period (Knibbe and Alzinger, 1980, p. 759; Halfmann, 2001, p. 10), and prior to the 1st century BC, there is practically no evidence of any artists, scholars or literati (Knibbe, 1970, p. 291).

4.3.4. Trade

The wealth so ostentatiously on display in Pergamon's impressive buildings came from tax money and the royal treasury and had little to do with a state of prosperity that had been achieved through business and trade. We must assume, of course, that there were at least regional trade activities in Pergamon because the city had purchasing power and could afford to import goods. Moreover, the resident artisans and craftsmen doubtlessly took advantage of the presence of traders and businessmen to produce goods in excess of local demand for export, for example the Pergamon fine ware (cf. Meyer-Schlichtmann, 1988).

This is supported by the fact that at this time the harbour of Pergamon, Elaia, was expanded, (cf. Zimmermann, 2011, pp. 114–115). However, it is not merely a matter of coincidence that we have no proof that Pergamon was truly a trading centre (Rostovtzeff, 1955, pp. 442–444). After all, Pergamon was not centrally located and it appears to have been more a final

destination for trade routes than a crossroads on the way to supply other markets located further in the interior of Asia Minor.

In Ephesos, the situation was basically the opposite: its geographic location was ideally suited to support strong flows of transit traffic. A variety of sources indicate that Ephesos' potential for trade increased during the Hellenistic era and that the city grew into a centre of business and trade. For example, Italian bankers and tradesmen were present in the city relatively early on (Knibbe and Alzinger, 1980, p. 751; see also Broughton (1938, p.623) on the export of the dyestuff "Sinopia" through Ephesos, and, in general, see Magie (1950), Rostovtzeff (1955, pp.133ff., 532, 633ff.), and Halfmann (2001, p. 21)). The most impressive evidence for the city's flourishing trade, however, is certainly Stabon's description of Ephesos on the eve of the Roman Imperial period as a city experiencing dynamic growth and as one of the largest trading centres in Asia Minor (Strabon 14,1,24 in S. Radt, 2005, pp. 26–27).

4.3.5. Cult/religion

During the 3rd and 2nd centuries BC the Attalids enlarged and richly decorated the temples of Pergamon (Radt, 1999, p. 159ff.; Zimmermann, 2011, p. 93ff.). However, most of the cults and temples in Pergamon were only important for the city and the surrounding countryside (Zimmermann, 2011, p. 45). The case might have been different for the Temple of Asklepios outside Pergamon, constructed around 350 BC and rebuilt by the Attalid kings (Radt, 1999, p. 220ff.), as during the Roman Imperial era at the latest many pilgrims and cure-seekers sought out this temple honouring the healing god.

By contrast, Ephesos has been an important religious centre since the Archaic and Classical periods (Bürchner, 1905, pp. 2804–2805). The most important cult was the Cult of Artemis and her temple (Fleischer, 1981). The goddess was most likely worshipped here from the Bronze Age onwards; the oldest temple structure dates back to the 8th century BC (Scherrer et al., 1997, p. 1081). There is also evidence of foreign gifts for the Artemision dating to the 6th century BC. The late-classical building, which was erected after the catastrophic fire in 356 BC, was counted among the Seven Wonders of the Ancient World (Bammer and Muss, 1996, pp. 10ff., 53ff.). Therefore, we can assume that visitors to the area made sure to see this attraction. Moreover, the right of sanctuary and asylum which it offered made this temple a treasury and bank (Bürchner, 1905, pp. 2811–2812).

4.4. Roman Republic and High Empire (133/30 BC–200/250 AD)

During the era of the Roman Empire, the differences between Ephesos and Pergamon disappeared. Both cities managed to catch up in those areas in which they had previously been inferior so that in the end, they basically stood on equal footing. Without a doubt, this was due to the fact that the central government in Rome more or less pushed the developments in this direction. However, Ephesos remained more important in terms of economy and demography, simply due to its more advantageous geographical position. Pergamon seemed to hold onto its position despite a rather disadvantageous starting point in terms of its "natural character" which, in turn, speaks to a level of momentum regarding centrality. In the end, however, Pergamon did lose some of its relative importance as the competition became stronger. For Ephesos, on the other hand, the Imperial era was marked by a continuous upswing (Fig. 6).

After the Romans took direct political control over western Asia Minor, the situation of the local population deteriorated when Roman businessmen exploited the new province. During the end of the civil war, after Caesar's assassination in 44 BC, Roman generals exacted large amounts of money from the cities of Greece and Asia

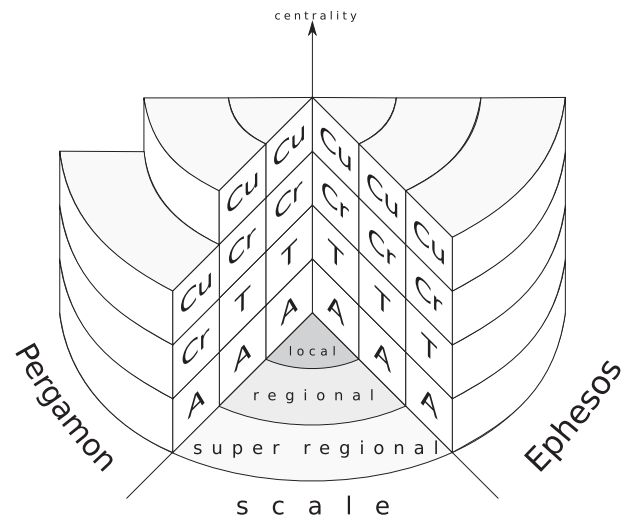


Fig. 6. Centrality assessment using central functions for the Roman era around Pergamon and Ephesos. Capital letters correspond to central functions: A: Administration; Cr: Craft/Industry; Cu: Cult; T: Trade.

Minor (Broughton, 1938, pp. 535ff., 590; Magie, 1950, pp. 232ff., 379ff., Marek, 2010, p. 318ff.). Shortly afterwards, the situation calmed down when Emperor Augustus began to reorganize his empire after defeating Mark Antony and Cleopatra in 30 BC and established himself as the sole Roman ruler.

4.4.1. Security

The proverbial Pax Romana made strong fortresses dispensable (Marek, 2010, p. 389ff.). Accordingly, all over the empire settlements emerged on the unprotected plains, and Pergamon and Ephesos were not exceptions (Klose, 1999, pp. 489–490; Radt et al., 2000, p. 551).

4.4.2. Administration

It remains unclear whether the capital of the Roman province of Asia, which was established as of 129 BC, was Ephesos or Pergamon (Haensch, 1997, p. 298ff.). There is evidence that from 50 BC at the latest Ephesos was the main administrative centre, especially as Roman tax collectors were based in the city (Haensch, 1997, p. 312ff.). The good transport connections of Ephesos made it a suitable administrative centre for the Roman Empire, especially as the city was also the place where most of the new governors of Asia first set foot on the soil of Asia Minor (cf. Dig. 1.16.4.5 in Behrends, 1995, pp. 155–156).

Both Ephesos and Pergamon became cities of virtually the same rank. Augustus had already divided the politically significant official imperial cults equally among Ephesos and Pergamon (Dio 51,20,6–7 in Cary, 1917, pp. 56–57), and both cities were, together with Smyrna, the third most important city of Western Asia Minor, meeting sites for the provincial assembly (Magie, 1950, pp. 447–448, 1295). Later Pergamon and Ephesos became home to additional temples for the provincial cults of the emperors (Haensch, 1997, pp. 315–317). A fierce competition for privileges and titles arose between both cities. Pliny the Elder referred to Pergamon in the second half of the 1st century AD as "by far the most famous city of Asia", whereas Ephesos was merely described as "alterum lumen", a polite way of saying that he appraised the city to be the number two only (Pliny, NH 5,120; 5,126 in Winkler and König, 1993, pp. 86–87, 90–91). Not until the reign of Antoninus Pius (138–161 AD) did Ephesos become the "first Metropolis of Asia". The city held this honour only briefly and had ascended to this

position because the emperor himself had a special connection to Ephesos that dated back to his time as governor of Asia (Knibbe, 1998, pp. 158–159; Halfmann, 2001, pp. 75–76).

4.4.3. Trade

The first two centuries AD were a period of prosperity and growth all over the Roman Empire (Pleket, 1990). This general affluence did not necessarily cause structural changes of the individual cities. Hence, for Pergamon there is no evidence of noteworthy cross-regional trading activities during the Imperial period (Broughton, 1938, p. 868ff.). Rather, the elites of Pergamon seemed to have primarily gained their wealth from land ownership (Halfmann, 2001, pp. 20, 97ff.).

In Ephesos, businessmen and financiers were well represented in the elites (Halfmann, 2001, p. 97ff.). The technical measures which were repeatedly undertaken to combat the siltation of the harbour in Ephesos are a clear indicator for the importance of this waterway. Around 160 AD, the rhetorician Aelius Aristides praised the city as a crossroads of trade known through the entire Mediterranean area and as the “bank and treasury of Asia” (Aristides 23,24 in Dindorf, 1964, p. 775; Behr, 1981, p. 30; Knibbe, 1998, pp. 136–137). After Alexandria, Ephesos was the second largest city in the eastern empire, one of the few cosmopolitan cities of the Imperium Romanum (Seneca, Epist. 102,21 in Gummere, 1925, pp. 180–181). It had a population of about 100,000, compared to the estimated 40,000 inhabitants living in Pergamon (Kolb, 1984, pp. 177, 191; Knibbe, 1998, p. 149; Halfmann, 2001, p. 61; Zimmermann, 2011, pp. 86, 111).

4.4.4. Craft/industry

The development of Pergamon under the Attalids turned the city into a “synthesis of artworks” (Zimmermann, 2011, p. 78), and so construction during the Imperial period was at first limited to the maintenance and embellishment of the existing structures. This changed during the 2nd century AD when several citizens of Pergamon were appointed as Roman Senators and, in parallel, a temple dedicated to the Emperor Trajan (98–117 AD) was built on the Acropolis. New buildings such as several thermal baths appeared in the lower city, and the Temple of Asklepios was completely renovated (Radt, 1999, p. 230ff.).

In Ephesos the “building boom” of the Imperial era appeared earlier (Knibbe, 1998, p. 109ff.; Halfmann, 2001, pp. 21ff., 36ff., 63ff.). All over the city new squares, halls, temples, and other monumental buildings were built (Knibbe and Alzinger, 1980, p. 811ff.). The list of craft trades known for Ephesos is impressively long (Broughton, 1938, p. 842). Until the 2nd century AD, Ephesos was certainly equal to Pergamon as a cross-regional centre of art and crafts, and during this period, both cities regained their long-lost reputations in terms of culture. Together with Smyrna, Ephesos and Pergamon were at the heart of the so-called “second sophistic” literary movement that shaped intellectual life throughout the entire Greek-speaking eastern regions of the empire (Bowie, 2002; Zimmermann, 2011, pp. 66, 110–111).

4.4.5. Cult/religion

In terms of cults and religious aspects, Pergamon and Ephesos also reached about the same level, but in this case, it was Pergamon that caught up with Ephesos. The imperial cults mentioned earlier were cults for the entire province and therefore enjoyed trans-regional importance (in the end, Pergamon had three imperial temple wardens [so-called neokoroi] see Burrell, 2004, p. 30ff.). More importantly, however, the 2nd century AD marked the heyday of the Asklepios Temple (Radt, 1999, p. 227ff.; Zimmermann, 2011, pp. 66, 100ff.). The entire complex was remodelled under the Emperor Hadrian (117–138 AD) and we know that afterwards

countless numbers of visitors from around the entire empire sought out the healing powers of this temple, including two emperors and many other high-ranking people. The famous Galen who later became the personal physician of Marcus Aurelius (161–180 AD) also studied and worked at the Asclepieion which, like the Artemision, was ultimately considered to be one of the Wonders of the World (Zimmermann, 2011, p. 102).

4.5. 20th century

Today, Bergama and Selçuk belong to Izmir Province. They are local supplying centres for their hinterland, though Bergama is markedly bigger and grew faster during the 20th century (Table 3). Both profit from their antique remains and the corresponding tourism that enables the cities to offer craft/industry on regional and supra-regional scale (Fig. 7).

Table 3
Inhabitants of Bergama and Selçuk in the 20th century.

Year	Bergama	Selçuk
2000 (Turkish Statistical Institute – Regional Statistics, 2010)	106,536 City/village: 52,173/54,363	33,594 City/village: 25,414/8180
Early 20th century	20,000 (Philippon, 1912, 56) or 15,000 (Banse, 1919, 129)	2793 (Meyer, 1902, 216)

5. Discussion

The gradual increase of centrality in the surroundings of Selçuk is related to its favourable location regarding supra-regional trade and communication. It shows the typical characteristics of a static gateway location (Burghardt, 1971, p. 273). Different transport axes connected Inner Anatolia with the Aegean, granting access to the coast via the valleys that drain to the north and west. These guidelines of interaction created a transition zone between the Aegean and Anatolian cultural spheres, represented by the archaeological record (Fig. 9). Findings at Liman Tepe, Bakla Tepe or Çukuriçi Höyük suggest that from prehistory onward this area was

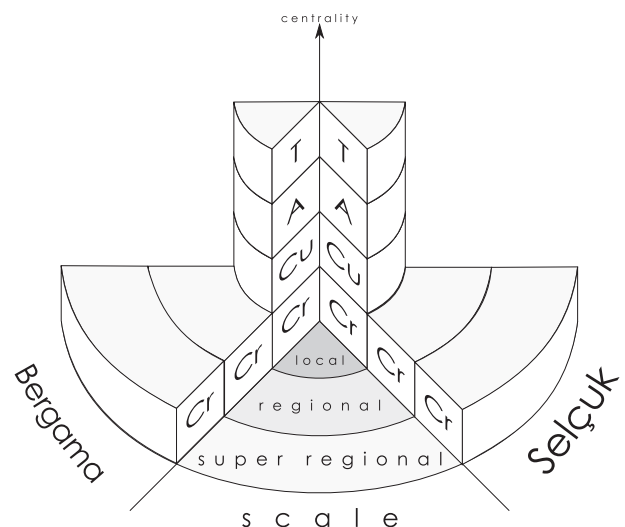


Fig. 7. Centrality assessment using central functions for Bergama and Selçuk. Capital letters correspond to central functions: A: Administration; Cr: Craft/Industry; Cu: Cult; T: Trade.

not just the margin of cultural spaces but an important centre of production and trade with its own identity (Lichter, 2006, p. 30; Erkanal, 2008, p. 181). The strong connections to the Aegean islands and to the hinterland of the sites as far as the central Anatolian sites are indicated by (a) obsidian trade and (b) the changing inventory of sites located at putative trade routes (Lichter, 2006, pp. 31–32; Rahmstorf, 2006, pp. 80–82; Thompson, 2007, pp. 94–96). These are all features that show the influencing role of sub-nodal functions, related to specific trading agents, characteristics for the inter-city relations of central flow theory (Taylor et al., 2010, p. 2814).

Regarding these transport axes, the region around Bergama was and is located marginally. It caused most likely its low centrality in early epochs and its decline after the boom of ancient Pergamon. The marginality may be caused by the heterogeneous relief character of Bergama's surroundings that obstructs trade and cultural development (Philippson, 1912, p. 57; Banse, 1919, pp. 126, 127; Radt, 1999, p. 17). Today, the region of Bergama profits from tourism and gold mining activities at Ovacik. The continuous economic growth of Izmir has led to the planning of an international harbour that will be built in the gulf of Çandarlı.

The decline of Selçuk has different reasons: siltation is a severe problem of all harbours in Western Anatolia which are located at the mouths of the big rivers. Historical examples are Troy (e.g. Kraft et al., 2003), Priene and Milet (Müllenhoff, 2005) and Ephesos (Kraft et al., 2007). By relocating the city, Lysimachos was the first who reacted to the siltation of the harbour (Thiele, 1907, p. 117). Afterwards the Romans repeatedly dug out the harbour (e.g. under the reigns of Nero (Tac. Ann. 16,23 in Church et al., 1942) and Hadrian (Börker et al., 1979, pp. 71–72), and even in the 3rd century AD (Meriç et al., 1981, pp. 72–73)) but finally the harbour silted up, eliminating the advantages of the city's dynamic economic agents. In consequence, its centrality has deteriorated to the present state, though modern tourism plays an important role and caused the 20th century upswing of the place.

The heterogeneous diachronic development of the sites (Fig. 8) highlights the different kinds of centrality: There is a high potential for centralization at Selçuk in prehistory and antiquity due to the environmentally favourable hinterland, the combination of transport connection and the location in an area of exchanging cultural spheres. Hence the potential levels of central place and central flow theory are high. By contrast, the supra-regional exchange potential around Bergama is low. The locally favourable hinterland is too remote from supra-regional developments to participate as an independent core area of centrality. Owing to the enormous wealth of

the Attalid dynasty and their political power, they were able to increase temporarily Pergamon's potential centrality by pulling different functions towards the location. Thus, politically triggered central functions such as craft/industry, administration, and security based on specific agents prevailed. Supra-regional functions, typical for gateway locations, were not sustainably integrated into the central functions offered by Pergamon. Thus, after political influence vanished in the Roman Empire, Pergamon's centrality deteriorated to a lower level. However, according to the established structures and the advanced traffic this level was higher than the natural centrality of prehistoric time.

6. Synthesis and conclusion

The centrality assessments show that the investigated areas differ regarding their central functions and their development. A general characteristic is the gradual increase of centrality in the area around Selçuk until the end of antiquity, followed by its decrease to only local importance (Figs. 4–8). By contrast, the region around Bergama shows a sudden increase in centrality at the beginning of the Hellenistic Age. This centrality was maintained well into Roman times, before Bergama gradually lost its importance (Figs. 4–8).

The reasons for the centrality of the places differ. According to trade and cult, Ephesos was the centre of Western Anatolia while Pergamon's importance was mainly due to its role as residence seat of the Attalid dynasty and a resulting cultural importance. It is the combination of advantages regarding central flows and its effects on the local central place that caused centrality and, if this combination is not sustainable, leads to its decline.

This diachronic, comparative analysis documents that the centrality of a site is not only related to the favourability of its surroundings or location – as also indicated by theoretical considerations of Jacobs (1970), Soja (2003) and central flow theory (Taylor et al., 2010; Taylor, 2012). The example of Pergamon shows that it is possible to increase a low level of potential centralization, due to pulling supra-regional agents, to create a regional and supra-regional importance.

Furthermore, the high potential of centralization can also change over time. As the analysis around Selçuk shows, natural dynamics are able to diminish a location's importance. During prehistory and antiquity the potential of centralization was high, but it deteriorated owing to the gradual increase of unfavourable conditions at the site's harbour, causing a decrease of trade; hence

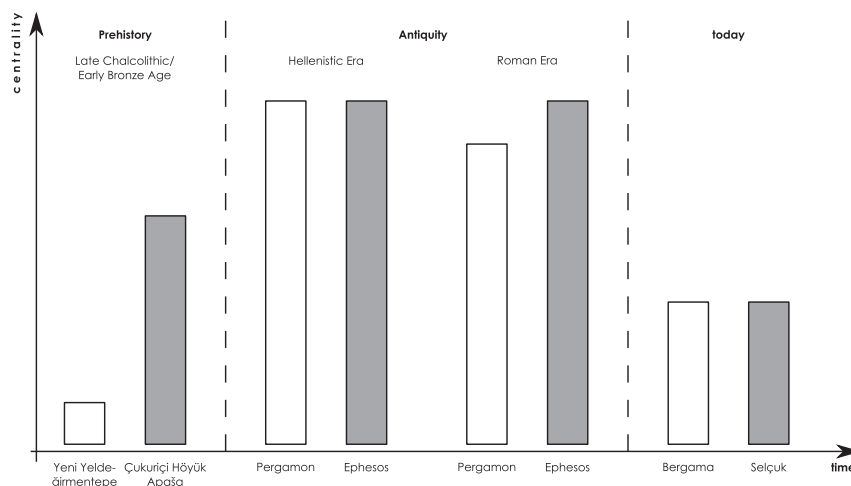


Fig. 8. Overview of the centrality of the studied areas throughout time. Centrality is indicated by the number and weighting of central functions regarding their scale: local 1×, regional 2×, supra-regional 3×.

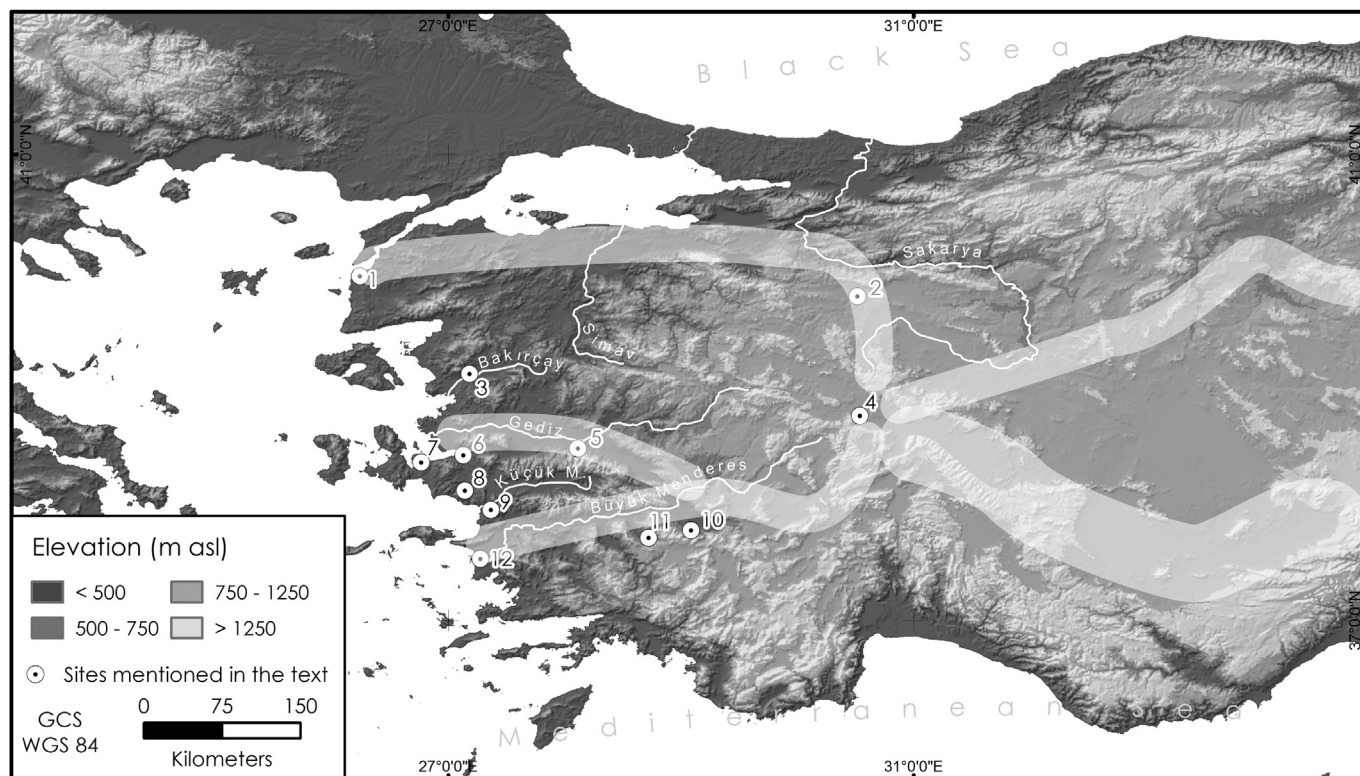


Fig. 9. Major routes of trade and cultural exchange in Western Anatolia; Sites according to numbers: 1 – Troy, 2 – Eskişehir, 3 – Bergama, 4 – Afyonkarahisar, 5 – Sardes, 6 – Izmir, 7 – Liman Tepe, 8 – Bakla Tepe, 9 – Selçuk, 10 – Denizli, 11 – Aphrodisias, 12 – Milet; (routes after Şahoğlu, 2005; Rahmstorf, 2006; Efe, 2007; streams Harita Genel Komutanlığı Sayısal Olarak Hazırlanmış ve Basılmıştır, 2002. Türkiye Fiziki Haritası. Her Hakkı Saklıdır; base map Jarvis et al., 2008).

unfavourable conditions for supra-regionally acting agents. These conditions, in conjunction with generally changing socio-economic circumstances and competition with other cities, decreased the potential of centralization to a level where the effort needed to dig out the harbour could no longer be afforded. Thus, a continuation of the city's supra-regional importance, based on its function as a gateway, was impossible. Consequently, the supra-regional importance was left to another city, whose supra-regional centrality has lasted until today – Izmir.

In summary, it can be stated that central functions on different spatial scales are able to assess the centrality of a place and offer the possibility for diachronic comparisons. Based on the analysed centrality pattern, it becomes obvious that local, natural or social factors alone are not able to give a full and sufficient explanation of the differences in a location's centrality. The integrated investigations of site and situation, deviated from considerations of central place and central flow theory, throughout time allows us to explain differences in the development of central places.

Acknowledgements

We are grateful to the cluster of excellence Exc. 264 Topoi – The formation and Transformation of Space and Knowledge in Ancient Civilizations who supported this study. The authors would like to thank the two anonymous reviewers for their helpful comments.

References

- Bammer, A., Muss, U., 1996. Das Artemision von Ephesos. Mainz.
 Banse, E., 1919. Die Türkei. eine moderne Geographie, third ed. G. Westermann Verlag, Berlin.
 Beavon, K.S.O., 1977. Central Place Theory: a Reinterpretation. Longman, London.

- Behr, C.A., 1981. Aelius Aristides, The Complete Works, vol. II. Translated into English. Leiden.
 Behrends, O., 1995. Corpus Iuris Civilis. Text und Übersetzung, vol. II. Digesten 1–10. Lat.-German. Heidelberg.
 Bergner, M., Horejs, B., Pernicka, E., 2009. Zur Herkunft der Obsidianartefakte vom Çukuriçi Höyük. *Studia Troica* 18, 249–272.
 Bleicken, J., 2004. Geschichte der römischen Republik, sixth ed. Oldenbourg Grundriss der Geschichte, München.
 Blotvogel, H.H., 2005. Zentrale Orte. In: Ritter, E.-H. (Ed.), *Handwörterbuch der Raumordnung*. Akademie für Raumforschung und Landesplanung, Hannover, pp. 1307–1315.
 Boardman, J., 1981. Kolonien und Handel der Griechen. München.
 Börker, C., Merkelbach, R., Engelmann, H., Knibbe, D. (Eds.), 1979. Die Inschriften von Ephesos, Teil II, pp. 101–599. Bonn.
 Bottema, S., Van Zeist, W., 1990. Vorderer Orient. Vegetation im Frühholozän (ca. 8000 B.P.). *Tübinger Atlas des Vorderen Orients (TAVO)*.
 Bowie, E., 2002. Der Neue Pauly, vol. 12/2. Zweite Sophistik, pp. 851–857.
 Breyer, F., 2010. Ägypten und Anatolien. Politische, kulturelle und sprachliche Kontakte zwischen dem Niltal und Kleinasien im 2. Jahrtausend v. Chr., *Denkschriften der Österr. Akademie d. Wiss.*, Wien.
 Broughton, T.R.S., 1938. Roman Asia minor. In: Frank, T. (Ed.), *An Economic Survey of Ancient Rome*, pp. 503–916. Baltimore.
 Brückner, H., 2005. Holocene shoreline displacements and their consequences for human societies: the example of Ephesus in Western Turkey. *Zeitschrift f. Geomorphologie N. F., Suppl.* 137, 11–22. Berlin, Stuttgart.
 Brückner, H., Vött, A., Schriever, M., Handl, M., 2005. Holocene delta progradation in the eastern Mediterranean – case studies in their historical context. *Mediterranean 1–2*, 95–106. Aix-en-Provence.
 Brückner, H., Müllenhoff, M., Gehrels, R., Herda, A., Knipping, M., Vött, A., 2006. From archipelago to floodplain – geographical and ecological changes in Miletus and its environs during the past six millennia (Western Anatolia, Turkey). *Zeitschrift f. Geomorphologie N. F., Suppl.* 142, 63–83. Berlin, Stuttgart.
 Büchner, L., 1905. Pauly-Wissowa Realencyclopädie, V 2, 2773–2822 s.v. Ephesos (1).
 Burghardt, A.F., 1971. A hypothesis about gateway cities. *Annals of the Association of American Geographers* 61, 269–285.
 Burrell, B., 2004. Neokoroi: Greek Cities and Roman Emperors. Leiden.
 Calapà, A., 2009. Das Stadtbild von Ephesos in hellenistischer Zeit. In: Matthaei, A., Zimmermann, M. (Eds.), *Stadtbilder im Hellenismus, Die hellenistische Polis als Lebensform*. Verl. Antike, Berlin, pp. 322–347.
 Cary, E., 1917. Dio's Roman History in nine volumes, vol. VI. Greek-Engl. Loeb Classical Library, London.

- Chesworth, W., 2008. Biomes and their soils. In: Chesworth, W. (Ed.), *Encyclopedia of Soil Science*. Springer, Dordrecht, pp. 61–68.
- Chisholm, M., 2007. *Rural Settlement and Land Use*. 1st Paperback. Hutchinson, London.
- Christaller, W., 1968. Die zentralen Orte in Süddeutschland – Eine ökonomisch-geographische Untersuchung über die Gesetzmäßigkeiten der Verbreitung und Entwicklung der Siedlungen mit städtischer Funktion, second ed. Wissenschaftliche Buchgesellschaft, Darmstadt. Reprint of edition 1933, Jena.
- Church, A.J., Brodribb, W.J., Bryant, S., 1942. *Complete Works of Tacitus*. Random House, New York. edited for Perseus.
- Denecke, D., 1972. Der geographische Stadtbegriff und die räumlich-funktionale Betrachtungsweise bei Siedlungstypen mit zentraler Bedeutung in Anwendung auf historische Siedlungsepochen. In: Jankuhn, H., Schlesinger, W., Steuer, H. (Eds.), *Vor- und Frühformen der europäischen Stadt im Mittelalter: Bericht über ein Symposium in Reinhausen bei Göttingen in der Zeit vom 18. bis 24. April 1972*. Abhandlungen der Akademie der Wissenschaften in Göttingen 3. Vandenhoeck und Ruprecht, Göttingen, pp. 33–55.
- Dindorf, W., 1964. *Aristides*, vol. I. Leipzig, 1829, reprinted Hildesheim.
- Dusar, B., Verstraeten, G., Notebaert, B., Bakker, J., 2011. Holocene environmental change and its impact on sediment dynamics in the Eastern Mediterranean. *Earth-Science Reviews* 108, 137–157.
- Efe, T., 2007. The theories of the “Great Caravan Route” between Cilicia and Troy: the Early Bronze Age III period in Inland Western Anatolia. *Anatolian Studies* 57, 47–64.
- Ehrhardt, N., 1983. Milet und seine Kolonien. Frankfurt am Main.
- Erdogu, B., 2003. Visualizing Neolithic landscape: the early settled communities in Western Anatolia and Eastern Aegean Islands. *European Journal of Archaeology* 6, 7–23.
- Erkanal, H., 2008. Liman Tepe: new light on prehistoric Aegean cultures. In: Erkanal, H., Hauptmann, H., Şahoglu, V., Rıza, T. (Eds.), *Proceedings of the International Symposium: the Aegean in the Neolithic, Chalcolithic and the Early Bronze Age*. October 13th–19th 1997, Urla – Izmir (Turkey). Ankara University, Ankara, pp. 179–190.
- Erol, O., 1982a. Türkei. Naturräumliche Gliederung (Westteil); A-VII-02. Tübinger Atlas des Vorderen Orients (TAVO). L. Reichert, Wiesbaden.
- Erol, O., 1982b. Türkei. Naturräumliche Gliederung (Ostteil); A-VII-02. Tübinger Atlas des Vorderen Orients (TAVO). L. Reichert, Wiesbaden.
- Erol, O., 1983. Die naturräumliche Gliederung der Türkei, Beihefte zum Tübinger Atlas des Vorderen Orients (TAVO). L. Reichert, Wiesbaden.
- European Soil Bureau Network (Ed.), 2005. *Soil Atlas of Europe*. European Commission. Office for Official Publications of the European Communities, Luxembourg.
- Finné, M., Holmgren, K., Sundqvist, H.S., Weiberg, E., Lindblom, M., 2011. Climate in the eastern Mediterranean, and adjacent regions, during the past 6000 years – a review. *Journal of Archaeological Science* 38, 3153–3173.
- Fleischer, R., 1981. Artemis Ephesia und Aphrodite von Aphrodisias. In: Vermaseren, M.J. (Ed.), *Die Orientalischen Religionen im Römerreich*, pp. 298–315. Leiden.
- Frey, W., Lösch, R., 2010. *Geobotanik: Pflanze und Vegetation in Raum und Zeit*, 3rd ed. Spektrum Akademischer Verlag.
- Galik, A., Horejs, B., 2011. Çukuriçi Höyük – various aspects of its earliest settlement. Papers of the International Workshop 8th–9th April 2009, Istanbul. Menschen – Kulturen – Traditionen. In: Krauß, R. (Ed.), *Beginnings – New Research in the Appearance of the Neolithic Between Northwest Anatolia and the Carpathian Basin*. Studien aus den Forschungslustern des Deutschen Archäologischen Instituts. Rahden, Westfalen, pp. 83–94.
- Greaves, A.M., 2010. *The Land of Ionia. Society and Economy in the Archaic Period*. Oxford.
- Gringmuth-Dallmer, E., 1996. Kulturlandschaftsmuster und Siedlungssysteme. *Siedlungsforschung* 14, 7–31.
- Gringmuth-Dallmer, E., 2011. Zentren unterschiedlichen Ranges im nordwestslawischen Gebiet. In: Macháček, J., Ungerman, S. (Eds.), *Frühgeschichtliche Zentralorte in Mitteleuropa; Internationale Konferenz und Kolleg der Alexander von Humboldt-Stiftung zum 50. Jahrestag des Beginns archäologischer Ausgrabungen in Pohansko bei Brěclav, 5–9.10.2009, Brěclav, Tschechische Republik*. Studien zur Archäologie Europas. Habelt, Bonn, pp. 431–440.
- Gummere, R.M., 1925. *Seneca, Ad Lucilium epistulae morales*, vol. III. Lat.-Engl. Loeb Classical Library, London.
- Haensch, R., 1997. *Capita provinciarum. Statthaltersitze und Provinzialverwaltung in der römischen Kaiserzeit*. Mainz.
- Haider, P.W., 1999. Vom Nil zum Mäander. Die Beziehungen zwischen dem Pharaonenhof und dem Königreich Arzawa in Westkleinasien. In: Scherrer, P., Tauber, H., Thüer, H. (Eds.), *Steine Und Wege. Festschrift D. Knibbe*, Wien, pp. 205–219.
- Halfmann, H., 2001. Städtebau und Bauherren im römischen Kleinasien: ein Vergleich zwischen Pergamon und Ephesos. Tübingen.
- Heinhold-Kramer, S., 1977. Arzawa. Untersuchungen zu seiner Geschichte nach den hethitischen Quellen. Texte der Hethiter, Heidelberg.
- Heinritz, G., 1979. Zentralität und zentrale Orte. B.G. Teubner, Stuttgart.
- Hertel, D., 2011. Das vorklassische Pergamon und sein Siedlungsprofil. *Istanbuler Mitteilungen* 61, 21–84.
- Hettner, A., 1905. Das Wesen und die Methoden der Geographie. *Geographische Zeitschrift* 11, 545–564.
- Horejs, B., 2008. Eine spätbronzezeitliche Bestattung in Halkapınar bei Ephesos. *Jahreshefte des österreichischen archäologischen Institutes in Wien* 77, 107–129.
- Horejs, B., 2010. Bronzezeitliche Besiedlungsmuster im Kaikostal. Interpretationen erster Surveyergebnisse im Umland von Pergamon (Türkei). In: Horejs, B., Kienlin, T.L. (Eds.), *Siedlung und Handwerk – Studien zu sozialen Kontexten in der Bronzezeit, Universitätsforschungen zur Prähistorischen Archäologie*. Verlag Dr. Rudolf Habelt GmbH, Bonn, pp. 47–67.
- Horejs, B., 2011. Neues zur Frühbronzezeit in Westanatolien. In: Blakolmer, F., Reinholdt, C., Weilharter, J., Nightingale, G. (Eds.), *Österreichische Forschungen zur Ägäischen Bronzezeit 2009-Akten der Tagung vom 6. bis 7. März 2009 am Fachbereich Altertumswissenschaften der Universität Salzburg*. Sonderdruck, Wien, pp. 157–171.
- Horejs, B., Galik, A., Thanheiser, U., Wiesinger, S., 2011. Aktivitäten und Subsistenz in den Siedlungen des Çukuriçi Höyük. Der Forschungsstand nach den Ausgrabungen 2006–2009. *Prähistorische Zeitschrift* 86, 31–66.
- Hughes, J.D., 2005. The Mediterranean: an environmental history. In: *Nature and Human Societies Series. ABC-CLIO*, Santa Barbara.
- Hütteroth, W.-D., Höpfeld, V., 2002. *Türkei: Geographie, Geschichte, Wirtschaft, Politik*, second revised ed. Wissenschaftliche Buchgesellschaft, Darmstadt. Wissenschaftliche Länderkunden.
- Huxley, G.L., 1966. *The Early Ionians*. London.
- Jacobs, J., 1970. *The Economy of Cities*. Vintage, Random House, New York.
- Jarvis, A., Reuter, H.I., Nelson, A., Guevara, E., 2008. Hole-filled Seamless SRTM Data V4. International Centre for Tropical Agriculture (CIAT). URL: <http://srtm.csi.cgiar.org> (accessed 19.10.11).
- Kayan, I., 1999. Holocene stratigraphy and geomorphological evolution of the Aegean coastal plains of Anatolia. *Quaternary Science Reviews* 18, 541–548.
- Kerschner, M., Kowallek, I., Steskal, M., 2008. Archäologische Forschungen zur Siedlungsgeschichte von Ephesos in geometrischer, archaischer und klassischer Zeit: Grabungsbefunde und Keramikfunde aus dem Bereich von Koresos. Österreichisches Archäologisches Institut, Wien.
- Klinger, J., 1972. Die Hethiter: Geschichte – Gesellschaft – Kultur. Beck, München.
- Klose, D.O.A., 1999. Türkei. In: Brodersen, K. (Ed.), *Antike Stätten am Mittelmeer*, pp. 438–644. Stuttgart/Weimar.
- Knibbe, D., 1970. *Pauly-Wissowa Realencyclopädie Suppl. XII*, 248–297 s.v. Ephesos A: Historisch-epigraphischer Teil.
- Knibbe, D., 1998. Ephesus. Geschichte einer bedeutenden antiken Stadt und Portrait einer modernen Großgrabung. Frankfurt u.a.
- Knibbe, D., Alzinger, W., 1980. Ephesos vom Beginn der römischen Herrschaft in Kleinasien bis zum Ende der Prinzipatszeit. In: *Aufstieg und Niedergang der Römischen Welt II.7.2*. pp. 748–830.
- Kolb, F., 1984. *Die Stadt im Altertum*. Beck, München.
- Kottek, M., Grieser, J., Beck, C., Rudolf, B., Rubel, F., 2006. World Map of the Köppen-Geiger climate classification updated. *Meteorologische Zeitschrift* 15, 259–263.
- Kraft, J.C., Bückner, H., Kayan, I., Engelmann, H., 2007. The geographies of ancient Ephesus and the Artemision in Anatolia. *Geoarchaeology* 22, 121–149.
- Kraft, J.C., Kayan, I., Bückner, H., Rapp, G.R., 2003. Sedimentary facies patterns and the interpretation of Paleogeographies of Ancient Troia. In: Wagner, G.A., Pernicka, E., Uerpmann, H.-P. (Eds.), *Troia and the Troad – Scientific Approaches*. Springer, Berlin, pp. 361–377.
- Ladstätter, S., Pütz, A., 2007. Ephesus in the Late Roman and Early Byzantine Period: changes in its urban character from the third to the seventh century AD. In: Poulter, A. (Ed.), *The Transformation of the City. On the Danube and Beyond*, *Proceedings of the British Academy*, pp. 391–433. Oxford.
- Lichter, C., 2006. Zum Forschungsstand des Neolithikums und frühen Chalkolithikums in Westanatolien. In: Gatsaov, I., Schwarzbach, H. (Eds.), *Aegean – Marmara – Black Sea: The Present State of Research on the Early Neolithic*; *Proceedings of the Session Held at the EAA 8th Annual Meeting at Thessaloniki, 28th September 2002*. Schriften des Zentrums für Archäologie und Kulturgeschichte des Schwarzmeerraumes. Beier und Beran, Langenweissbach, pp. 29–43.
- Magie, D., 1950. *Roman Rule in Asia Minor*, 2 vols. Princeton.
- Marek, C., 2010. *Geschichte Kleinasien in der Antike*. München.
- Meriç, R., 2009. Das Hinterland von Ephesos. Archäologisch-topographische Forschungen im Kaystros-Tal. In: *Ergänzungshefte zu den Jahresheften des Österreichischen Archäologischen Institutes in Wien*. Wien.
- Meriç, R., Merkelbach, R., Nollé, J., Sahin, S. (Eds.), 1981. *Die Inschriften von Ephesos Teil VII 1, Nr. 3001–3500*. Bonn.
- Meyer, H.J., 1902. *Meyers grosses Konversations-Lexikon – Ein Nachschlagewerk des allgemeinen Wissens*. In: A bis Astigmatismus, sixth ed., Band 1. Bibliographisches Institut, Leipzig, Wien.
- Meyer-Schlichtmann, C., 1988. *Die pergamenische Sigillata aus der Stadtgrabung von Pergamon*. Mitte 2. Jh.v.Chr. – Mitte 2. Jh.n.Chr. De Gruyter, Berlin, New York.
- Mountjoy, P.A., 1998. The East Aegean–West Anatolian interface in the Late Bronze Age: Mycenaeans and the Kingdom of Ahhiyawa. *Anatolian Studies* 48, 33–67.
- Müllenhoff, M., 2005. Geoarchäologische, sedimentologische und morphodynamische Untersuchungen im Mündungsgebiet des Büyük Menderes (Mäander), Westtürkei, Marburger geographische Schriften. Marburger Geographische Gesellschaft, Marburg/Lahn.
- Murray, O., 1988. The Ionian Revolt. In: *Cambridge Ancient History*, pp. 461–490.
- Nagle, G., 2004. *Changing Settlements*. Nelson Thornes Ltd., Cheltenham.
- Natural Earth Data, 2011. *Natural Earth Data – Free Vector and Raster Map Data*. URL: <http://www.naturalearthdata.com> (accessed 19.10.11).
- Niemeier, W.-D., 2007. Westkleinasien und Ägäis von den Anfängen bis zur ionischen Wanderung: Topographie, Geschichte und Beziehungen nach dem archäologischen Befund und den hethitischen Quellen. In: Cobet, J., Graeve, V.,

- Niemeier, D., Zimmermann, K. (Eds.), Frühes Ionien – Eine Bestandsaufnahme: Panionion-Symposium Güzelçamlı, 26. September–1. Oktober 1999. Philipp von Zabern, Mainz, pp. 37–96.
- Paton, W.R., 1926. Polybius, the Histories in Six Volumes, vol. V. Greek-English Loeb Classical Library, London.
- Philippson, A., 1910. Einleitung – Das westliche Mysien und die pergamenische Landschaft. A. Petermann's Mitteilungen aus Justus Perthes' Geographischer Anstalt; Ergänzungsband 36 (Heft 167–171). Perthes, Gotha.
- Philippson, A., 1912. Geographisch-geologische Übersicht der Landschaft. In: Königliche Museen zu Berlin (Ed.), Pergamon – Stadt und Landschaft, Altertümer von Pergamon. Verlag von Georg Reimer, Berlin, pp. 43–58.
- Philippson, A., 1914a. Das östliche Lydien und südwestliche Phrygien. A. Petermann's Mitteilungen aus Justus Perthes' Geographischer Anstalt; Ergänzungsheft 180, Ergänzungsband 38, Perthes, Gotha.
- Philippson, A., 1914b. Das Mittelmeergebiet: seine geographische und kulturelle Eigenart, third ed. B. G. Teubner, Leipzig, Berlin.
- Pirson, F., 2007. Pergamon – Bericht über die Arbeiten in der Kampagne 2006 Mit Beiträgen von Martin Bachmann, Ralf von den Hoff und Martin Zimmermann. Archäologischer Anzeiger 2, 13–70.
- Pirson, F., 2011. Stadtraum und Städtebau im hellenistischen Pergamon. In: Grüssinger, R., Kästner, V., Scholl, A. (Eds.), Antikensammlung der Staatlichen Museen zu Berlin. Pergamon. Panorama der antiken Metropole. Begleitbuch zur Ausstellung. Imhof, Petersberg/Berlin, pp. 66–73.
- Pirson, F., Zimmermann, M., 2011. Das Umland von Pergamon – Wirtschaftliche Ressourcen, ländliche Siedlungen und politische Repräsentation. In: Grüssinger, R., Kästner, V., Scholl, A. (Eds.), Antikensammlung der Staatlichen Museen zu Berlin. Pergamon. Panorama der antiken Metropole. Begleitbuch zur Ausstellung. Imhof, Petersberg/Berlin, pp. 58–65.
- Pleket, H.W., 1990. Wirtschaft. In: Vittinghoff, F. (Ed.), Europäische Wirtschafts- und Sozialgeschichte in der Römischen Kaiserzeit. Handbuch der Europäischen Wirtschafts- und Sozialgeschichte, vol. 1, pp. 25–160. Stuttgart.
- Pott, R., 2005. Allgemeine Geobotanik: Biogeosysteme und Biodiversität. In: Springer-Lehrbuch. Springer, Berlin.
- Radt, S., 2005. Strabons Geographika, vol. 4. Buch XIV–XVII: Text und Übersetzung. Göttingen.
- Radt, W., 1999. Pergamon: Geschichte und Bauten einer antiken Metropole, first ed. Wissenschaftliche Buchgesellschaft.
- Radt, W., Eder, W., Berger, A., 2000. Der Neue Pauly, vol. 9. Pergamon, pp. 543–561.
- Rahmstorf, L., 2006. Zur Ausbreitung vorderasiatischer Innovationen in die frühbronzezeitliche Ägäis. Praehistorische Zeitschrift 81, 49–96.
- Roberts, N., 2008. The Holocene – An Environmental History, second ed. Blackwell, Oxford.
- Rostovtzeff, M., 1955. Die hellenistische Welt, Gesellschaft und Wirtschaft, 3 vols. Tübingen.
- Şahoglu, V., 2005. The Anatolian trade network and the Izmir region during the Early Bronze Age. Oxford Journal of Archaeology 24, 339–361.
- Schachner, A., Meriç, R., 2000. Ein Stempelsiegel des späten 2. Jahrtausends v. Chr. aus Metropolis in Ionien. SMEA, SMEA 4vol. 42, pp. 85–102.
- Scherrer, P., Wirbelauer, E., Höcker, C., 1997. Der Neue Pauly, vol. 3. Ephesos, pp. 1078–1085.
- Schulz, M., Paul, A., 2002. Holocene climate variability on centennial-to-millennial time scales: 1. Climate records from the North-Atlantic realm. In: Wefer, G., Berger, W., Behrke, K.-E., Jansen, E. (Eds.), Climate Development and History of the North Atlantic Realm. Springer, Berlin, Heidelberg, pp. 41–54.
- Seeher, J., 2005. Überlegungen zur Beziehung zwischen dem hethitischen Kernreich und der Westküste Anatoliens im 2. Jahrtausend v. Chr. In: Horejs, B., Jung, R., Kaiser, E., Terzan, B. (Eds.), Interpretationsraum Bronzezeit. Bernhard Hänsel von seinen Schülern gewidmet Universitätsforschungen Zur Prähistorischen Archäologie. Habelt, Bonn, pp. 33–44.
- Soja, E.W., 2003. Putting cities first: remapping the origins of urbanism. In: Bridge, G., Watson, S. (Eds.), A Companion to the City, Blackwell Companions to Geography. Blackwell, Malden, Mass., pp. 26–34.
- Sträßer, M., 1999. Klimadiagramm-Atlas der Erde. Teil 2: Asien, Lateinamerika, Afrika, Australien und Ozeanien, Polarländer: Monats- und Jahresmittelwerte von Temperatur und Niederschlag für den Zeitraum 1961–1990, Duisburger Geographische Arbeiten. Dortmund: Vertrieb für Bau- und Planungsliteratur. Dortmund.
- Taylor, P.J., 2012. Extraordinary cities: early “city-ness” and the origins of agriculture and states. International Journal of Urban and Regional Research 36, 415–447.
- Taylor, P.J., Hoyler, M., Verbruggen, R., 2010. External urban relational process: introducing central flow theory to complement central place theory. Urban Studies 47, 2803–2818.
- Thiele, R., 1907. Im Ionischen Kleinasien. Erlebnisse und Ergebnisse, Gymnasial Bibliothek. Bertelsmann, Gütersloh.
- Thompson, D., 2007. At the crossroads: prehistoric settlement in the Maeander valley. Anatolian Studies 57, 87–99.
- Tsetschladze, G.R. (Ed.), 1998. The Greek Colonisation of the Black Sea Area. Stuttgart.
- Turkish Statistical Institute – Regional Statistics, 2010. Regional Statistics. URL: <http://tuikapp.tuik.gov.tr/BolgeSel/anaSayfa.do?dil=en> (accessed 15.11.11).
- Ullman, E.L., 1980. Geography as Spatial Interaction. University of Washington Press, Seattle.
- Uzel, B., Sözbilir, H., 2008. A first record of a strike-slip basin in western Anatolia and its tectonic implication: the Cumaovası Basin. Turkish Journal of Earth Sciences 17, 559–591.
- Walter, H., Breckle, S.-W., 1991. Ökologie der Erde. In: Spezielle Ökologie der gemäßigten und arktischen Zonen Euro-Nordasiens: Zonobiom VI–IX, UTB für Wissenschaft: Große Reihe, Bd. 4. Fischer, Stuttgart.
- Weichhart, P., 1978. Naturraumbewertung und Siedlungsentwicklung. Das räumliche Wachstum ausgewählter Siedlungen des politischen Bezirkes Braunau a. I. im Vergleich mit dem Naturraumpotential ihrer Standorte. Oberösterreichische Heimatblätter 32, 171–208.
- Winkler, G., König, R., 1993. C. Plinius Secundus d.Ä., Naturkunde Buch V. Lat.-German. München.
- Zimmermann, M., 2011. Pergamon: Geschichte, Kultur und Archäologie. Beck, München.